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The Phonology of Kenyan Sign Language (Southwestern Dialect)

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The Phonology of Kenyan Sign Language (Southwestern Dialect)

A dissertation submitted in partial satisfaction of the
requirements for the degree
Doctor of Philosophy

in

Linguistics with a Specialization in Anthropogeny

by

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2017

The Dissertation of Hope E. Morgan is approved and it is acceptable in quality and form for publication on microfilm and electronically:

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ACKNOWLEDGEMENTS

The seeds of this project grew directly out of relationships and experiences from living in southwestern Kenya. From my first KSL teacher—the patient, kind, and very funny Carolyne Aoko—to the Deaf Education and interpreting team working with U.S. Peace Corps—Isabel, Leonida, Aggrey—my introduction to Kenyan Sign Language was a great pleasure. I immediately loved this language. Making friends at Kuja Primary School for the Deaf in Rongo planted even more permanent seeds of connection, and I am particularly grateful to one of the teachers there (at the time), Mr. Jared O. Osome, for his friendship, generosity, and level-headed wisdom. I am also grateful for many other friendships there—with Lorna Awuor, Veronica Adede, Charles Otieno & Pamela, and others. This community of deaf Kenyans, and a wider network that grew over time, has sustained me throughout this project. Although this research is very technical, I hope that it may play a role in helping KSL to become more widely acknowledged and respected as the complex and sophisticated language that it is.

The many of years of work on this project were made easier by a community of friends and fellow researchers, from my graduate cohort to the many bright minds and caring people in the Mayberry Lab for Multimodal Development—including Rachel Mayberry herself—as well as Carol Padden's working group and Karen Emmorey's research team. San Diego has been a wonderful place to become a sign linguist! In particular, I wish to thank Amy Lieberman, Matt Hall, and Kate Davidson for illuminating the way forward. Looking back, I also credit several important conversations with Susan D. Fischer—a woman who knows how to say "yes" to life—for marking my transition from grad student to independent researcher. And for moral support and camaraderie during this time, I am especially grateful to Rodolfo Mata, Mara Green, Ryan Lepic, Gwen Gillingham, Bethany Keffala, Deniz Ilkbasaran, Lynn Hou, and Brandon Scates.

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Lastly, thank you Phillip, my dear companion in life who has been up for all the adventures, yet also extraordinarily patient with the tedium, and who makes me laugh every day.

Chapter 3 contains material on pages 114-115 as it appears in “Establishing the typical number of minimal pairs in signed and spoken language” by Kaplan, Abby and Morgan, Hope E. The dissertation author was a co-author of this manuscript.

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ABSTRACT OF THE DISSERTATION

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by

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Doctor of Philosophy in Linguistics with a Specialization in Anthropogeny

University of California, San Diego, 2017

Professor Rachel Mayberry, Co-Chair
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Kenyan Sign Language (KSL) is a thriving national sign language used by tens of thousands of signers in Kenya, and which emerged out of two deaf schools in western Kenya in the early 1960s. In this thesis, I provide a thorough description and analysis of the basic phonological components of the KSL lexicon used in the southwestern region of Kenya (formerly south Nyanza Province).

This phonological grammar of (SoNy)KSL makes contributions in three domains. In the descriptive domain, it provides a thorough report of the basic units in the main phonological parameters; i.e., Handshape (Ch. 4), Location (Ch. 5), and

Movement (Ch 6, 7), as well as the evidence for the distinctiveness of each unit. The description for Movement and Location are particularly noteworthy because those parameters have received less attention in sign linguistics in general compared to Handshape.

In the methodological domain, the grammar is based on a KSL Lexical Database built for this project, in which over 50 phonetic characteristics of 1,880 non-compound signs were coded. This database is currently one of only a few such richly coded lexical databases of sign languages. In addition, this grammar employs a rigorous approach to determining lexical contrast, which has yielded a separate dataset of 461 minimal pairs (Ch. 3). This dataset is unique in sign linguistics and reveals patterns of lexical contrast that were not previously known—and which have generated new hypotheses about how lexical contrast may be constrained by degrees of visual similarity.

Finally, this thesis makes a theoretical contribution by comparing how different models of sign phonology can account for sign types in KSL. By evaluating the explanatory power of the main theories of sign phonology on the basis of specific descriptive data, this thesis gives unique insights into the theoretical validity of these models. It also proposes modifications in some cases, especially with regard to how the Dependency Model (DPM) can account for the representation of movement features and their relationship to the timing tier. In addition, a new movement feature, [dispersed], is described and its implementation worked out in the DPM.

Chapter 1:
Introduction and Background of Kenyan Sign Language

1. Introduction

Kenyan Sign Language (KSL) is a dynamic, thriving language of East Africa and is the daily language of communication for at least tens of thousands—if not hundreds of thousands—of deaf (and some hearing) Kenyans. This language originated in the first schools for the deaf in western Kenya in the early 1960s, but also emerged out of an existing substrate of gestural traditions in East Africa (Creider 1977, Zaslavsky 1999, Brookes & Nyst 2014). It has gone through waves of convergence (Okombo & Akach 1997), helped along by an expanding deaf school system that has resulted in a language used across the country (Morgan et al. 2015), yet with some degree of regional variation—the boundaries of which have yet to be determined. This descriptive grammar of KSL phonology focuses on the KSL used in the southwestern region of Kenya, formerly known as south Nyanza Province,[1] and marks the most extensive linguistic treatment of KSL (in any dialect) to date.

The first part of this chapter introduces the goals of the thesis, the broader context in which it has been written, and its unique contributions. The second part of the chapter provides a background of Kenyan Sign Language and information about the deaf community in Kenya.

1.2 Goals of this thesis

This thesis has three main goals. First and foremost, it seeks to describe the phonological structure and categories of Kenyan Sign Language, organized around each of the three main phonological parameters: handshape, location, and movement. Second, this project makes a

[1] In 2013, Kenya began the transition from provincial governments to county governments.

methodological contribution by connecting the data with the analysis in a transparent way and making improvements to analytic procedures, especially regarding the use of minimal pairs to determine inventories of phonological units. And the third goal has been to evaluate how well existing theories of sign phonology can explain the KSL data, and propose new or different constructs where necessary. These goals are addressed in the following three sub-sections.

This grammar also relates to two larger domains of inquiry: (i) a typology of sign languages and (ii) better understanding of linguistic universals by comparing sub-lexical structure across modalities. While not the main foci of this project, these topics connect this grammar to the larger endeavor to understand the language faculty and its many diverse expressions. In the first domain, the added value of a descriptive grammar is typological; i.e., it can clarify how the phenomena in a particular language correspond to other related and unrelated languages. Thus, at several points throughout the thesis and summarized in Chapter 8, I compare aspects of KSL phonology with other sign languages. However, developing good typological generalizations requires at least three things: (i) data on multiple languages, (ii) data that is described well enough to know that it is equivalent or comparable, and (iii) quantification or at least contextualization of the data (how frequent/common). A lack of existing phonological grammars of other sign languages makes it very difficult at this point to formulate meaningful generalizations about typological norms or patterns based on linguistic heredity or areal features. It is therefore hoped that the data presented here will contribute to that larger goal.

In the second domain regarding linguistic universals, this thesis keeps a relatively tight focus on the local phenomena specific to the visual-manual language modality of sign languages as opposed to the aural-oral modality of spoken language. However, the findings involve several strands of evidence that relate to universal properties of language. In particular, similarities between the modalities are evident in how predictable phonetic regularities help to reinforce phonological categories (discussed at various points in the analysis). Also, the minimal pair findings in Chapter 3 show that the phenomenon of "functional load" described for spoken languages is also demonstrable in the sign modality.[2] These phenomena point to the same dynamics found in spoken languages and may provide a basis for subsequent research in psycholinguistics and computational quantitative analyses of sign language phonologies.

In the next three sub-sections, I address each of the three main goals in turn: description, methodology, and analysis.

1.2.1 A grammar of KSL phonology

The primary goal of this thesis is to report on the phonological structure of the southwestern dialect of Kenyan Sign Language. The main material of the thesis is contained in the three chapters related to the major phonological parameters: *Handshape* (Chapter 4), *Location* (Chapter 5), and *Movement* (Chapter 6). Each of these chapters begins with a background of that parameter in the literature and its representation in theoretical models, and then provides a quantitative overview of the phonetic and phonemic units in KSL. Analytic methods specific to each parameter are also presented, either as a summary of diagnostic criteria (i.e., for location [§5.5])—or at relevant points throughout the chapter (i.e., handshape, movement). But in keeping with this project's commitment to be a "reference grammar" in the truest sense—that is, to function as a resource for other studies—much space is dedicated to describing specific features and primes in a systematic way, presenting the evidence for their existence as categorical units in the phonology of KSL. Here, a **feature** is a contrastive

[2] "Functional load" refers to how often a phoneme is found in a lexical contrast (Jakobson 1931, Hockett 1967). In spoken languages, this can determine how likely a sound is to participate in a sound merger over time (Wedel et al. 2013).

characteristic, usually below the level of a parameter; e.g., the *direction* of a path movement, the *joint configuration* of a handshape, the *lateral symmetry* of a location. A **parameter** refers to one of the main class nodes: handshape, location, movement, orientation. And a **prime** is a phonemic unit in a sign language inventory that cannot be further decomposed into features; e.g., the handshape *C*, the location *cheek*. For handshapes, this takes the form of an extended appendix (Appendix 4: *Inventory of KSL Handshapes*). For locations, the descriptions are presented in the second part of the chapter. And for movements—without the same large inventories of primes—the descriptions are organized by articulatory types and manner feature, throughout the chapter.

This level of detail is seen as necessary because previous phonological descriptions of other sign languages have not been explicit about the evidence upon which phonological decisions were based. Indeed, this thesis has been motivated by the fact that there are few previous exemplars of phonological grammars to follow, and that many of these have had shortcomings. The goal of this grammar is not to offer a perfect exemplar, but to make significant advancements in language-specific descriptions of sign phonology.

There are a few traditional fieldwork-based linguistic descriptions that contain some information on phonological inventories, including: Zeshan (2000) for Indo-Pakistani Sign Language, Nyst (2007) for Adamorobe Sign Language in Ghana, and Marsaja (2008) for Kata Kolok in Indonesia. However, these sketches either offer inventories without further explanation (e.g., Marsaja 2008), or provide inventories of one or two parameters with some elaboration (such as handshape variants that are likely allophones) but leave out other parameters (e.g., Zeshan 2000). Or, a more complete accounting of some inventories is given, including quantitative data, but without considering all parameters equally (e.g., Nyst 2008).

The most complete phonological grammar based on traditional fieldwork is Schmaling's description of Hausa Sign Language in Nigeria (2000), which covers four parameters (handshape, orientation, location, and movement) in addition to signs with different hand arrangements and non-manual features. Schmaling is also explicit about where the evidence for a prime or feature is supported by a minimal pair, and provides the phonemic content for many signs using a special notation system (HamNoSys; see §2.8). This description was a helpful source for language comparison, but was not fully forthcoming about its analytic methods, and only lightly engages with existing theories about sign structure. There is also Friedman's description of ASL phonology (1976, 1977), which covers a range of parameters and discusses reasons for considering certain primes to be phonemic, but applies these criteria inconsistently and only uses English glosses to represent signs.

In addition to single-author fieldwork-based accounts, van der Kooij's description of the phonology of Sign Language of the Netherlands (NGT) is based on a corpus of NGT combined with a lexical database (SignPhon database; Crasborn et al. 2001), as well as supplementary elicitation. It also builds on a phonetic analysis of NGT by Crasborn (2001). This grammar of NGT differs from a traditional description because it serves as the reification of a specific model of sign phonology developed over many years by Dutch researchers (van der Hulst 1993, 1996; van der Kooij 1994, 1996; Crasborn & van der Kooij 1997), realized in its latest form as the Dependency Model in van der Kooij's book (2002). This is currently the most complete phonological description available, as it is grounded in rich phonetic data, is relatively explicit about methods, provides visual examples, and is supplemented by quantitative data. At the same time, the NGT project was a team effort over many years and is based in the same location as the language participants—a project design not possible to replicate for a fieldwork-based, single author project.

The challenges faced by those trying to produce a phonological grammar based on original fieldwork is captured by this observation from an overview on sign language research methods (bold added):

> "Writing reference grammars for sign languages is complicated by the **shortage of standard methods and tools**. First, no conventional phonetic notation system equivalent to the International Phonetic Alphabet (IPA) for spoken languages is available. Second, there is **no standard procedure to identify the basic phonological and morphological units** of sign languages. Thus there is no way to adequately describe the gradient and iconic elements in the lexical and grammatical units or to analyze and describe the phoneme inventories of a given sign language. This makes it hard to describe sign languages in a way that allows for the cross-linguistic comparison that would be necessary for a typology." (Nyst 2015: 110)

The present phonological grammar is a direct response to these challenges and leads to the second goal of the thesis—a methodological contribution.

1.2.2 Methodological contributions

Having reviewed the literature in the early stages of planning this project, it was clear that it would be necessary to innovate ways to thoroughly yet efficiently arrive at the goal of describing the phonological structure of KSL. As Nyst explains (above), there have been no clear procedures laid out for identifying the basic phonological units. There are many clues scattered throughout the literature and assumptions about best practices (e.g., minimal pairs, the distribution of sign types that occur with different features/primes, asking signers about well-formedness, etc.), but much about the methods has remained implicit.

There at least five ways that this project has attempted to advance a methodology for phonological analysis. These are described in some detail in Chapter 2, *Methodology*, and

Chapter 3, *Minimal pairs and the phonemic analysis*, but here I summarize the ways that this thesis has tried to think strategically about methods and foreground them in the grammar itself.

The **first** and most essential methodological tool used in this project was the KSL Lexical Database. The creation of the lexical database itself is not an innovation, but in practice, this one joins only one other that has been coded for a similar degree of phonetic detail—the SignPhon database for NGT (Crasborn et al. 2001). The creation and contents of the database is discussed in the next chapter. The **second** innovation has been the development of a process for finding minimal pairs and determining their truly minimal contrastiveness, which is described in Chapter 3. This has given the phonological analysis a firm grounding. Relatedly, the **third** contribution is the development of a novel dataset consisting of 461 true minimal pairs from the set of 1,880 signs used in the phonological analysis (described in Chapter 3). This has led to some unexpected discoveries about the distribution of contrastiveness in the lexicon, and also has the advantage of supporting the analysis with quantifiable data.

The **fourth** contribution is the thorough treatment of the Location parameter, which includes the development of diagnostics for determining a phonological location (§5.5), which can be applied to phonological analyses of other sign languages. The systematic presentation of evidence for each of the 37 phonemic locations is also a type of methodological contribution—in the sense of establishing a standard for what counts as evidence of phonemic status. Location has long been treated as relatively transparent and simple compared to handshape and movement. The analysis in Chapter 4 shows that location is just as categorical and complex as other parts of the phonology.

Fifth and finally, the use of a lexical database means that phenomena that are difficult to categorize cannot be inadvertently overlooked in the analysis. The role of a grammar should be to at least list odd cases, if not explain them, so that they may be understood in the context of language families or even the whole language modality. In this thesis, I therefore provide a section at the end of each chapter (at the end of Appendix 4 for handshape) to address difficult, ambiguous, or complex cases.

1.2.3 Theoretical contributions

A third goal of this thesis emerged out of the descriptive facts and findings of the analysis, leading to new proposals for structural constructs in the phonological representation. These hypotheses and theoretical points are distributed throughout the thesis, so I will briefly summarize them here.

For handshape, the analysis of minimal pairs revealed an unexpected pattern showing that contrasts for some features below the level of the whole handshape were surprisingly scarce compared to minimal pairs on the basis of whole handshapes. This presents the possibility that whole handshapes are not fully decomposable in KSL—and possibly other sign languages as well (see §4.2).

For the location parameter, there were several aspects that had either not been examined much in the literature or that deserved to be re-examined. As explained in the previous section, this led to a relatively thorough treatment of location in this thesis, and subsequently led to reanalyses of some longstanding theoretical concepts. For example, I question two longstanding concepts in the literature: major areas (§5.3) and orthogonal planes in neutral space (§.5.11.1). The evidence in KSL (which is not fundamentally different than other sign languages) shows that these concepts may be relevant to phonetic organization (for major area) and semantic/metaphoric concepts (for orthogonal planes), but are not necessarily phonological constructs. I also address the issue of whether neutral space should be considered a specified location or remain a ‘null’ location in the phonology, and I discuss what kind of *lateral symmetry* features are required to account for all of the realizations of location, especially as it pertains to various configurations of two-handed signs (§5.4). And finally, I describe the theoretical relevance of a small set of ‘two location’ signs. That is, signs that have two *sequential* locations (§5.12.4) and signs that have two *simultaneous* locations (§5.12.5). These pose different challenges for theories of sign phonology, which some models are able to handle better than others (§5.12.6).

For movement, I describe the existence of “hold” signs in KSL that are not specified for any movement, which is counter-evidence to previous statements that all signs must contain movement to be well-formed. I discuss how these signs challenge models of sign phonology in different ways, and how the models might be able to accommodate them (with differing success; §6.5.1). I also detail a class of signs that have not been sufficiently described in the literature, and therefore not adequately accounted for in phonological models. This group of signs includes, but is not limited to, those known as “double contact” signs (e.g., HOME or COMMITTEE in ASL). I refer to the whole class as “dispersed” signs and propose a manner feature, [dispersed], to accommodate them in the phonology (§6.6.7). I show how dispersed signs require movement features that apply to different prosodic domains, at the syllable level and the word level, and I explore how different models might be able to integrate these sign types.

As will be explained in the next two chapters, this project did not start from a particular theoretical perspective and its goal is not to propose a new theoretical model, but as a result of several steps along the way, including the evaluation of how different models can accommodate the data just described, two theoretical models (sharing a similar framework) emerged as the most able to account for the full range of phenomena: the Prosodic Model (Brentari 1998) and the Dependency Model (van der Kooij 2002). At the same time, the data in this thesis shows that there is a need to modify or at least clarify the existing models. In Chapter 7, I summarize several ways that the Dependency Model in particular could be modified to better fit certain types of signs found in KSL.

1.3 Origins and History of Kenyan Sign Language

The origins of sign languages are often tied to social factors—marriage patterns, educational policies, healthcare policies, social upheaval, etc. From that perspective, although the basic story of KSL has been documented (Yego 1990, Akach 1990; Okombo & Akach 1997; Adoyo 2002, 2007; Hochgesang 2006; Ndurumo 2008a, 2008b; Kimani 2012; Mweri 2014; Kaula 2014; Morgan et al. 2015), many pieces of the entire picture of KSL have not yet been written. Such an account would include a full history of deaf schools and the lives of the students in those schools, of the policies that have affected deaf education, of deaf organizations, and of the pedagogies, influential people, and literature relevant to the deaf community. It might also view these in the context of wider events in Kenya, Africa, and the world, such as the influence of deaf empowerment ideologies, spread of American Sign Language and International Sign, changes in social perspectives on disabilities, etc. And it would certainly include personal stories directly from deaf Kenyans. In lieu of such a comprehensive account, I provide a very light sketch here, and encourage others to take up this challenge—especially considering that the first generation of deaf students from the first deaf schools in Kenya are now at least in their mid-60s.

In this part of the chapter, I address the historical and linguistic evidence for the origin of Kenyan Sign Language, touch on deaf education in Kenya and what is known about the demographics of deaf Kenyans, and profile the existing literature on KSL.

The best information about the origin of Kenyan Sign Language suggests that it emerged out of the first residential schools in western Kenya, and the evidence is both historical and linguistic. The historical evidence for the origin of KSL is based on the record of deaf education in Kenya and on discussions with graduates from the first deaf schools collected by the Kenyan Sign Language Research Project (Okombo & Akach 1997). The very first educational institutions to cater to deaf students were classes held in the 1950s at the Aga Khan institutions in Nairobi and Mombasa (1997: 136); however, there are no known traces of sign language that emerged from those classes.

The founding of the first two residential schools for deaf pupils in Kenya appears to have been the critical spark in the creation of KSL. These two schools, Mumias and Nyang'oma (Fig. 2), were both established in 1961 by the Catholic Church and became "the most influential centers in the growth of Kenyan Sign Language" (1997: 136). The schools are only around 50 miles (85km) apart on modern roads, but Nyang'oma is actually quite remote—relatively far from a main highway and any urban centers. These two schools are also located in two ethno-linguistically distinct regions. Mumias is further north, in the Kakamega area where the Luhya ethnic group is predominant. Nyang'oma is located in the Siaya area where most people are from the Luo ethnic group.

Sign languages were not used as a medium of instruction in these first two schools (Ndurumo 2008a, 2008b). The pedagogy in the first classrooms was from **oralism**, a method of training deaf children to understand lip-reading and to communicate by speech. Although now largely regarded in Kenya as a poor intervention for the majority of deaf students with severe hearing loss, this pedagogy was entrenched in deaf education in Europe and North America at the time. While oralism dominated the early deaf school classrooms, the students began to develop a sign language on their own (Okombo & Akach 1997: 135; Ndurumo 2008: 2). Thus, the emergence of KSL is roughly parallel to the well-documented situation in Nicaragua in which deaf children without sign language were suddenly placed together in a school and had frequent contact and a highly contextual shared experience of their day-to-day interactions (Senghas et al. 2005). Unlike the Nicaraguan situation, however, these were institutions where the students lived for at least nine months out of the year rather than day schools; and this may have provided an even more intense crucible for language emergence. As explained in the next section, some KSL signs that are used all over the country still reflect forms that must have emerged early from these first schools.

So how did an emerging sign language that originated in two remote schools become essentially a single national sign language (with regional variants) in just a few decades? Okombo and Akach state that "the main factor leading to the convergence of nascent sign languages is interschool transfers. Usually, when a school is established nearer home, a deaf child is transferred to the home school" (139). The history of the founding of deaf schools also supports this process of students carrying the new sign language from school to school. Figure 1 illustrates the growth of deaf schools from 1961 to the present (based Okombo & Akach 1997, U.S. Peace Corps 2007, Kenya MoE 2007).[3]

[3] Some schools and units were confirmed via personal communication with Jared O. Osome, deaf teacher and president of the South Nyanza Deaf Association.

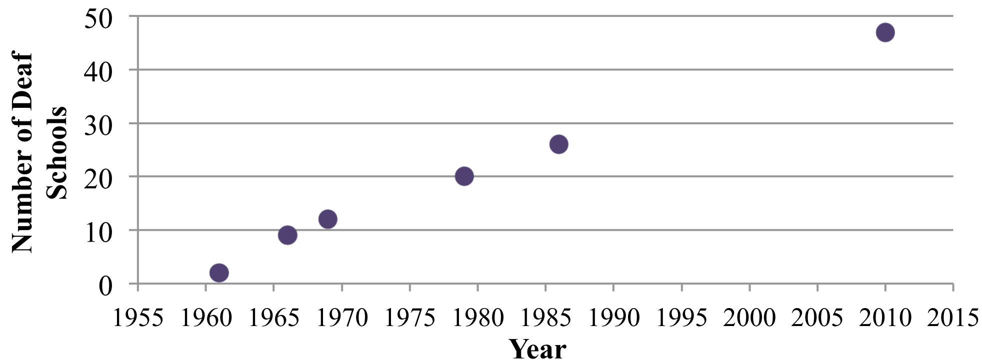

Figure 1. Growth in the number of deaf schools in Kenya (data compiled from Okombo & Akach 1997; U.S. Peace Corps 2007; Kenya MoE 2007)

The first two deaf schools were open for four years before a new group of schools opened in central Kenya. Some of the deaf students at Mumias and Nyang'oma in the early years were presumably from families living in closer to the middle of the country (around Nairobi) who transferred their students closer to home and seeded the new schools with existing signs. Four years after the first two schools, more schools opened in central area of Kenya, and a couple years later, deaf schools reached the coast of Kenya. After that, secondary schools (i.e., high schools) opened and other populous communities got a deaf school. Today, the geographic distribution of deaf schools in Figure 2 broadly mirrors the overall population centers in Kenya, such that the greater density in deaf schools and deaf units (deaf classes in hearing schools) in the south and west of the country corresponds to greater population density, while fewer schools/units in the north and along the coast correspond to a sparser population in those areas.[4]

[4] Deaf schools are usually residential, with students staying for three three-month terms during the year, returning home for one month between terms. Deaf units are usually located in day schools in the same community where the student's family lives.

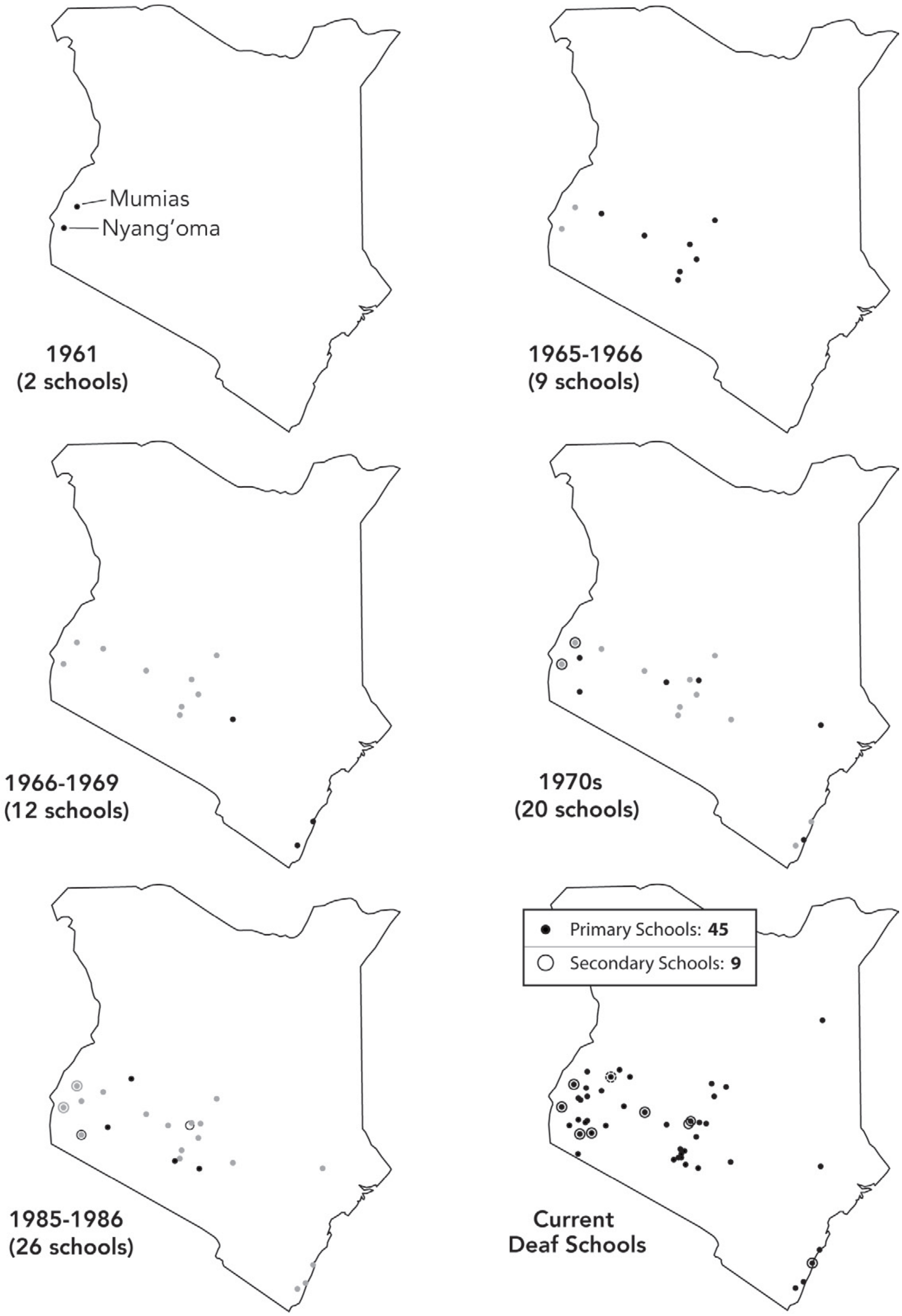

Figure 2. Number and distribution of deaf schools in Kenya, from 1961 to mid-2010s

According to Okombo & Akach, other factors that contributed to "language convergence" of KSL—that is, the natural process of dialectal standardization through interaction between many individuals—included sporting events involving multiple deaf schools, migration to urban areas (including around deaf schools) for work, and marriage between deaf partners. When the first generation of deaf students graduated, some of them created "postschool deaf communities" by finding work around deaf schools where they could maintain a social network. And in urban areas, deaf people were able to find each other and create communal meeting places in towns, especially in the evenings or on weekends (1997: 140). Indeed, the small town that serves as the main site of data collection in this project, Rongo, is that kind of hub for the local deaf community.

Yet a picture of the history of KSL is not complete without considering contact with other sign languages, which Okombo & Akach do not address. Various influences on KSL are taken up in the next section.

1.3.1 Linguistic origins of KSL

Kenyan Sign Language is only around six decades old—within a human lifetime. While we don't know the exact details of how the language emerged in the first few years, we can investigate the language today to understand its origins and influences.

Some clues to the past are captured in the etymologies of KSL signs. For example, the sign HUNDRED (Fig. 3a) is made at the tongue, because the sign was named for a 100-shilling bill that was red and the sign RED is on the tongue. Looking at past records of Kenyan currency,[5] the red 100-shilling note was first printed in 1958, but reverted to purple in 1964 (as part of the new

[5] Online sources: http://www.centralbank.go.ke/Currency/NotesInCirculation.aspx/
http://banknoteworld.com/kenya?Denomination=200_Shilling#Kenya
http://www.rodsell.com/enotes/eastafrica.htm;

currency of independent Kenya), providing a historical marker to support the origin of KSL in the early 1960s. Also, the sign TANZANIA (Fig. 3b) relates to the style of moustache worn by the Tanzanian president, Julius Nyerere, who presided from 1962 to 1985, and the sign for UGANDA (Fig. 3c) is signed under the chin, which references the deadly years that Idi Amin was president of Uganda, 1971-1979 (i.e., based on the sign KILL and DIE-1). And KSL numbers seem to derive from the manual numbering system used in western Kenya by the general (hearing) population (Zaslavsky 1999, Creider 1977), which is where the first two deaf schools were located. Indeed, Ndurumo writes that these schools "became the cradles of sign language and most signs, especially those related to numbers, towns, family, currently remain unchanged" (2008a: 2).

a. b. c.

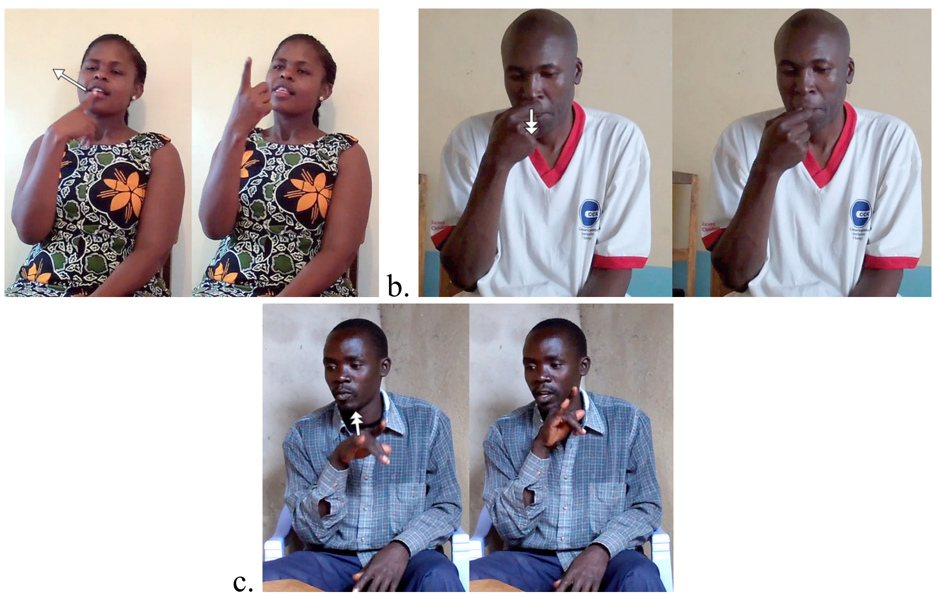

Figure 3. KSL signs with historical relevance: a. ONE-HUNDRED, b. TANZANIA-1, c. UGANDA-1

The history of the deaf community itself is also preserved in KSL signs. For example, the sign MONDAY is made with a *flat* handshape touching the top of the head. An attendee of one of the first deaf schools, Charles Otieno, reports that this is related to oralist training in the early days. The sign represents the action of placing the student's hand on top of his/her head to detect voicing vibrations resonating through the skull, in order to make a sensory connection to the bilabial nasal continuant sound, [m] for "Monday." Another example is the KSL sign for COLLEGE. Daniel Ogembo reports that this sign originates from the sign for AUDIOLOGY because the first deaf Kenyan to advance to college—a proud event for deaf Kenyans—went into a special education program with an audiology component. And in another example, Jared Osome Otieno reports that the sign for the Kenya Institute of Special Education, K.I.S.E., derives from the sign for Denmark (but with a *K* handshape) because the initial funding that established this government institute came from Denmark. All of these sign etymologies—and many more that have yet to be documented—illuminate important events in the history of deaf people in Kenya.

When it comes to influences on the KSL lexicon from foreign sign languages, one can draw on known historical events to hypothesize about the likely sources of borrowed signs. First, Kenya was a British colony until 1964 and the first deaf schools were established by Catholics from the United Kingdom; therefore BSL could be a source language.[6] Second, as mentioned, K.I.S.E. was funded by Denmark and was pivotal to the growth of deaf schools. Danish signers could have brought signs from either their own language—or from International Sign (Rosenstock & Napier 2016), which was being considered around that time as a lingua franca for the global deaf community.

And finally, there is the importation of American Sign Language into Kenya, which could have followed many paths. These include: (i) the use of ASL by missionaries for many decades, (ii) important of ASL by attendees of the ASL-centric Total Communication[7] workshops held by Andrew Foster in West Africa from the 1960s to the 1980s (Nyst 2010), (iii) the influence of the American-educated deaf scholar Michael Ndurumo who lobbied for Signed

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[6] Immigrants from India entered Kenya during the British colonial period. While it is possible that some contact with signers from India occurred and influenced KSL, there is no known evidence of such contact.

[7] Total Communication is a pedagogical approach in deaf education in which multiple means are used to convey material; i.e., voicing/mouthing, signing, pictures, pantomime, writing, etc.

English to be included in a book of signs used in deaf schools (Morgan et al. 2015); (iv) American sponsorship of some deaf schools using ASL teaching materials and resulting in repeated contact with ASL signers, (v) occasional contact with ASL-signing American volunteers and workers who pass in and out of Kenya, and (vi) deaf Kenyans who live and/or study in the United States, learn ASL, and return to use it in Kenya.

A portion of the KSL lexicon consists of ASL cognates, due to some mix of all these factors. However, studies that have compared KSL and ASL have determined that the composition of the language is primarily Kenyan in origin. Lexicostatical comparisons have consistently found that the languages do share a proportion of signs, nearly to a degree shared by languages within the same family, but at the low end of that range (Yego 1990, Roberts 2009, Miyamoto & Mori 2015). Beyond the lexicon, an analysis of basic word order finds that KSL is SOV dominant, compared to ASL's dominant SVO word order (Morgan 2014, Miyamoto & Mori 2015), and the order of nouns and modifiers is consistently Noun-Modifier in KSL (Morgan 2014), while ASL is much more often Modifier-Noun. Although other structures have not been thoroughly analyzed in KSL, the morphosyntax of each language appears to be distinctly different, with no evidence that borrowing has affected linguistic structure of KSL beyond the lexicon. Another clue is that KSL signers and ASL signers report a lack of mutual intelligibility between the languages on first contact, and have the impression that they are different languages.

A full lexicostatistical analysis is beyond the scope of this current thesis, but fields in the KSL Lexical Database were created to track the relatedness of KSL signs used in the southwestern region to the possible influences listed above. Some of these results are referenced in the inventory of KSL handshapes in Appendix 4. Overall, 19% of signs were marked as likely to have an ASL (or Signed English) origin, though some of these also have synonymous KSL-indigenous signs. For instance, the KSL signs HOME-1, NAME-1, and NUMBER-1 are indigenous to Kenya, while HOME-2, NAME-2, and NUMBER-2 are ASL borrowings. The synonyms in each pair are used in free variation in southwestern Kenya.

What about other foreign sign languages? A handful of BSL cognates have been identified in the KSL Lexical Database, though these are relatively small in number: i.e., PROBLEM, TO-TRAVEL, TO-HIDE, JUDGE (noun), and MIGORI (town name; uses the BSL fingerspelled letter 'M'). Likewise, there are a small number of cognates with Danish Sign Language (DTS): PROJECT, RICH, CHEAP, GAY-MALE.[8] Thus, these languages appear to have left traces in the lexicon, but they are not significant.

It is also important to investigate the relationship between KSL and other sign languages in East Africa. In the concluding chapter (Ch. 7), I discuss some features of KSL phonology that may be characteristic of African sign languages. Also, in preliminary unpublished work with Brandon Scates, a subset of the lexicons of East African sign languages were compared using available dictionaries. We find the sign languages of Kenya, Uganda, Rwanda may be similar enough to be included in the same language family. And, crucially, they share some of the same indigenous African signs. An explanation of how these languages came to share such signs awaits future research.

Another potential source of borrowing is from spoken languages. This can manifest in various ways: the mouthing of spoken words during signing, calques, the order of syntactic constituents, etc. Because they manifest at the phonetic level, mouthings were coded in the KSL Lexical Database. The results show that when a KSL sign is accompanied by a spoken language

[8] These BSL and DTS signs were compared against signs from multiple other European languages in www.spreadthesign.com to make sure they were not actually part of a larger language family.

word, the mouthing is overwhelmingly from English—and specifically **Kenyan English** (Buregeya 2007). Mouthings were also sometimes truncated, presumably to fit the short prosodic length of signs (Udoff 2014). There are 1,039 signs or 55% of the database produced with English mouthings. Kiswahili mouthings are the next most common, accompanying 31 signs,[9] and there are only eight signs with Dholuo mouthings.[10] This is presumably due to the dominance of English as the language of education in Kenya (Kanyoro 1991, Michieka 2005), including in deaf schools and the Kenyan deaf community in general.[11]

Finally, the role of gestural communication in East Africa and its impact on these languages should not be overlooked. Research comparing the gestures and sign languages in this region of the world promises to elucidate how forms, meanings, and their mappings are recruited and reanalyzed from co-speech gesture and emblematic communication to the primary linguistic mode of communication (e.g., Morgan 2016).

Next, I address the characteristics of the Kenyan signing community, including population numbers, levels of deafness, and school attendance.

1.4 Demographic profile of deaf Kenyans

Several research projects have attempted to quantify the prevalence of hearing impairment (HI) in Kenya, with school-based studies located in Kiambu district (Hatcher et al. 1992), Kilifi district (Mung'ala et al, 2006), Kisumu district (Omondi et al. 2007), Mbita district (Kawakatsu et al 2012), and in a selection of schools located in six districts around Kenya

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[9] The Kiswahili words may actually be part of Kenyan English, according to Buregeya (2007). Much overlap is seen between Buregeya's list and the Kiswahilli mouthings in the database: e.g., "shamba" for farm, "jembe" for hoe, "mzungu" for white person, etc.

[10] Note that these were based on utterances from different types of genre/mode, from naming individual words to full sentences to fluid conversation. Mouthing is likely to vary to some degree by the situation: type of speech act, setting, interlocutor(s), etc.

[11] In fact, Kaula (2014) finds that even hearing KSL interpreters have a bias towards English. Her study finds that interpretations from Kiswahili are measurably impoverished compared to interpretations from English.

(Newton et al. 2001). The best summary of these findings is that “the mean prevalence of childhood HI in Kenya varies between 2.3% and 5.6%” (Omondi et al. 2007: 416).

Yet this rate obviously doesn’t represent the number of KSL signers in Kenya. It has to be evaluated with respect to a few facts. First, the degree of hearing loss in these students varies from moderate (cannot hear below ~50 dB) to profound (cannot hear below ~80 dB). If a child has moderate hearing loss, s/he will likely not have enough impairment to join to a deaf school, which limits students to those with severe hearing loss, and therefore is unlikely to learn KSL. Second, even though most of these studies used large subject pools (n = 480; 738; 5,368; 6,363; and 10,218), most of them relied on testing students in schools, and no study included a deaf school or deaf unit in their subject pool, despite the relatively high number and distribution of deaf schools in Kenya. This almost certainly led to an under-counting of deaf students with severe hearing loss. Only one study, Kawakatsu et al. (2012), explicitly mentions this oversight. And finally, another issue with relying on school populations is that deaf children who are kept at home will be undercounted (Adoyo 2007; see below). Thus, these studies are almost certainly undercounting hearing impairment, particularly severe impairments. At the same, when considered with the points just made, this rates do reveal a high prevalence of hearing loss among Kenyan students.

With all these caveats in mind, if we apply a conservative rate of moderate-to-profound hearing loss of 2.3% and consider an estimated population in of 46.8 million people in Kenya in 2016 (CIA Factbook 2016), then there may be at least 1.07 million people in Kenya with moderate to severe hearing loss. If 1.0% of the population had profound hearing loss, this would be around 468,000 deaf Kenyans.

Attending a deaf school is how nearly all deaf people in southwestern Kenya acquire KSL (see §2.3), which is assumed to be the same situation all over Kenya. Given this vital role for deaf schools, what is known about attendance at these schools? As shown in Figure 1, we know that the number of deaf schools has grown over time, hopefully serving a greater proportion of children with profound hearing loss. However, the Kenyan population has also "experienced dramatic population growth" during this time (https://www.cia.gov/library/publications/the-world-factbook/geos/ke.html). Also, in the early 2000s, the Kenyan Society for Deaf Children (KSDC) reported that 30% of deaf children were not attending any school, deaf or hearing (Adoyo 2007). It is not clear if the increase in deaf schools has been able to offset both of these situations—i.e., students who were kept at home and the growth in the general population.

Data on primary schools in Kenya from the Kenya Ministry of Education offers some insight into deaf schools. A report in 2007 by the Kenya Ministry of Education provides data on all 26,199 primary schools in Kenya, as well as "special units," which are classrooms for students with disabilities (hearing, vision, cognitive, and possibly physical disabilities), located in hearing schools. Forty-one deaf schools are listed in the report, as are seventeen deaf units. Altogether, based on this data, approximately 3,590 deaf students attended primary schools in Kenya in 2007 (3,260 in deaf schools and ~330 in deaf units[12]).[13] The average enrollment in a hearing primary school is 333 students (median: 280 students), while the average enrollment in a deaf school is less: 88 students (median: 70 students). Enrollments at deaf schools ranged from

[12] The number of deaf students was not listed for Jaribu Primary School in Garissa or for Joseph Kangethe Primary School in Nairobi, so the number was estimated as 2% of the total student population.

[13] Also, four deaf schools did not provide any enrollment numbers.

as few as 20 pupils at Givavei Friends School for the Deaf (north of Kisumu) to 323 pupils at Mumias Primary School for the Deaf (near Kakamega in western Kenya).

Deaf and hearing schools also differ markedly in the ratio of teacher to students. In hearing primary schools, there are an average of 34 pupils per teacher, while deaf schools have a ratio of 7.25 pupils per teachers. This reflects education policy in Kenya designed to have a smaller student-teacher ratio in "special schools" (for students with disabilities). In practice, this does not necessarily reflect actual class sizes in deaf schools as teachers are deployed in different ways depending on the age of the students; i.e., pupils may have one homeroom teacher or several teachers during the day for different subjects.

1.5 Literature on Kenyan Sign Language

Kenyan Sign Language has a relatively high level of recognition and status within Kenya compared to sign languages in other African countries. For example, recognition of sign language is not only mentioned in the constitution, but KSL is reportedly the only sign language in Africa to be specifically recognized in a constitution by its name, i.e., as *Kenyan Sign Language* rather than simply being referred to as "sign language."[14] This degree of recognition is likely a long-term consequence of having an established deaf education system in Kenya (Christoffel Blindenmission 2014). That is, deaf education has engendered a robust adult deaf community in the past several decades. In turn, the robustness of this community has probably influenced the profile of KSL in the literature—including the current project, which was greatly facilitated by the active social network of deaf signers in southwestern Kenya as well as people at the Kenya National Association of the Deaf in Nairobi.

[14] This should provide protection for KSL in the event that policies threaten to diminish its use in the future (Professor Okoth Okombo, *personal communication*).

Compared to other African sign languages that may not have even one dictionary, let alone journal articles and a web presence, Kenyan Sign Language is much better represented and documented. For example, there are more dictionaries and repositories of KSL signs than for most other African sign languages (Schmaling 2011). These dictionaries include hardcopy books (Rotheborg-Jensen & Yego 1988; Akach 1991; KSLRP 1998; Mweri 2001; RDYAP 2002) and a video dictionary on CD-ROM (Mjitoleaji Productions 2004). There are also other caches of signs, such as online video dictionaries (*KSL Online Plus* [www.kslop.co.ke] and *KSLDictionary.com*), a poster of basic KSL signs (U.S. Peace Corps 2007), and many KSL instructional signs, stories, speeches, etc. available online (e.g., via YouTube). There have also been efforts recently to collect sign variants from around Kenya by KNAD (Kenya National Association of the Deaf) and in a U.S. Peace Corps project, although neither resource is publically available at present.

The existing literature on KSL also stands out because many different parties have contributed, comprised of a mix of (mostly hearing) Kenyan and American authors: Okombo & Akach 1997; U.S. Peace Corps 2004; Hochgesang 2007; Roberts 2009; Mweri 2009a; Mweri 2009b; Morgan 2013, 2014, 2015b.

However, there are some caveats about this literature. First, much of it is unpublished and therefore not widely available to either the deaf community or the research community (e.g., Akach 1991b; Mweri 2009a; Roberts 2009; U.S. Peace Corps 2004). Second, many of these sources do not provide detailed or comprehensive data or descriptions of the linguistic structure of KSL. Other literature on KSL comes from material that is pedagogical in nature. For example Warnke, et al. (2007) is an important manual for training the teachers of the deaf about KSL. It contains a description of grammatical sentences in KSL and several examples, but it is not meant as a linguistic description of the language and subsequently provides just a snapshot of KSL syntax.

Another caveat is that not all linguistic levels of KSL have been addressed—let alone described—although to be fair this is the case for many sign languages around the world. The syntax of KSL has been addressed to some extent (Akach 1991a: xvii-xix; Akach 1991b; Warnke et al. 2007; Morgan 2014; Morgan et al. 2015; Miyamoto & Mori 2015), but a full accounting of sentence types and grammatical constructions used by KSL signers has yet to be undertaken. Some morphological constructions have been broadly sketched in Morgan et al. (2015), and the system of KSL numeral incorporation has been addressed in unpublished work (Morgan 2013), but many other aspects of morphology and word formation have yet to be detailed (e.g., plurality, perfectives, compound signs, calques, polysemy, grammatical categories, etc.). At the phonological level, prior to this thesis, the only published literature is Morgan & Mayberry (2012), who describe constraints on two-handed signs in KSL—one small aspect of sign language phonology.

Thus, the current thesis endeavors to thoroughly document one aspect of this thriving language of East Africa. This project has a fairly narrow scope—to describe the phonological system of the dialect of KSL in southwestern Kenya—yet it can enable “horizontal” comparisons with lexical data in other KSL dialects (e.g., a coastal/Mombasa variant, a Central/Nairobi variant, etc.) and across neighboring sign languages in Uganda, Tanzania, etc., as well as “vertical” connections to other domains of linguistic organization in KSL including morphology, syntax, discourse structure, socio-linguistic categories, etc.

To that end, an important tool that comes out of this overall project is the lexical database for the southwestern dialect of KSL (described at length in the next chapter). A full documentation of a language should include a lexicon, texts (i.e., stories, monologues, conversations, etc.), and an annotated corpus. And when it comes to corpora of sign languages in particular, which lack a phonetic orthography, many linguists have argued for the use of ID-glosses (see §2.8) that can link words in utterances (in the corpus) and words in the lexicon (in a lexical database). Thus, the next step for this research would be to work with signers to come to a more informed understanding of the lexical semantics of KSL signs so that they can be assigned ID glosses and used in annotations.

This also leads to an important point, especially for the KSL signing community: the KSL Lexical Database in this project *is not a dictionary.* A dictionary requires the careful analysis of the usage of each word to discern its meaning in actual daily conversation among signers. For example, the same sign can have a variety of somewhat related meanings (e.g., the sign 'HARSH' can mean "awful", "dangerous", emphatic, etc.), or the same-looking sign can have very different meanings (e.g., FRIDAY and TO-WASH have the same form); or two very different-looking signs can have the same meaning (e.g., NUMBER-1 from KSL, NUMBER-2 from ASL). These interactions of form and meaning in the standard lexicon should be captured in a dictionary.

In this project, the KSL Lexical Database has been used to analyze the forms alone, and has therefore included signs that are relevant for the phonology, but may be temporary slang terms, or not widely used beyond the local community; e.g., an informal sign meaning "easy" or "child's play" (pinch at neck) or less common variants for "sex." These words may not be included in a dictionary, which should be a relatively long-term document for a general population. Yet these signs are still of interest to linguists, who want to capture the full range of the language used in the community and understand its patterns.

1.6 Summary

This chapter introduced the goals of the thesis: a description of KSL phonology, which advances methods for the linguistic description of sign languages and contributes to theories about the sub-lexical organization of signed words. This chapter also provided a background about the historical origins of KSL, as well as linguistic evidence of these origins, found in the etymology of signs and in words borrowed from foreign sign languages. Information was provided about the potential size of the deaf population in Kenya and a snapshot of the deaf school population. And finally, a brief profile of the existing literature on Kenyan Sign Language was given, ending with a look ahead to future research on KSL that can build from the documentation created for this project.

Chapter 2:
Methodology

2.1 Introduction

This chapter explains how the current project was undertaken. It describes the scope of the data, how it was selected, coded, etc. §2.2 describes the research site and demographics relevant to KSL signers in the region and §2.3 describes the participants. §2.4 then explains the procedure for how data was gathered and the KSL Lexical Database that houses the KSL signs in §2.5. The basic criteria for inclusion of lexical items into the database is provided in §2.6, and then §2.7 describes the process of phonetic coding. The chapter ends with comments on representing signs through glossing and notation systems in §2.8

2.2 Research site

This project focuses exclusively on the KSL variant used in southwestern Kenya, in the southern part of the former Nyanza Province, which is now composed of three counties: Migori County, Homa Bay County, and Kisii County (Fig. 4).[15] For this reason, the dialect is periodically referred to in this thesis as (SoNy)KSL for "South Nyanza Kenyan Sign Language". However, it is important to note that a full understanding of the dialects in different regions of Kenya has yet to be established.

The decision to limit the scope of investigation to this one region is grounded in both research and practical considerations. First, focusing narrowly on a single dialect ensures as much systematicity in the phonology as possible, which is especially important considering that

[15] Provinces have been phased out in Kenya's transition to a county government structure, based on the 2013 national constitution. The eight provinces are now 47 counties. However, while the term 'Nyanza' may no longer be a relevant geopolitical entity, it is still the best single term to refer to this region, which roughly delineates a common ethno-linguistic, economic, geologic (Meert et al. 1994), and climatologic region.

there seems to be a relatively high degree of lexical variation in Kenya. Second, on a practical level, it would not have been feasible to collect signs from all over the country within the timeframe and scope of a dissertation-level project. Another consideration was the author's existing level of familiarity with the deaf community and language in this particular region of Kenya, having worked there as a teacher at Kuja Primary School for the Deaf from 2005 to 2007.

The main site of data collection was Rongo, a small but growing town in Migori County with two deaf residential schools adjacent to each other—Kuja Primary School for the Deaf and Kuja Secondary School for the Deaf. The schools serve deaf students from three counties: Migori, Homa Bay, and Kisii (Fig. 4). Students live at the school for nine months out of the year, with month-long breaks in April, August, and December. At the time of data collection, around 200 students attended the primary school and at least 125 attended the secondary school. These schools employ several deaf adults, and some alumni of these schools settle in or near Rongo after graduating, creating a local residential deaf community concentrated around this town.[16]

Rongo is on a main north-south highway, and was established at a three-way junction of roads leading to Tanzania, Kisumu (and Kisii), and Lake Victoria, and therefore a convenient transit hub in the region—including for deaf people—to stop on the way to another destination. Services available in Rongo include a twice-weekly market, banking, a health clinic, pharmacy, internet cafes, hardware stores, gas stations, and a transportation hub. Deaf adults come to town to meet each other and socialize, share news, get assistance, and/or worship at deaf church services. An office for the South Nyanza Deaf Association (SNAD) was located in town at the time of data collection. SNAD advocates for the local deaf community and liaises with the national deaf organization, KNAD, in Nairobi.

[16] Rongo is not unique in this way. There are small local deaf communities who come together in multiple towns all over Kenya.

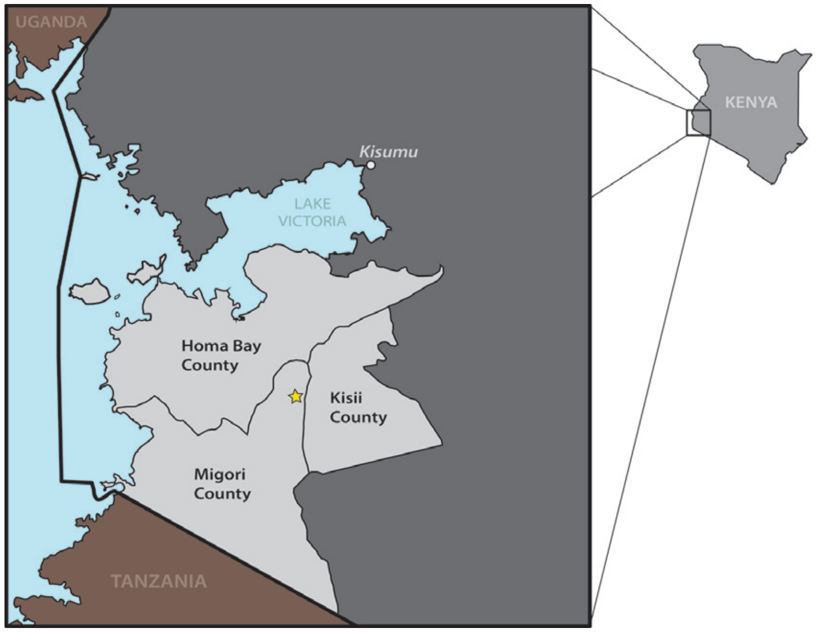


Figure 4. Three counties adjacent to Rongo (yellow star), in the south part of former Nyanza Province: Homa Bay, Migori, Kisii

Economically, this region is overwhelmingly agricultural, with both small-scale farming by individual families as well as large-scale sugarcane production, fishing from Lake Victoria, and small-scale mining. Compared to other regions in Kenya, Nyanza Province has a relatively high incidence of malaria and a higher rate of HIV infections than other regions.

An estimate of the deaf population in local area can be calculated from the last Kenyan census in 2009 (KNBS 2009) and a conservative estimate of Kenyans with severe hearing loss (1%, as explained in §1.4). The total population of these three counties in 2009 was 3.14 million people; therefore, an estimate of the deaf population in the South Nyanza region is around 30,000 people.

2.2.1 Languages in contact at the field site

Outside of a few main cities, most Kenyans grow up speaking one of the 55+ local languages in their home and then learn English and Swahili in school. The language boundaries of the languages surrounding the field site are shown in Figure 5. Ethno-linguistic groups are important political entities in Kenya so the geographic boundaries of these groups are not trivial in terms of social affiliation and its influence on language. The county boundaries in the research area, shown in Figure 4, run along an ethno-linguistic border between Luo (or Dholuo) speaking people to the west in Migori and Homa Bay Counties and Gusii (or Kisii or EkeGusii) speaking people in Kisii County to the east. Other local languages in this region are Kuria, spoken near the Tanzanian border, and Suba along the coastline of Lake Victoria (although 95% of Suba speakers grow up speaking Luo [Lewis, et al. 2015]).

Figure 5. Local languages spoken near Rongo (yellow star): Dholuo (Luo), EkeGusii (Gusii or Kisii), Kuria, and Suba

One clue to the ethno-linguistic background of the deaf community in Rongo the ethnic composition of students at Kuja Primary School for the Deaf. Names and naming traditions are distinctly different among ethnic groups in Kenya, and Luo names are particularly easy to recognize. Therefore, based on an etymology of names, as well as the author's familiarity with many of the students at the time, it was found that in 2007, among 182 students at Kuja Primary, at least 75% were Luo, 6-16% were Gusii, and 1% each were Kuria, Massai, and Somali. Thus, despite close proximity to the Gusii-speaking region,[17] the overwhelming majority of students were from Luo-speaking families.

While this is more relevant for a study of KSL morphosyntax because of possible contact phenomena with word order, compounds, calques, etc., such language contact does show up in phonology with the mouthing of spoken language words (often in reduced form) during signs. These mouthings were coded in the lexical database, and it was found that only eight signs are accompanied by Luo mouthings. This is compared to 24 signs with Swahili word mouthing, and 995 English word mouthing—presumably due to English-centric teaching at deaf schools (described in §1.3.1).

2.3 Participants

During two visits to the field in 2011 and 2012, data was collected from 29 participants, all of them deaf KSL-fluent adults. All but one person had attended a deaf school in western Kenya (one man became deaf as an adult). However, for the construction of the lexical database, four main signers contributed the majority of signs. These four spent many years in close association with the Kuja deaf schools, and exemplify the variant of KSL in this region.

Demographic data was collected on 27 of 29 signers who participated, providing a snapshot of the deaf community in this area. The information was collected by the author in an interview format and includes current age, age at onset of deafness, age when first attended a deaf school, and history of attendance at deaf schools. Table 1 presents the data in a chronological form, ordering signers from oldest to youngest. The name(s) of the deaf school(s) attended are also shown. Note that this is self-reported data and may contain some errors. To protect privacy, only numbers are given for each signer here. Otherwise, throughout the thesis,

[17] The closest Gusii market is only a 30-minute walk from Kuja Primary.

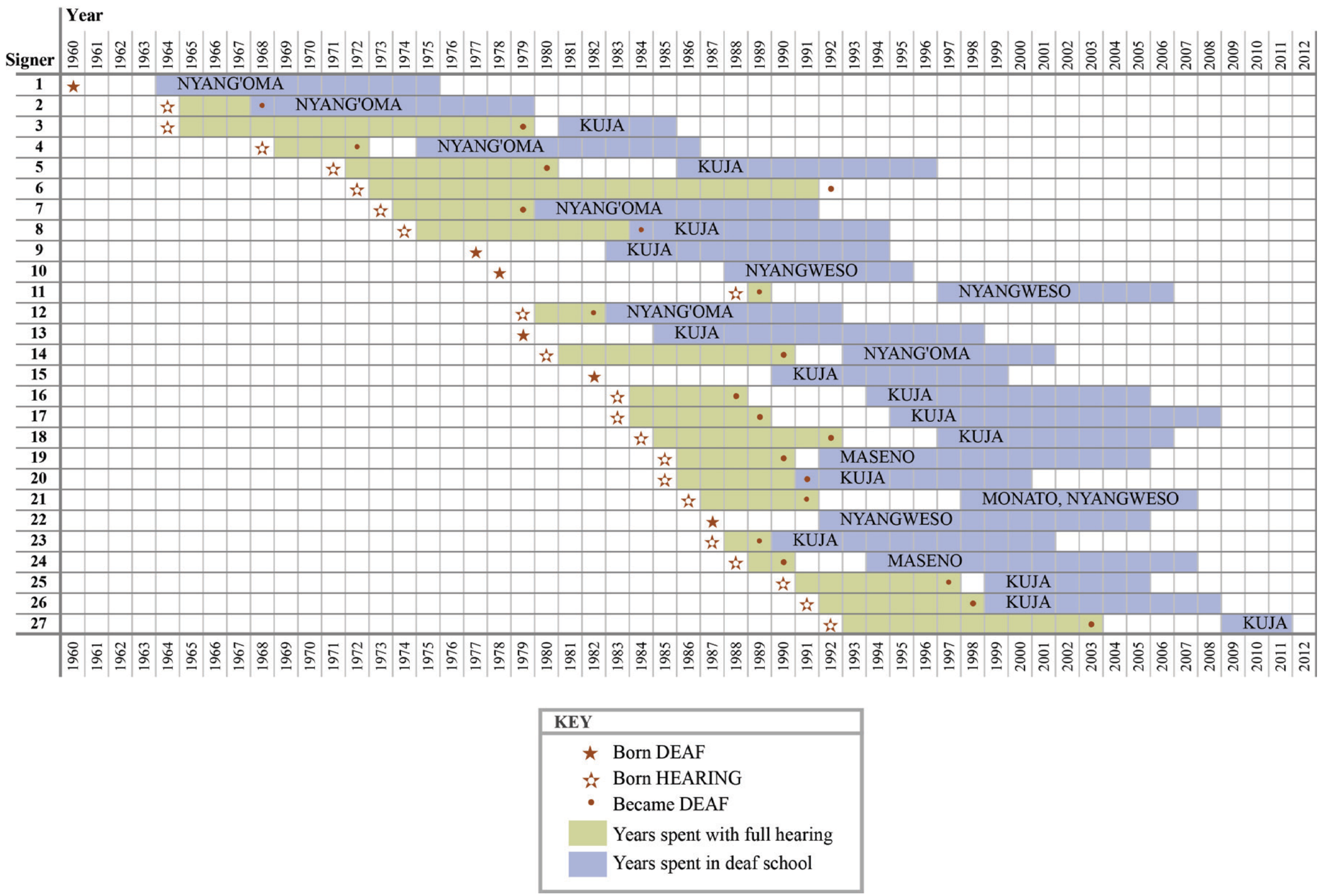
signers are represented by letter and number combinations in chronological order of participation; e.g., A1, B1, C1.

As shown in Table 1, the signers range from 20yrs to 50yrs. 22% were born deaf (6 of 27), while 78% were born hearing. Although signers became deaf anywhere from 1-20yrs old, the median age of deafness for the signers who were born hearing is 4.5yrs. This conforms to anecdotal reports that most deaf people in this region became deaf as a result of illness in childhood (Adoyo 2007; Biggs 2013: 53; Kimani 2012: 33). Twelve signers experienced a gap in education before entering a deaf school, ranging from one to five years. This time was either spent attending a hearing school or living at home or, most often, a mix of both.

Even though a few participants are from Gusii families (not depicted), all of the participants attended deaf schools in the Luo-speaking region of Nyanza Province.[18] Most participants attended deaf schools inthe south Nyanza region: 13 people had attended Kuja Primary in Rongo (site of data collection) and 4 people attended Nyangweso Primary School for the Deaf in Homa Bay County. The remainder attended schools in the north Nyanza region: 6 attended Nyang'oma primary school (one of the two oldest deaf schools) and 2 attended Maseno Primary School for the Deaf. However, among those who went to schools in north Nyanza, five come from families in living south Nyanza.

[18] The former Nyanza Province was essentially coterminous with the Luo-speaking region of Kenya that borders Lake Victoria.

Table 1. *Timeline of KSL Participants' History*



2.4 Procedure

In order to undertake a phonological analysis of any language, a reliable and sufficiently complete set of words/signs must be collected from speakers/signers. The current analysis of Kenyan Sign Language is based on a dataset of lexical signs that was collected specifically for this thesis.

The final dataset for phonological analysis is 1,880 signs. It is housed in a FileMaker Pro database that is referred to here as the **KSL Lexical Database**. In the remainder of the chapter, I describe the procedure for how signs were collected, how their usage was verified, and how their formational/phonetic features were coded. Also, I explain the types of signs encountered in the data collection process and how sign variants (morphological, lexical, phonological, phonetic) were classified and integrated (or not) into the database. Finally, I explain some classificatory facts about the database at its current stage. All this serves to establish information about the dataset from which the phonemic analysis was done, which is described in the following chapter.

2.4.1 Gathering data

The KSL Lexical Database was constructed over several years and in many stages. The first stage involved **collecting lexical items** to be elicited. An initial pool of signs was drawn from a KSL video dictionary produced in 2004 by the KSLRP (KSL Research Project) at the University of Nairobi in collaboration with KNAD and U.S. Peace Corps volunteers (Mjitoleaji 2004). This video dictionary was developed for Kenyans and visitors to Kenya to learn basic conversational KSL and therefore includes signs essential for everyday communication in Kenya, including different parts of speech (nouns, verbs, prepositions, conjunctions, modifiers, etc.), relevant place names, and several sample sentences. While not perfect (Hochgesang 2015), this dictionary is a reasonably good representation of the shared KSL lexicon in Kenya, and substantially better than many other "dictionaries" of Africa sign languages, which may be no more than a list of drawn or photographed signs without any information on grammatical properties, usage, etymology, or variants (Schmaling 2011).

As will be explained further, the data under investigation for the phonological analysis are exclusively monomorphemic KSL signs that are relatively standardized with a single lexical meaning and no added morphological modification.[19] This excludes compound signs (e.g., MIND^BREAK ['*depressed*'], WORLD^WATER ['*ocean*']), constructed action (e.g., 'I hammered nails into the ceiling', 'it jumped all around') and expressions with morphological modification (e.g., aspectual constructions such as 'to put in multiple places over time').

A list of around 900 signs from the 2004 dictionary was supplemented by a list of 138 signs that the author recorded in a hardcopy notebook while living in Rongo in south Nyanza province from 2005-2007.[20] From 2007 to 2012, the author continued to periodically add signs to this list that had been observed while in Kenya but were not already in the dictionary or on the custom list; e.g., SUGAR, AVOCADO, INFLUENCE, DOUBT, TWINS, etc.

Several hundred more signs (including their lexical variants; see §2.5.2) were added during data collection in Kenya and later while annotating the video. These were signs that hadn't made it onto a list prior to elicitation, but came up in several different ways: (i) during filmed conversations about the signs that were being elicited (e.g., MARABOU-STORK, LEOPARD); (ii) during more free-ranging conversations or stories that spontaneously occurred on film during elicitation (e.g., PYTHON, EXECUTIVE); (iii) signs that were observed and noted in conversation

[19] These signs have been referred to as those in the "frozen lexicon" (Johnston & Schembri 1999: 131-132, 144-148). However this term implies a grammaticalization process that is still under some debate (Johnston & Ferrara 2012, Lepic 2015)

[20] This was also the period when the author learned to sign KSL, both through formal lessons and informal daily conversation with deaf adults in Rongo. Many of these conversational partners (and friends) were participants in the elicitation for this project.

outside of elicitation and then later elicited on video ("CHILD'S-PLAY", "HANDS"[21]); and (iv) signs that had been accidentally overlooked, but were discovered later while annotating passages of video and were subsequently added to the lexical database (e.g., THANK-YOU, THAN).

In this way, lexical data were gathered in a ground-up way; nearly all the lexical items elicited were those already observed to be used by Kenyan signers in this region, or those that emerged out of conversation during filming. On only a few occasions were signs elicited that had never been observed by the author but were suspected to have dedicated signs (e.g., *Ebola*, *island*, *granary*, etc.). However, these were only added to the lexical database if multiple signers had the same form and signers treated it like an established sign (see Morgan 2015a for an analysis of lexical and phonological variants in KSL that are not conventionalized).[22]

For those signs that were on the elicitation list, the next stage was to **capture signs on video**, which was done during the two trips to Kenya in 2011 and 2012. Signs were elicited in three ways. First, for items that were easily picture-able (e.g., *goat*, *Nile perch*, *charcoal stove*, *nurse*), photographs were found online using Google Image searches and presented on a laptop screen (Fig. 6a). Photos were chosen for their natural fit in a Kenyan context, with most pictures actually photographed in Kenya and neighboring countries. Hardcopy materials were also used, including pictures from Kenyan schoolbooks showing family relationships and printouts of maps of Africa and the world (Fig. 6b). Second, for items that were not easily picture-able (e.g., *quality*, *create*, *jealous*, *do*, *forever*), translation from English was used by using words printed out on slips of paper and presented in groups by topic (e.g., health, school, emotion, etc.) (Fig.

[21] These two signs are colloquial terms that are not easy to gloss in English.

[22] Note that the elicitation methods used in this project closely overlap with those described by Schmaling in her grammar of Hausa Sign Language in Nigeria (2000: 51).

6c). This was only used with English-literate signers,[23] though even then, some glosses were unhelpful—especially for colloquial KSL signs whose glosses were tentatively assigned by the author; e.g., *egotistical*, *belligerent*. In these cases, a description of the word was given or the intended target sign was provided and then its use in a sentence was requested (again, the signs elicited were already observed to be in use in the community). Other than these translations, all interactions with signers, including elicitation sessions, were in Kenyan Sign Language. Also, as just described above, signs not previously on the elicitation list were proffered by signers, observed in conversations and later elicited, or identified later while annotating video.[24]

a.  b. 

c. 

Figure 6. Examples of elicitation procedure: a. eliciting digital photos on a laptop computer, b. eliciting from printouts of images, and c. eliciting from English words that were gloss translations of existing KSL signs

Another step required **verifying signs** from the 2004 video dictionary that were not thought to be used at the field site. I flagged around 120 of the 900 dictionary signs that I had not

[23] As explained in Chapter 1, Kenyan schools are English-dominant.

[24] Immediately after the last visit to the field, KSL signs that had been inadvertently overlooked started to pop up; e.g, ANNOUNCE, DIVORCE, THREATEN, POLICY, VIRGIN, MUNGIKI, etc. A new elicitation list was started is presently over 130 signs to elicit in the future. Due to the poor infrastructure and lack of access to technology at the research site, these could not be collected by other means (e.g., cell phone video).

seen used in the Rongo community in the two years spent there—or I couldn't be sure whether I had or not. Many of these were lexical variants from different locations in Kenya[25] and were not included in the KSL Lexical Database. However, around half of these signs were possible variants used in Rongo. Sixty-six signs were shown to a signer for confirmation. Twenty-eight were confirmed to be used in the local area and were added to the database for phonological analysis. Eight signs were compounds or are still of questionable status; these were not included in the dataset for the phonological analysis. For the thirty remaining signs, the signer who served as the main informant (signer O1) either knew the signs but confirmed they weren't used in the local area, or their meaning was not retrievable to him.

2.4.2 Participating signers

Although 29 signers participated in the overall data collection, the bulk of signs in the lexical database comes from four signers: V1, B1, K1, and O1. Three of them (V1, B1, K1) lived and worked together at the same deaf primary school for many years; and three attended primary and/or secondary school in Rongo (B1, O1, K1). It was therefore assumed that they would use a shared lexicon. Each of these individuals also had experience in teaching KSL, either formally (O1, B1) or informally (V1, K1), and they were quick to understand the elicitation task and clear in their responses. I also knew them personally to be individuals who were insightful in meta-linguistic awareness of KSL usage. For all these reasons, they were good candidates for language elicitation.

2.4.3 Filming and processing video

Filming was done with two cameras, a VIXIA HV30 video camera using mini-DV cassette tapes and a digital video FlipCam. Thirty-three total hours of video were filmed,

[25] The 2004 dictionary includes few synonymous terms that are regional variants.

approximately thirty hours of which was filmed with two cameras simultaneously. There were several advantages to using two cameras: (i) as a back-up during filming in case of a dying battery or full tape/hard drive (a frequent occurrence), (ii) as a back-up in case one is damaged or stolen, (iii) to more accurately capture multi-dimensional movement through space, and (iv) to be a second "eye" for some unclear articulations.[26] One camera was usually positioned to capture both the signer and elicitor (author), as shown in Figures 6a. The other camera framed the signer mostly head-on, which is the camera angle included most often in the KSL Lexical Database (see Fig. 7).

The footage on mini-DV cassette was uploaded to a Mac computer. Once digitized, the footage from the cassette and the FlipCam were both temporally synchronized using the video editing software Final Cut Express. Each video was also tagged with an onscreen metadata label. This label is also used throughout the filenaming process, linking all files back to the project metatadata, currently stored in a spreadsheet.

The next step was to annotate and then extract individual signs into standalone videos from long passages of video footage. Since many hundreds of videos needed to be extracted, an automated solution was highly desirable. This led to using the free software program ChronoViz (www.chronoviz.com; Fouse 2013), which has some of the same functionality as ELAN and can automatically create multiple video clips based on the *in* and *out* time points of annotations.[27]

Once the videos of each sign were exported based on the annotations, they were ready to be imported into the KSL Lexical Database for phonetic coding.

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[26] It is worth noting that using two cameras required a copious amount of time manually syncing timelines, especially because videos were uneven as camera batteries died or tape ran out—something that technological advances can now address (i.e. using audio waveforms to auto-sync, or using digital-only recording with synchronized clocks).

[27] ChronoViz annotations can also be converted into ELAN files, and vice versa.

2.5 Creating the KSL Lexical Database

The KSL Lexical Database was created in the relational database software FileMaker Pro because of its flexibility: customizable layouts that facilitate efficient data entry and the ability to easily add new fields and modify custom value lists on-the-fly. At the same time, the database structure was intentionally kept as "flat" as possible; that is, avoiding too many dynamic relationships between tables or complex lookup scripts. This is to make the data maximally accessible for future use. Figure 7 shows the master data entry layout.

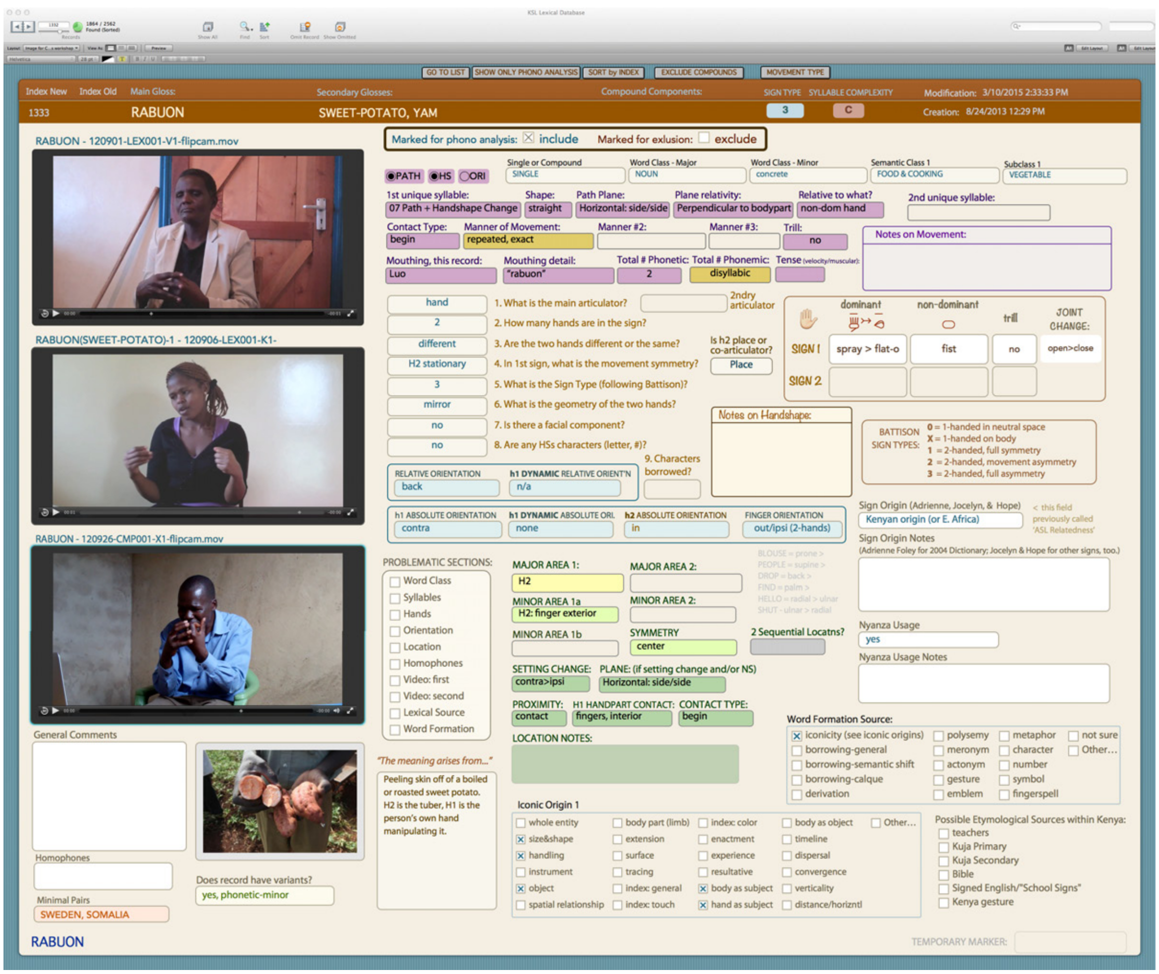


Figure 7. Screenshot of data entry screen used for some movement features

Over 85 fields appear on the master layout, and a separate list of these fields is provided in Appendix 1, *Fields in the KSL Lexical Database*. These include all aspects of the phonetic and phonemic form, as well as video container fields (three total), lexical and semantic information, and record-tracking fields (e.g., index number, modification timestamp, filenames for videos, etc.). Around 55 fields are specifically relevant for the phonological analysis.

(1) Database terms:
  a. **record**: a single lexical entry with all of its associated data (phonetic coding, videos, morphological details); analogous to a row in a spreadsheet
  b. **field**: one type of data (e.g., number of hands in a sign; major area; relative orientation) associated with a single record; analogous to a column in a spreadsheet
  c. **value**: the specific data entered in a field (e.g., '2 hands'; 'head'; 'ulnar orientation')
  d. **value list**: list of possible values to choose from in a field (e.g., {1 hand, 2 hands} or {palm, ulnar, radial, back, tips, root}); usually appears as a drop-down list when entering a field

2.5.1 Criteria for the inclusion of lexical items in the KSL Lexical Database

During the construction of the database, it was necessary to ask at certain points: what counts as a distinct sign that deserves its own record in the database? Many, even most, signs were straightforward to establish, being the only monomorphemic lexical sign for that referent, and with minor phonetic/articulatory variation between or within signers; e.g., HAPPY, CLEAN, FEAR, FRIEND, IMPORTANT, WATCHMAN, etc., etc. However, not all possible lexical items collected on video were used for the phonological analysis. This includes three main types of signs, briefly described here: fingerspelled words, compound signs, and some types of variants (discussed at length in the next section).

Fingerspelled words are those that use handshapes representing letters to spell names or words from a spoken language. The fingerspelling alphabet used in the southwestern area of Kenya is shown in Appendix 5. The use of fingerspelled words is not common in everyday signing in southwestern Kenya. Signers do use fingerspelling to disambiguate meanings, but then readily create a new signs or descriptive phrase for a new referent. At the same time, handshapes representing letters can be incorporated into signs in other ways (Brentari & Padden 2001, Cormier et al. 2008), such as in **initialized signs** in which the handshape in the sign represents the first letter—the initial—from a spoken word, such as the letter 'B' handshape in the KSL sign BOARD-OF-GOVERNORS from English or the 'I' handshape in the sign INSHA from Swahili (meaning a composition written in Swahili). Initialized signs are common in the KSL lexicon and are described for each handshape in Appendix 3. However, there are also a small number of KSL signs made up of short fingerspelled words or abbreviations that have been conventionalized in communication. There are around 15 of these signs in the database. These are made up of short 2- or 3-letter words such as #T-V for "*television*", #K-B for "*Koderobara*" (a community close to the research site), and #V-C-T for "Voluntary Counselling & Testing center."[28] There are also short letter blends with lexically-specified movement (e.g., #E-X with movement only on the 'X' for "*executive*"), but KSL has fewer of these and with less complexity than letter blends in ASL and British Sign Language (Cormier et al. 2008). At some points of the analysis, these signs are set aside, which is indicated in the relevant sections.

The other type of signs that were not considered in this thesis are **compounds** in which two individual signs are combined to make a word with a new lexical meaning; e.g., THINK^SELVES to mean "*invent*".[29] In sign languages, compound signs are subject to phonological reductions (Liddell & Johnson 1986) that turn them into blended forms, subject to the robust prosodic constraints on signed words (Brentari 1998). However, there are many compounds that do not reduce (Perlmutter 1996, Lepic 2014); e.g., COMPUTER^HOUSE in KSL for "*cyber café*". In this project, both types have been collected and added to the KSL Lexical

[28] For HIV/AIDS testing, counseling, and related services.

[29] As evidence of the language-specific nature of compounds, the blend THINK^SELF has a different meaning in ASL, "it's up to you."

Database. There are currently 550 compounds in the database, with many of them being lexical variants; e.g., three compounds for "*stove*": MATCH^LIGHT-LIGHT, BOIL^HEAT, COOK^HEAT. While an analysis of phonological reduction would be an appropriate addition to this grammar, it fell beyond the scope of what was possible within the project timeframe An analysis of KSL compounds, both reduced and otherwise, is left for future research.

Otherwise, the most challenging issue in creating the lexical database was **variation** among signers. To provide an example at one extreme end of the spectrum, the sign GUAVA was elicited from ten signers, nine shown in Figure 8.[30] While these signers produced variants with largely overlapping phonology (Table 2), no two signers had identical productions (Morgan 2015a).

Figure 8. Multiple signers' productions for GUAVA (elicited from photograph)

[30] One person declined to have their likeness shared, and Table 2 leaves out one signer (top-left in Fig. 8) who only produced a descriptive narrative for 'guava', but not a distinct sign.

Table 2. Phonological features for productions of GUAVA

Signer	Handshape	Palm orient.	Finger orient.	# Hands	Location	Movement (A)	Movement (B)	Mouth mvmnt?	Repetition
Signer Y1	closed-claw	inward	upward	1	mouth-center	path	vertical	biting	yes
Signer M1	A	inward	upward	1	mouth-inside	*none*	*n/a*	biting	no
Signer Z1	fist	inward	upward	1	mouth-center	path	midsagittal	biting	yes
Signer J1	A (loose)	inward > downward	upward > inward	1	mouth-side	orientation	nodding	open	no
Signer B2	fist	inward	upward	1	mouth-inside	orientation	twisting trill	open	yes (trill)
Signer A2	A	inward	upward	1	mouth-side	orientation	twisting trill	no	yes (trill)
Signer W1	claw-stacked	inward	upward	1	mouth-side	orientation	pronation	biting	yes
Signer O1	S	dynamic	contra	1	mouth-center	orientation	supination	open	yes
Signer X1	S	dynamic	contra	1	mouth-center	orientation	pronation	no	Yes

The sign GUAVA poses two challenges, one for the construction of the lexical database and one ultimately for the phonological analysis. The challenge for the lexical database is that no one sign can stand in as the common variant, and creating nine different records for each one would overlook the significant overlap in form. The database solution for this sign, and a few others (e.g., *island*, *watermelon*) was to keep a single indexed record in the database, but remove such signs from the phonological analysis (the 1,880 signs included in the phonological analysis are designated by a check box field) and mark the record as having very high variability. The solution for this extreme variability in the phonemic analysis is described further in the next chapter, in §3.5.1, but in short, it was discovered that signers are systematic within their own idiolects, so that the phonemic analysis is exclusively built upon lexical contrast within the same signer. This bypasses the problem of inter-signer variability and the risk of creating a "pseudo-grammar"—that is, an amalgamation of forms that do not represent the grammar of any one person.

The case of GUAVA and other types of variation prompted the need for a procedure to handle these cases. The next section defines the types of variants that were encountered and how they were managed in this project.

2.5.2 Types of lexical variants in the dataset

There are several different types of sign variants found in natural language data (Johnson & Schembri 1999; Fenlon, et al. 2015), and it was necessary to develop a set of principles for handling the different types encountered during data collection. These types include: *morphological variants*, *lexical variants*, *phonological variants*, and *phonetic variants*. Also, the next section (§2.5.3) addresses signs with the same form, but different meaning: *polysemes* and other *homonyms*. Here, I describe these types and explain how they were integrated into the KSL Lexical Database (or not), and into the phonological analysis (or not).

Such sign types can be organized around a *lemma*, or a headword that unites variants in both form (phonological, phonetic variants) and meaning (polysemes, homophones). This is how dictionaries are organized, and is a fundamental tool for lexical databases that interface with language corpora (Johnston 2008; Crasborn & de Meijer 2012; Fenlon, et al. 2015). While lemmatization is a next logical step for this lexical data, it is not necessary for the current phonological analysis. In fact, being able to distinguish between certain phonological variants (and not collapse them into one lexeme) was imperative for the phonological analysis. Further, lemmatization requires careful parsing of form and meaning with fluent signers, which is outside the scope of the current project. This is addressed briefly again in §2.8, regarding ID-glosses. That said, it is necessary to explain how variants were handled in this project. The following describes the four different sign types found in the data and how each was treated.

Morphological variants are those whose phonological properties have been modified for grammatical purposes, such as to indicate agreement for person by changing the path direction of the verb (e.g., '*I gave her*' with outward movement vs. '*you gave me*' with inward movement), reduplication in different locations to indicate distribution or plurality, a change in velocity to indicate intensity, etc. These modifications were not considered in current project. It should be noted that no existing analysis of KSL morphology already exists that would provide a means of easily classifying the ones that were found. However, it should be noted that these modifications were not very common in the video data—perhaps because so much of the elicitation was for basic uninflected signs (modified forms are more likely to emerge in normal discourse).

Lexical variants are synonymous signs that share the same gloss, and which may or may not share formational properties. For example, there are five variants for 'money' in the KSL Lexical Database, three of which are shown in Figure 9. Each lexical variant has its own record in the database and is used in the phonological analysis. These variants are labeled in the Gloss field with a hyphen and number after the main gloss: MONEY-1, MONEY-2, MONEY-3, MONEY-4, MONEY-5.[31]

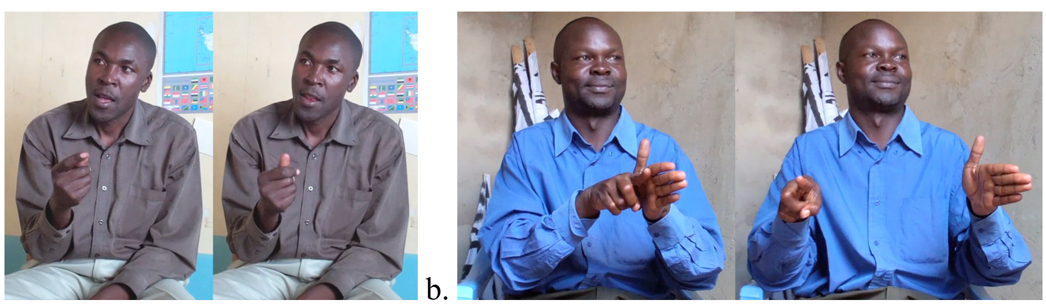
a. b.


Figure 9. KSL lexical variants for "money": a. MONEY-1, b. MONEY-5, c. MONEY-3

[31] The order of numbering of variants were assigned based on the author's evaluation of frequency and/or degree of prototypicality. For example, MONEY-1 is the generic sign for money and is also the most frequent. As with assigning glosses, more research needs be done to confirm these impressions, so these numbers should be treated with some caution. However, research has shown L2 speakers/signers (like the author) are particularly sensitive to lexical frequencies (Diependaele et al. 2013, Mayberry et al. 2014), so these judgments should be afforded some degree of reliability.

c. 

Figure 9 (continued). KSL lexical variants for "money": a. MONEY-1, b. MONEY-5, c. MONEY-3

A sub-type of lexical variants are **phonological variants**. These are also synonyms, but share a higher degree of formational overlap. For example, the sign for *samosa* (a meat-filled fried pastry) has at least two similar variants used in south Nyanza: both have the same number of hands, selected fingers, absolute orientation, axis of path movement (horizontal), movement symmetry and handpart contact, but differ in their setting changes, repetition, and overall movement type (path+HS change vs. path only) (Fig. 10). Like lexical variants, phonological variants are given separate entries in the lexical database if they meet the requirements for inclusion in the dataset used for phonological analysis (see §2.6). These phonological variants are stable lexical items in their own right (unlike phonetic variants, discussed next) so that signers in the same small language community may be consistently using different variants.

a.  b. 

Figure 10. Examples of phonological variants: a. SAMOSA-2, b. SAMOSA-3

Around half of the records in the database have glosses with labels indicating that they are lexical variants (e.g., GLOSS-1, GLOSS-2, etc.). This includes both lexical and phonological variants because they were not marked differently in the database. As shown in Table 3, 902 glosses indicate no other variants, while 962 other signs have lexical variants. Of these, 302 glosses have two variants, 85 glosses have three variants, 17 glosses have four lexical variants, and seven glosses have five lexical variants (e.g., MONEY).

Table 3. *Proportions of lexical variants in KSL Lexical Database*

	unique glosses	total signs	% of signs in database
Meanings with no other variants	902	902	48.4%
Meanings with 2 lexical variants	302	604	32.4%
Meanings with 3 lexical variants	85	255	13.7%
Meanings with 4 lexical variants	17	68	3.6%
Meanings with 5 lexical variants	7	35	1.9%
TOTAL	*1313*	*1864*	*100%*

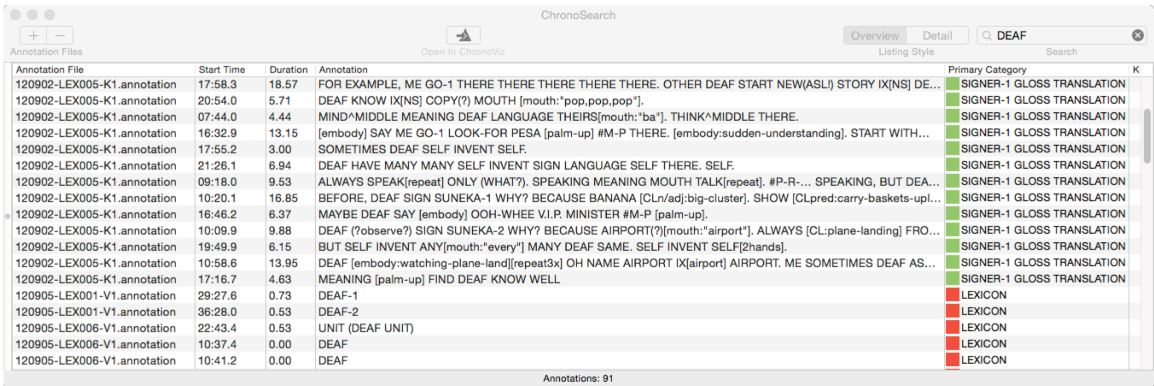
While this may seem like a high number of variants, caveats are in order. This way of measuring variants is solely based on the English gloss, which can be highly problematic. Consider the following example: there are two different varieties of avocados available in the local markets and two completely different signs for AVOCADO used in this region. While many signers appear to use only one of the two signs to mean all avocados, at least one signer reported that he used the two different lexical variants to differentiate between types of avocados (small black ones and big green ones). Therefore, using an English gloss may obscure a lexical difference between two very different KSL signs. At the same time, choosing different glosses, such as AVOCADO-BLACK and AVOCADO-GREEN, would not fit the lexical meanings attributed by other signers. As mentioned, a careful lexical semantic analysis of these signs is still needed, and will surely lead to different, more refined glossing. For example, MONEY-5 in Figure 9b might be glossed as CASH or DOUGH.[32]

[32] This brings up yet another problem with the glossing of KSL: if English is used, which English should it be? These glosses should probably be made in Kenyan English, derived from British English (but not perfectly overlapping contemporary British English) that best fits the local context. Also, occasionally the best gloss is in Swahili or the Luo language, as will be seen in examples throughout the thesis.

However, there was some concern about the phonological variants for the phonological analysis. As mentioned at the beginning of this chapter, one reason for limiting the dataset to KSL signs from a single local area was to try to better capture phonological patterns specific to a particular variant of KSL. With a relatively high number of phonological variants even within this small community of signers, the concern still exists that false phonological contrasts might be identified by selecting signs in different lects. This is explained further in §3.5 in the next chapter, along with the methodological solution pursued in this thesis: using minimal pair contrasts from only the same signer.

Finally, there are **phonetic variants** that were found in the video data. These are signs produced with slight changes from a citation/prototype form and vary for the same sign and the same signer from token to token. These are articulations that do not result in a change in meaning and are usually influenced by certain conditioning environments, such as other simultaneous features/primes in the sign, ease of articulation, changes in language style, or signing that is offset somehow for communicative reasons. Because sign tokens with this type of variation do not cause a word-level change in meaning, they are not afforded separate entries in the database, but are represented in the three video container fields for each lexical record.

Phonetic variation has proven to be very informative in previous phonological analyses for determining the boundaries of allowable variation in form for certain phonological features (Crasborn 2001; van der Kooij 2002). The current thesis likewise finds phonetic variation to be helpful in clarifying phonological categories. As mentioned, the KSL Lexical Database includes three video fields to hold videos of the same sign by three signers (or slightly different productions by the same signer), but more tokens of the same sign could be found using the ChronoViz annotated video, and using the free companion software, ChronoSearch to quickly find and access all the instances of a sign across all annotated videos. An example of a search in ChronoSearch for the sign DEAF is shown in Figure 11. Explanations about how phonetic variants were used to illuminate phonemic categories are presented at various places in the analysis in the three main chapters on Articulator/Handshape, Location, and Movement.



Annotation File	Start Time	Duration	Annotation	Primary Category	K
120902-LEX005-K1.annotation	17:58.3	18.57	FOR EXAMPLE, ME GO-1 THERE THERE THERE THERE THERE. OTHER DEAF START NEW(ASL!) STORY IX[NS] DE...	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	20:54.0	5.71	DEAF KNOW IX[NS] COPY(?) MOUTH [mouth:"pop,pop,pop"].	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	07:44.0	4.44	MIND^MIDDLE MEANING DEAF LANGUAGE THEIRS[mouth:"ba"]. THINK^MIDDLE THERE.	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	16:32.9	13.15	[embody] SAY ME GO-1 LOOK-FOR PESA [palm-up] #M-P THERE. [embody:sudden-understanding]. START WITH...	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	17:55.2	3.00	SOMETIMES DEAF SELF INVENT SELF.	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	21:26.1	6.94	DEAF HAVE MANY MANY SELF INVENT SIGN LANGUAGE SELF THERE. SELF.	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	09:18.0	9.53	ALWAYS SPEAK[repeat] ONLY (WHAT?). SPEAKING MEANING MOUTH TALK[repeat]. #P-R-... SPEAKING, BUT DEA...	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	10:20.1	16.85	BEFORE, DEAF SIGN SUNEKA-1 WHY? BECAUSE BANANA [CLn/adj:big-cluster]. SHOW [CLpred:carry-baskets-upl...	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	16:46.2	6.37	MAYBE DEAF SAY [embody] OOH-WHEE V.I.P. MINISTER #M-P [palm-up].	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	10:09.9	9.88	DEAF (?observe?) SIGN SUNEKA-2 WHY? BECAUSE AIRPORT(?)[mouth:"airport"]. ALWAYS [CL:plane-landing] FRO...	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	19:49.9	6.15	BUT SELF INVENT ANY[mouth:"every"] MANY DEAF SAME. SELF INVENT SELF[2hands].	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	10:58.6	13.95	DEAF [embody:watching-plane-land][repeat3x] OH NAME AIRPORT IX[airport] AIRPORT. ME SOMETIMES DEAF AS...	SIGNER-1 GLOSS TRANSLATION	
120902-LEX005-K1.annotation	17:16.7	4.63	MEANING [palm-up] FIND DEAF KNOW WELL	SIGNER-1 GLOSS TRANSLATION	
120905-LEX001-V1.annotation	29:27.6	0.73	DEAF-1	LEXICON	
120905-LEX001-V1.annotation	36:28.0	0.53	DEAF-2	LEXICON	
120905-LEX006-V1.annotation	22:43.4	0.53	UNIT (DEAF UNIT)	LEXICON	
120905-LEX006-V1.annotation	10:37.4	0.00	DEAF	LEXICON	
120905-LEX006-V1.annotation	10:41.2	0.00	DEAF	LEXICON	

Annotations: 91

Figure 11. Screenshot of ChronoSearch results for the sign 'DEAF'

To summarize, morphological variants were not considered in the current phonological analysis. In contrast, lexical variants—including phonological variants—constitute many records in the database and participated in phonological contrasts that have elucidated the structure of KSL phonology. Phonetic variants were also used in this project in order to understand phonological structure; however they were not given separate entries.

2.5.3 Types of signs: polysemy and homophony

While lexical variants have the same meaning but different forms, some signs have the same forms but different meanings; i.e., they are homophonous. These come in two types: polysemes and other homophones. These sign types have no effect on the phonological analysis at hand, but are described briefly for the purpose of clarifying the contents of the database.

Polysemous signs have a shared etymological source, but two distinctly different meanings. Some examples from the database include: VILLAGE and HUT, SCHOOL and CLASS, FIRE and COOK, HOW-MANY and MATHEMATICS-2. Polysemy is therefore a common type of word formation in KSL, such as when naming places for a representative object, feature, or practice; for example in the following polysemes: TO-HAWK and SUNEKA, a town where passing buses are mobbed by hawkers; WOOD-CARVING and KAMBA, an ethnic group known for its woodcarving products; TOOL and TABAKA, a town known for its soapstone carved with tools. Some days of the week use a similar naming strategy where a day of the week is given a sign associated with a thing or activity done on that day in the weekly schedule of a particular deaf school: WASH and FRIDAY, FISH and THURSDAY, DANCE and WEDNESDAY-2. Note that these are highly conventionalized signs, and are used regularly without misunderstanding.

Homophones that are not polysemous are also found in the database. These are signs with the same articulation, but no apparent shared historical or etymological relationship. Examples include BLUE-1 and MINISTER, MATHEMATICS-1 and NAIL, SAMOSA-3 and VAGINA-1, FUNERAL-1 and BORED-2, FLOUR-1 and QUALITY-1.

Polysemes and homophones are given their own separate records in the database because of their distinct lexical meanings. A text field in the database allows them to be flagged, showing around 20% of signs are homophonous (380 signs), field does not differentiate between whether their meanings are related or not.

2.6 Basic criteria for signs in the phonological analysis

Having explained the various sign types that were encountered during elicitation sessions, I present here the basic criteria for considering a sign to be part of the local 'South Nyanza' lexicon, and to be eligible for the phonological analysis.

(2) Basic criteria for inclusion in the dataset for phonological analysis:
  a. The sign is not a compound or fingerspelled word.
  b. The sign is not a morphological variation of another sign in the database.
  c. The sign is not a phonetic variation of another sign in the database.
  d. The sign may be a lexical or phonological variant of another sign in the database.

(2, continued) Basic criteria for inclusion in the dataset for phonological analysis:

e. The sign must be represented by at least one video token[33] by a signer from the southwestern region of Kenya.[34]
f. The sign should be an established variant in the local dialect; this is determined by either of the two criteria:
    - Videos of at least two signers from the region producing exactly the same sign
    - Only one video, but with (i) an indication from the signer that it is used and understood in the community, or (ii) the author's firsthand observation of its use in the community.

As reported, there are 1,880 signs that fit these criteria and were used in the phonological analysis. Note that there are a few exceptions in the database for #2f which could not be confirmed from a second signer or my own observations, but are otherwise well-formed signs. These have been flagged in the database for follow-up.

These criteria were set up to limit entries in the database to only those signs having a minimal degree of standardization in this dialect of KSL. There are at least a couple reasons to make such a distinction: (i) to have data that can be used to determine the dialectal boundaries of KSL in the future, and also (ii) to limit the signs for analysis to a single dialect to prevent the creation of a 'pseudo grammar' by mixing different dialects. However, it was later determined that this last point could be controlled by only considering lexical contrasts within the same signer (described in the next chapter). This eased some of the burden on proving a minimal degree of standardization for the phonological analysis; however, understanding variation and standardization in this dialect remains an important descriptive and typological goal.

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[33] There are many KSL signs that I know the correct articulation for, but they were not captured on video (e.g., TAILORING, BRIBE, PETTICOAT, etc.). These are not included in the analysis.

[34] A few of the 29 participants lived away from south Nyanza for some years of their adult lives; their productions were double-checked against other signers' productions.

2.7 Coding phonetic information

This section provides an overview of the phonetic coding process. It addresses the conceptual approach taken, how different models of sign structure (i.e., features, not structural relationships) were accommodated, and how the coding started flexibly and gradually moved toward categorical structure. Although some examples are provided, I do not detail how all 55+ fields and their contents were determined.[35]

The core challenge for the phonetic coding was arriving at just the right degree of specificity. Because the intention from the beginning was to discover the categorical, phonological units of form, coding that was too granular would slow and possibly prevent the achievement of that goal.[36] At the same time, importing categories wholesale from other languages or from a given theory could risk overlooking KSL-specific data and categories, and possibly undescribed structures.

A second goal for the database was to make the data as compatible as possible with other research, including the major phonological models. However, while setting up the initial fields for features in the parameters of handshape, orientation, location, and movement, it became clear that among the four major phonological models of sign language, one of them assumes such fundamentally different structure that it would have to be accommodated in a very different way than the other three. Specifically, there is an irreconcilable difference between the Move-Hold model (Liddell & Johnson) and the other three major models: Hand Tier model (Sandler 1989), Prosodic model (Brentari 1998), and Dependency Models. The difference involves the relationship of features to the surface output. In the Hand Tier, Prosodic, and Dependency models, features are organized in tiered feature hierarchies that associate to surface outputs,

[35] See Morgan (2015b) for an outline of all the fields and their associated field values.

[36] Granularity without the context of categories is hardly informative anyway.

while in the Move-Hold model, features are tied to their segments and can only be referenced through segmental relationships. This means that a system of coding that was compatible with the Move-Hold model crucially requires the identification of the M and H segments for all words in the lexicon.

There are significant challenges to coding the lexicon for these hypothetical M and H segments. One reason is that Holds and Movements are defined by temporal attributes that are highly variable (Liddell 1984), making it very difficult to come to an objective and consistent determination about the segmental structure of each word. In fact, the unpredictability of Hold segments and a lack of evidence for their relevance as phonological entities has caused them to be questioned by other sign phonologists (described further in §3.3). Also, there is no existing sign language lexicon or dictionary (that I am aware of) that has been coded using the segmental structure of the Move-Hold model, which could function as a test case and a guide.[37] Finally, Liddell & Johnson have now abandoned their phonological model in favor of a complex phonetic approach (Johnson & Liddell 2010, 2011, 2012) that eschews phonological categories.[38] While L&J have developed an alternative phonetic coding system, it was determined that it would be inefficient to use two fundamentally different coding systems—especially one that may not be able to meet the primary goal of determining phonemic structure. Thus, the two goals of this project, discovering the categorical units of form and being compatible with multiple perspectives, reached an impasse here, and it was decided to set aside the Move-Hold model.

[37] In contrast, Stokoe Notation (and variations on it) has been used to encode the phonological structure of multiple sign languages.

[38] Johnson and Liddell write, "(w)e conclude that while the evidence for segmenting signs is compelling, each of the proposed systems of segmentation has significant problems, and…we argue for a new way of conceiving of signs as sequentially organized segments. The new proposal differs…in that we concentrate on representing segments phonetically rather than trying to conceive of sign structure at a more abstract phonemic level" (2010: 242).

The other three models posit phonological structures in the form of features and branching dependencies, which are described in more detail in the next chapter and the introductory parts of the chapters for Handshape (Ch. 4), Location (Ch. 5), and Movement (Ch. 6, 7). Here it will suffice to say that features are the smallest distinctive phonological units of form, and their distinctiveness is typically demonstrated by being in a minimal pair in which a single feature value results in a different lexical sign (Ch. 2). Examples of features are the location [forehead], the number of fingers in a handshape [all], or [repeated] for a movement that occurs twice. Features in the three models are relatively translatable with each other and therefore the coding of feature values can in many cases work within any of these three models. An overview of different types of "translation" between features and positions (in branching structures) in the models are shown in (3). In terms of simply coding featural specifications and not attending to them as theoretical constructs or where they appear in the underlying representation, the first three relationships do not require any special treatment, other than to know what labels are used for different features. The fourth relationship, 3d, depends on the feature in question; it may be possible to translate using existing featural information or it may require a new dedicated field. The fifth relationship in 3e involves features that are not shared between models, and requires adding a field to capture a completely different type of feature.

(3) Relationships between features and structures encountered when translating between theoretical models of sign phonology:

a. Similar feature label and similar position in model
b. Different feature label and similar position in model
c. Similar feature label and different position in model
d. Different feature label and different conception of the feature
e. Feature exists in one model but not in another

With this "translatability" in mind, and a desire to not leave anything out, the initial stage of coding was focused on setting up enough fields to cover all of the relevant (i.e., potentially categorical) observable data. Signs were coded in alphabetical order by English gloss (for more on glossing, see next section), and the initial stage lasted through the first several hundred signs.

In the initial phase, basic fields were first established related to each parameter (handshape, location, movement, orientation), done in a conservative way—i.e., fields were chosen that would be important to capture for any model or basic description (e.g., handshape 'name', major area on the body, number of hands in the sign, path shape, etc.). Second, fields that had been overlooked were added as signs came up that required them, or as I realized they would come up (e.g., finger orientation, trilled movement, secondary articulators [head, mouth], etc.). Whenever a new field was added, all the previous signs were coded for that characteristic. Value lists for each field were also slowly filled as each characteristic was given a new or existing label/value, and these values were double-checked to make sure that they were consistent across all signs (e.g., 'flat-tense' handshape, 'wrist-interior' location, 'zigzag' path shape, etc.). In fact, *this reassessment was a continual aspect of the coding from beginning to end, and is how categories started to emerge organically out of the data*.

At the end of the initial phase, the database went through an expansion and re-ordering. First, some fields that had grown to have long and descriptive value lists with too many sub-types were split up. For example, the *absolute orientation* field began as a single field to handle the orientation of both the dominant and non-dominant hands (e.g., 'contra/ipsi' for WITH, MEET), but after most of the dataset was coded, it was decided there were too many combinations and this single field was separated into one field for each hand. Similarly, *manner of movement* features (e.g, repeated, alternating, bidirectional, etc.) were split into three fields, and two different levels of lexical information were created (word class 1, 2; semantic class 1, 2). Second, the descriptive scope of the coding was expanded, and new fields were added that seemed to capture overlooked formational aspects that are not represented in formal models; (i) the geometric relationship of the hands to each other, and (ii) what path movement is relative to (body part, ground, variable to person, imaginary object, etc.). Also, new fields for the morphological and iconic origins were created. These haven't played a major role in the current thesis, but have been instructive at certain times (e.g., see §3.5.3 for a discussion of the role of iconicity in a phonological grammar), and form the basis for future research.

At this point, after around 500 signs had been coded, a period of coding continued with less modification to the database itself, though still punctuated by continual reassessments of feature values and category creation. Then around halfway through (~1,000 signs), the order of coding changed so that only the characteristics of a certain parameter (handshape, orientation, location, movement) would be coded at a time.[39] The data was broken into sets of 100 (still in alphabetical English order and with an index number) so that, for example, all the location information for that set was coded, then handshape information, then movement. Special data entry screens to visually narrow the data on the screen were created. This change was done to speed up the coding, especially since much of the work of to establish the basic features and primes had been done. Note, too, that the collection of minimal pairs was underway at this time. The process for determining minimal pairs is detailed in the next chapter.

At the end of this phonetic coding, it can be seen that this process has resulted in the language-specific feature and prime values of KSL already being categorized to a certain degree. However, there were still many feature/prime values that were uncertain as to their phonemic status, and this is where the phonological analysis began. This analysis relies mainly on two main types of data: (i) minimal pairs, and (ii) predictable phonetic gradience. The discussion of

[39] In this later phase, two undergraduate students at UC San Diego assisted with some of the more transparent phonetic coding, including location.

minimal pairs is covered in depth in the next chapter, while the discussion about phonetic variation and conditioning is specific to each aspect of the sign and is therefore addressed at relevant points in the individual chapters for each parameter.

This chapter closes by addressing the choices for how the presentation of data was decided

2.8 Representing signs: glossing, notation systems, ID-glosses

Without a widely accepted orthography for signs, akin to the International Phonetic Alphabet (IPA) for spoken languages, sign linguists have to make choices about how to represent signs, both in coding and in the presentation of data. This section addresses which choices were made, and why, in this project.

Glossing is the use of a written word from a spoken language to represent a signed word. By convention, glosses are written in small capital letters. For example, the gloss GOOD stands for the following KSL sign: *the two flat hands, palm down, with the dominant hand (h1) positioned above the non-dominant hand (h2); h1 moves downward once or twice, contacting the back of h2 with the palm of h1*, as in Figure 12. A gloss is always a translation and therefore imperfect for many reasons,[40]

a.  b. 

Figure 12. KSL sign GOOD: a. signer B1, b. signer K1

[40] For further discussion on problems with glossing see Johnston (2010), Pizzuto & Pietandrea (2001), Miller (2001), among others.

There are a few notation systems that have been developed for depicting the phonetic—and potentially phonemic—structure in signs that would avoid the problems with glosses (Miller 2001). Among these, Hamburg Notation System, or HamNoSys, (Prillwitz et al. 1990) is probably the best choice for several reasons: (i) it captures mostly the right level of detail for phonemic representation and some phonetic variation, (ii) it is usable with a computer font,[41] (iii) it is visually iconic in a way that is *relatively* easy to learn for sign linguists, and (iv) it has been used effectively in another phonological grammar, Schmaling (2000), and other phonological research (e.g., Rozelle [2003]). Figure 13 shows the HamNoSys representation for the sign GOOD using the format adopted by Schmaling in her description of Hausa Sign Language.

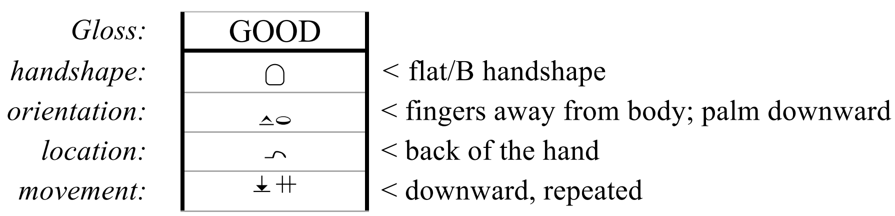


Figure 13. HamNoSys representation for GOOD using format of Schmaling (2000)

However, there are a few reasons why HamNoSys did not play a major role in this thesis. One reason is that during the phonetic coding of the database there was a need to be as flexible and quick as possible to name and code categories when going through a lot of data. This was most straightforwardly done using the written form of the coder/author's native language, English. And for the presentation of data in the thesis, it was decided that HamNoSys requires too much initial effort to learn to read that it presents a bar to entry for all but a small proportion of readers.

Also, it was decided that there are advantages to using photographs for the purposes of presentation instead of an orthographic notation. First, for a sign language that has not yet been

[41] There is also a website that generates HamNoSys symbols: http://www.sign-lang.uni-hamburg.de/hamnosys/input/

much described, I believe that there is value in seeing photographs of signers themselves. For example, I find that Nyst's descriptive analysis of Adamorobe Sign Language (2007) is greatly enriched by photos of the AdaSL signers' productions. Second, there are phonetic differences between sign languages in their "pronunciations" of what would be considered the same phonological categories (e.g., different types of 'fist' handshape in different languages); these can be made clear with photographs (or video).[42] Third, this grammar of KSL rests on formational evidence that is best conveyed by seeing the "raw" format of the actual articulation being produced: i.e., (i) minimal pairs produced by the same signer; (ii) several types of phonetic variation that give clues to phonological categories. That said, the phonemic values in the database are gradually being converted to HamNoSys (e.g., handshapes in Chapter 4 and Appendix 4), and may be used in future publications.[43]

In §2.5.2, I mention that variants can be organized around a headword or lemma. The creation of a well-defined lemma can be accompanied by an **ID-gloss**, which is a technical type of gloss used in sign language research to uniquely identify a specific sign and all its morphological variants consistently throughout an annotated text or corpus (Johnston 2008, 2010). Because such a gloss involves the type of lexical semantic analysis that occurs in a dictionary, and because the current form of the KSL Lexical Database as represented in this thesis is <u>not a dictionary</u>, the glosses used in this thesis should not be taken as an official ID-gloss. At various places in the thesis, I will point out examples of glosses that rely on interpretation and usage that are speculative and need to be verified.

[42] It will someday be possible to study the patterns of phonetic differences between sign languages in a more systematic way, and having photographic (or video) representations can help to stimulate hypotheses about these differences.

[43] New fields in the database contain the HamNoSys symbols; no data is being replaced.

2.9 Conclusion

This chapter has profiled how the project was undertaken, starting with characteristics of the field site and the deaf signers who live there, as well as the specific participants who contributed their time and knowledge. Most of the steps in the process of creating this phonological grammar of KSL have been described here, from identifying signs in the community to elicitation methods, to the annotation of video clips that were imported into a database, and then organized and coded for all aspects of their formational structure. The next chapter continues with the phonemic analysis and describes the approach taken to determine the truly categorical units of KSL, via a search for true minimal pairs.

Chapter 3:
Minimal pairs and the phonological analysis

3.1 Introduction

This grammar of (SoNy)KSL phonology has followed a strictly bottom-up, data-driven approach, from the collection of data, through the phonetic coding, and continuing into the phonemic analysis. Much of this analysis relies on the examination of minimal pairs from the KSL Lexical Database. The analysis has yielded the collection of 461 "true" minimal pairs, which is a unique dataset in sign linguistics. Yet determining what constitutes a minimal pair is not a trivial matter. It involves both theoretical judgments and, I will argue, methodological care and transparency.

This chapter serves as a nexus point for the thesis, introducing the theoretical grounding, describing the methodology for finding minimal pairs, and presenting the overall findings of the minimal pair analysis. Because of the standalone nature of the four main chapters that follow—on *Handshape* (Chapter 4), *Location* (Chapter 5) and *Movement* (Chapters 6, 7)—it is more conceptually coherent to address all aspects of minimal pairs and the underlying structure of the sign prior to presenting the more specific analysis. Also, a more detailed background for each of the three parameters is provided at the beginning of those chapters, where it is most relevant.

Here, I start with an overview comparing minimal pairs in the language modalities and introduce some of the basic issues regarding lexical contrast in signs (§3.2). Next, I explain the overall theoretical approach taken in this thesis to the existing models of sign phonology (§3.3). Then I turn to minimal pairs, first addressing why so much emphasis is placed on them in this grammar (and in sign phonology in general) in §3.4. In §3.5, I detail the process of finding and verifying "true" minimal pairs, and then describe three potential problems with the methodology and how they were addressed: (i) variation and idiolects in §3.5.1; (ii) near-minimal pairs in §3.5.2; and (iii) the relevance of iconicity in §3.5.3. In §3.6, I turn to the summary findings, with the quantitative results of the different proportions of minimal pair types (by parameter, inherent/prosodic features, etc.). This allows me to assess, in §3.6.1, the longstanding observation that minimal pairs are "hard to find" in sign languages. Finally, I evaluate what these pairs can tell us about the minimal unit of contrast in the sign (§3.7.), and conclude with a look at future directions in §3.8.

3.2 What counts as a minimal pair?

In both the spoken and signed language modalities, a minimal pair is the paradigmatic replacement (substitution) of one phonological unit for another, resulting in a different attested word, while all other units remain the same. In English, for example, the words '*cat*' and '*pat*' are minimal pairs that differ by the initial consonant in the word, the phonemic segments /k/ and /p/. The existence of this pair is taken to be evidence by phonologists that both segments belong in the language-specific inventory of English. But note that the *cat*/*pat* pair can also be interpreted as having a featural difference in place of articulation only—an alveolar location for /k/ and a bilabial location for /p/—while voicing and manner features in the segments /k/ and /p/ remain the same. This is depicted in Figure 14 as either the difference in segments, or a difference in one feature within the unique assemblage of features associated with each segment.

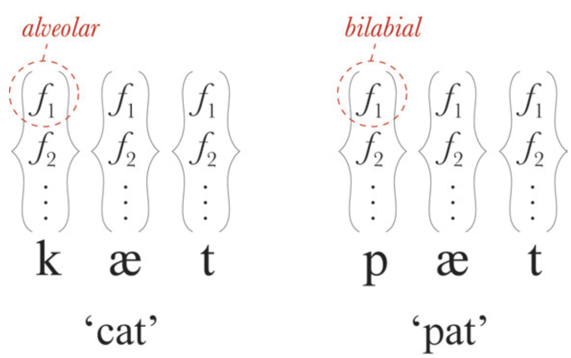


Figure 14. Schematic of *'cat'* and *'pat'*, a minimal pair in English (*f* = feature)

A parallel to this phenomenon is found in sign language minimal pairs, in which one phonological unit can be replaced with another, resulting in a change in meaning. For example, the KSL minimal pairs GOSSIP and TOMORROW, shown in Figure 15, differ by the handshape in each sign: a *flat* handshape in GOSSIP and a *1* handshape in TOMORROW. This indicates that *flat* and *1* are both primes[44] in the phoneme inventory (SoNy)KSL.

a.  b. 

Figure 15. KSL minimal pair for handshape and/or selected fingers: a. GOSSIP (*flat* handshape), b. TOMORROW (*1* handshape)[45]

And just as /k/ and /p/ also differ by only one feature, so too do these two handshapes. In many current models of handshape structure,[46] the handshape *flat* has the feature [all] for *selected fingers*, while the handshape *1* has the feature [one]. This is depicted in Figure 16, showing a single feature difference between pairs. In this way, it is possible to use minimal pairs in sign language as a test for phonemic units, just as it is in spoken languages.

[44] A neutral term for phonemic units in sign language inventories that can't be further decomposed into features; e.g., the handshape *C*, the location *cheek*.

[45] These tokens also differ slightly by mouth position and the point of contact on the dominant hand, but neither is distinctive.

[46] I.e., following the 'One over All and All over One' model for handshape (van der Kooij 1996; Brentari, et al. 1996).

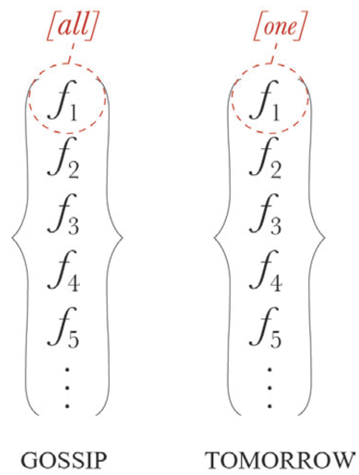


Figure 16. Schematic of GOSSIP and TOMORROW, a minimal pair in KSL

In both Figures 14 and 16, the feature bundle is depicted as an undifferentiated list, which is a simplification—especially of the sign data[47]—meant to illustrate the greater simultaneous structure in signed words as opposed to spoken words. Yet, most models of sign language phonology acknowledge that there is some kind of sequential, linear information in the sign and provide a structural way of encoding that in the representation. Two models at opposite ends of the spectrum regarding linearity are Oneseg (Channon 2002) and Move-Hold (Liddell & Johnson 1986). I will briefly describe these two models, then turn to the overall theoretical approach in this grammar, including an appraisal of the three models referred to the most in the thesis, and the guiding theory about what counts as a feature, segment, and syllable.

The first of the two models is the Oneseg Model by Channon (2002), who argues that linear structure in signs is fully predictable on the basis of phonetics and iconicity and that a single segment with a constellation of features that associate directly to the mono-segmental skeleton is sufficient to represent the phonological structure in a signed word. Channon's Oneseg Model (i.e., "one segment"), depicted in Figure 17, simplifies the phonological representation

[47] See Appendix 3 for different representations of internal organization in the signed word, and further discussions in the next three chapters.

down to one segment with virtually no further internal organization.[48] Channon also justifies a mono-segmental model by saying that it reflects the distinctive units in a signed word because in her definition, the segment is "the largest phonological unit where combinations of features are contrastive" (2002). Indeed, the majority of minimal pairs do involve the paradigmatic replacement of one simultaneous unit for another, in ASL and in the minimal pair findings of KSL reported in this chapter. However, Oneseg over-corrects in its goal for parsimony, and cannot sufficiently account for all the sign data found in a lexicon, including so-called "reduced compounds" with two locations, monomorphemic "two sequential location" signs (see §5.12.3), and certain disyllabic signs with differential distribution of secondary movement across the syllables; e.g., DESTROY in ASL or TO-MUSE in KSL (see §7.5, Fig. 235).

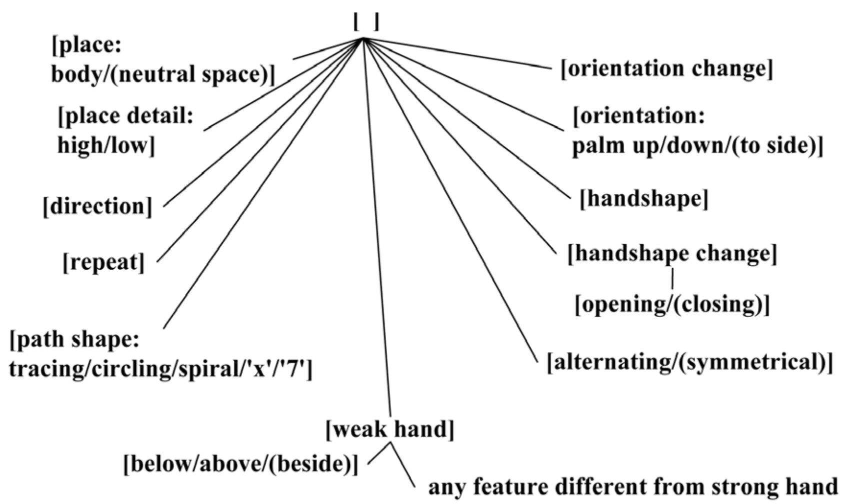


Figure 17. Oneseg model (Channon 2002: 144)

At the other end of the spectrum is Liddell and Johnson's Move-Hold model, which represents signed words as matrices of two different types of segments, Movement and Hold

[48] Channon does propose two simple dependencies: (i) a binary branch on the weak/non-dominant hand, and (ii) more detailed options for handshape opening and closing. All other features attach directly to a single segment.

segments, which are associated to feature bundles, as shown in Figure 18.[49] An H-segment is a period of stasis in the sign, often at a physical location, while an M-segment is the period of movement during the sign. For example, both GOSSIP and TOMORROW in Figure 15 above have a repeated approach movement (M) followed by a period of stasis on the cheek (H), resulting in an MHMH segmental structure (with a transitional movement that gets deleted by phonological rule). In the previous chapter, I explained that L&J's model poses challenges for a phonetic coding that wants to be efficient, translatable between models, and ultimately linked to phonemic structure. Their view of phonemic structure as sequences of M and H segments also affects what they determine to be legitimate minimal pairs.

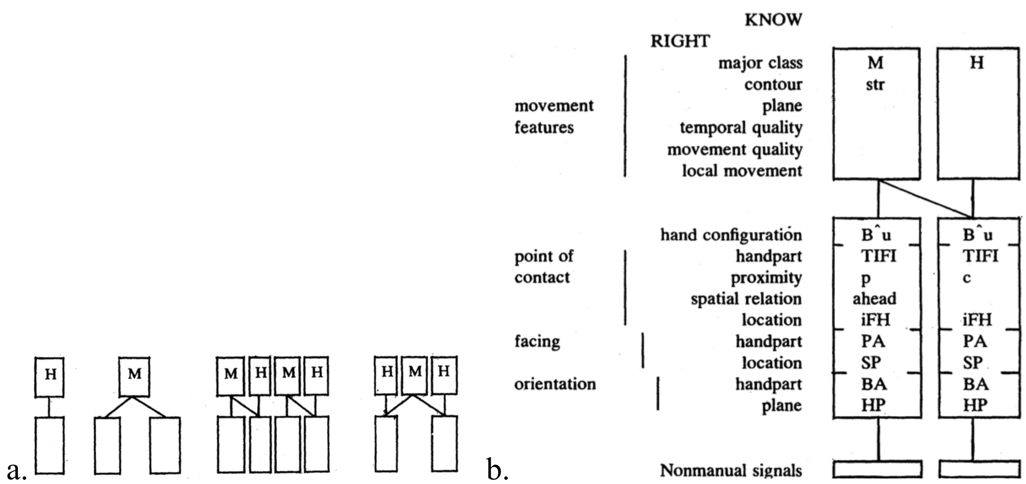


Figure 18. Move-Hold model: a. types of segmental MH sequences found in ASL words, b. representation of KNOW in ASL (reprinted from Liddell & Johnson 1986: 451-452)

In contrast to most other sign phonologists, Johnson and Liddell believe that substituting one unit (a feature or a prime) for another in a simultaneous bundle—as exemplified by GOSSIP vs. TOMORROW in Figure 15 or ONION vs. APPLE in ASL (*eye* vs. *cheek* minimal pair)—does not constitute a minimal pair: "(t)he problem here is that substitutability (Saussure's *paradigmatic*

[49] The abbreviations in KNOW are: **str** = straight; **B^u** = four fingers extended & unspread; **TIFI** = tips of the fingers; **p** = proximal; **c** = contact; **iFH** = ipsilateral forehead; **PA** = palm; **SP** = surface plane; **BA** = base of the hand; **HP** = horizontal plane

opposition) is not sufficient to demonstrate contrast (Saussure's *syntagmatic contrast*)" (2010: 250). They state that because "minimal pairs in speech can be identified only when there is a pair of words in which only one segment within a sequence of segments differs" then there is "no linguistic value from observing pairs such as ONION and APPLE" (2010: 252). That is, because the handshapes in GOSSIP vs. TOMORROW and locations in ONION vs. APPLE encompass the entire sign (paradigmatic opposition only) rather than occurring as a replaceable unit within a string of phonemic units, L&J believe this is not what Saussure intended as demonstrating truly contrasting phonological units in the language. For them, accepting ONION and APPLE as a minimal pair would necessitate fundamentally redefining what is said to be a language universal, **duality of patterning**. Duality of patterning refers to the fact that discrete, meaningless units (phonemes) can be combined and ordered to create units of meaning (morphemes, words). In spoken language, the units always occur in strings, and indeed the canonical example of duality of patterning used by Hockett in his influential article on language universals (1960) is 'cat' [kæt], 'act' [ækt], and 'tack' [tæk], which involve the syntagmatic reorganization of three discrete sounds to create distinctly different English words. Ultimately, this is cited as a key motivation for L&J's longstanding research on sequential structure in the sign: "(i)f … signs can be shown to consist of sequences of segments, then the concept of minimal pairs could be applied without the need to redefine the concept" of duality of patterning—their preferred outcome (2010: 253).

However, L&J's insistence on sequential structure and exclusively syntagmatic contrast overlooks evidence that simultaneous phonemic units like handshape and location extend throughout the entire sign in the overwhelming majority of signs in the lexicon, are perceived by signers as categorical units, and are referred to in word formation processes (Fernald & Napoli

2000, van der Kooij & Zwitserlood 2015). In other words, signs like APPLE and ONION *are* minimal pairs because this is how words in the sign language modality are distinguished from each other and how new signed words are created. It is also important to mention that the concept of duality of patterning has recently come under re-examination in spoken as well as signed languages, and is now considered by many linguists as a complex set of tendencies in linguistic patterning rather than the fixed universal that L&J assume it to be (de Boer et al. 2012, Ladd 2012, Blevins 2012).

Many sign phonologists have pointed out some shortcomings of the Move-Hold model for representing phonological structure in the signed word (Sandler 1989, Wilbur 1993, Wilbur & Petersen 1997, Brentari 1998, van der Kooij & van der Hulst 2005, Wilbur 2011). Their arguments are briefly recapitulated here as two main critiques.

The first critique regards the nature of the Hold segment itself, summarized most clearly by Sandler (1989: 17-22). She points out that these H segments are "attested to by instrumental measurement… rather than by any phonological test. Thus the segmentation of signs is not a function of phonological behavior or of the perceptual discrimination of the signer" (1989: 18). That is, there is no independent evidence that H segments are referred to by the phonology. Sandler also observes that H's are characterized by a "vast and (so far at least) unpredictable range of durations within signs," so they may actually "be related to phrase-level prosody… and rules of phonetic implementation" (1989: 20). And finally, she notes that in L&J's pervasive Hold Deletion rule, H segments delete in more contexts than those in which they actually occur and "seem predictable on a purely physiological basis" (1989: 20), again calling into question their fidelity as phonological objects.

The second critique involves the distribution of phonological information. In particular, many linguists have noted that the way that features are nested within strings of M and H segments misses the generalization—supported by fluent signer judgments and other psycholinguistic evidence—that the major formational parameters in a sign are handshape, location, and movement (this evidence is presented at the beginning of each of the next three chapters). In the Move-Hold model, features related to these parameters are nested within the segment, equal to other features, and appear redundantly across multiple segments throughout the sign. Thus, the categorical nature of the three main parameters is not respected by the position of their features in the sequential segmental structure. Because of this limitation, sign phonologists have specifically cited the inability of Move-Hold to pick out minimal pairs as one of its main shortcomings (Sandler 1989, Wilbur 1993, Brentari 1998).

If Oneseg collapses too much linear information in the sign and Move-Hold segments prioritize the wrong phonological information and cannot predict minimal pairs, how can we locate the correct domain for lexical contrast in the sign? This is addressed in §3.3.2, but first I will describe how the KSL phonology project described in this dissertation addressed the issue of different theoretical models of the sign.

3.3 Approach to theoretical models in this thesis

This grammar began with the intention to remain as objective as possible about various theories of sign-internal structure because of the typological goal of making the research compatible with other studies and interpretable by many different perspectives. It has also been motivated by the observation that when grammars hold too strictly to a particular theory, it can compromise their relevance and long-term utility. After all, a grammar "ought to have a shelf-life longer than any given grammatical theory" (Noonan 2006: 354). At the same time, it is understood that "there is no atheoretical or theory-neutral research: it amounts to a contradiction in terms" (from Madhavan 2001 in Rice 2005: 391). Indeed, not only did the phonetic coding make theoretical choices from the beginning, but as this project progressed and the analysis became more refined, some models of sign structure came to be seen as a better fit with the observable data than others.

As explained previously, it was found that the Move-Hold model could not be accommodated when it came to practical issues in coding (§2.7), and the theoretical issues just described further removed it from consideration. The three remaining sign phonology models that have been most thoroughly worked out to account for the range of signs types in a lexicon include: the **Hand Tier Model** (HTM; Sandler 1989), the **Prosodic Model** (PM; Brentari 1998), and the **Dependency Model** (DPM; van der Hulst 1993, 1996; van der Kooij 2002).[50]

I have tried to maintain a "translation" of these models where possible in the discussion about representations of individual parameters in the following chapters, and when it comes to distinctive features, all three were found to be relatively translatable with each other (location is the hardest to translate). However, during the analysis, there were two points at which there was an impasse over how phonological structure was best represented, necessitating a decision to choose one approach over another.[51]

The first of these decision points is the matter of *what counts as a segment?* The Hand Tier's canonical syllable comprised of three segments—two Location segments on either side of

[50] The Moraic Model by Perlmutter (1992) was not considered because its featural structure is not spelled out in relation to the Place and Movement segments. The Visual Phonology Model by Uyechi (1996) was not specifically compared because its novel approach would have required much more work to translate with the other models, and also some of its assumptions have been integrated into models that are considered here, namely PM and DPM.

[51] As Dryer (2006) points out, "theories" are different than "theoretical frameworks." Frameworks can often be translated with each other, and it is only when one cannot translate an analysis from one framework to another that a truly theoretical difference exists.

a Movement segment (the "LML syllable")—was found to not adequately fit the data. Evidence and arguments for this are presented in the next section.

The second decision point involves how movement features are represented in the two "X-slot" models. As explained briefly in §3.3.2 and further in the *Movement* chapter, this thesis supports the separation of movement into two types, following the Dependency Model: **core articulatory movements** (changes to handshape, location, and orientation), and **manner features** that dictate how core articulatory movements manifest. However, the Prosodic Model has an advantage over DPM with regard to how features license prosodic output (note: the hierarchical relationship of features and segments is addressed in §3.3.2). Therefore, I suggest that these two models could be combined to promote the best characteristics of each.

Next, I address what counts as a segment, and issues regarding the M segment in the Hand Tier model.

3.3.1 Evaluating the LML syllable

All three models, HTM, PM, and DPM, posit an autosegmental tier that allows for the linearization of phonological material via segments. In addition, they all theorize that a syllable is formed by a single movement realized as a sequence of these segments. However, the nature of the segments is quite different. The Hand Tier Model proposes that the tier has a canonical three segment structure filled with two different segment types, a location segment, L, and a movement segment, M, ordered to produce an LML monosyllable. In contrast, both the PM and DPM proposed a skeletal tier with two X positions/slots per syllable. While these two models differ about how the featural material associates to the skeletal tier, here it suffices to say that the same types of features occupy both positions/slots.

In evaluating the differences between these two types of segmental representation, referred to as 3-slot versus 2-slot models by Brentari (1998), I found the arguments against a 3-slot model (with movement as a separate M-segment) to be compelling, and will briefly describe these arguments in this section.

First, it has been noted that only path movements are represented in the M-segment of the LML syllable, while hand-internal movements (movements in both handshape and in palm orientation) are associated to L-segments (van der Kooij & Crasborn 2008); however all movements play a prosodic role in the sign.[52] Second, Brentari argues that "in order for a segmental account to hold up, … there should be at least one feature that is common to all movements, much as [sonorant] captures possible syllable nuclei in many spoken languages," however, ASL lacks such a feature (1998: 180). A third factor is the distribution of features within LML segments. Not only are there very few features specified in the M-segment, but also the second L-segment is highly redundant because nearly all its features are shared with the first L-segment. Also, van der Kooij and Crasborn point out that "the M-unit is redundant if both an initial and final value of the location, handshape or orientation aspects are specified" (2008: 1311). Thus, both the M-segment and second L-segment have diminished roles and independence in the representation, for different reasons.

The current analysis in this thesis identifies another difficulty for the HTM in accounting for some signs in the lexicon. In a description of KSL signs with complex locations (Appendix 9), I profile monomorphemic signs in KSL that have two simultaneous locations; e.g., CULTURE in KSL, and the sign INTERNAL(IZE) in ASL (see Appendix 9, pp. 631). In evaluating how the

[52] For example, it has been shown in both ASL (Brentari 1998) and NGT (Crasborn 2001) that movements can shift between more proximal (shoulder, elbow) or distal (fingers, wrist) joints on the arm for purposes such as emphasis, "whispering", and "shouting". That is, some path movements can be articulated as handshape movements and vice versa.

three models would account for these signs, I show that the HTM's LML structure faces a seemingly intractable problem in accommodating two simultaneous locations. According to the feature geometry theory that is the basis of the Hand Tier Model, each branch of structure may contain only one feature of a given type (Clements 1985; Sagey 1986) and having two simultaneous locations violates this principle (Brentari 1998: 264-265). In contrast, both the PM and DPM could account for these two location signs by branching Location at a higher level/node in the representation and the resulting structure would be more internally complex in a way that accords with both the rarity and greater phonological complexity of these signs.

Wilbur (1993) also points out that linguistic generalizations described in the literature appealing to segmental structure can be successfully stated without reference to segments: Padden & Perlmutter (1987) account for several phonological and derivational rules without reference to segments; Ahn (1990) accounts for Weak Freeze and Weak Drop using only tiers and features; and Corina (1993) describes several phonological processes in ASL without reference to segments.

Other behavioral studies also fail to provide support for the specific segmental structure in the LML syllable. One study analyzed a collection of signing errors ("slips of the hand") that exhibit changes to handshape, location, movement, and orientation (Klima & Bellugi 1979, Newkirk et al. 1980). There are no errors in this dataset that would be unambiguously consistent with a sign having LML sequential segments. For example, there are no "slips" featuring the metathesis of only the first L-segment in two adjacent signs, as shown in the hypothetical but unattested sign error in Figure 19.[53] Instead, only whole locations are swapped between signs,

[53] This hypothetical example uses two signs in the same overall area, upper torso, to avoid constraints against signs that move between major regions of the body (Battison 1978).

such as the attested slip made during production of the phrase 'RECENTLY EAT' shown in Figure 20, and exhibiting the metathesis of two whole locations, *cheek* and *mouth*.[54]

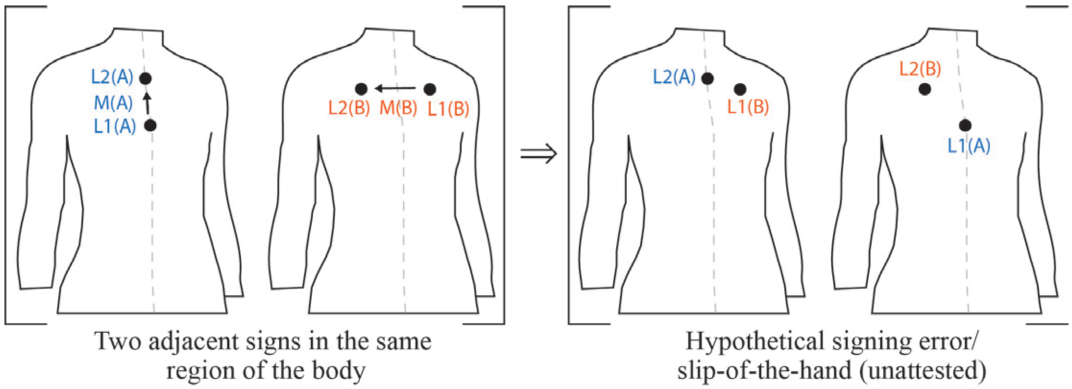


Figure 19. Unattested slip-of-the-hand with only the initial location metathesized (Sign A in blue text, Sign B in orange text; movement not shown in the error)

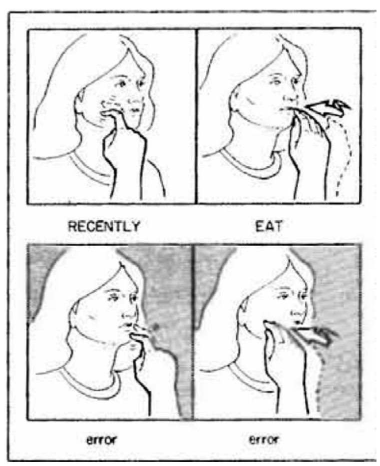


Figure 20. Attested slip-of-the-hand in ASL with metathesis of *cheek* and *mouth* locations (reprinted from Newkirk et al. 1980: 75)

Second, studies to determine statistically whether there was a predictable "rhythmic focus" in sign syllables evaluated signs of varying length and complexity (Allen et al. 1991, Wilbur & Allen 1991) but found no predictable syllable-internal target for any sign type for any of three subject groups (native deaf signers, native hearing signers, sign-naive hearing subjects). In other words, they could find no evidence for a sequential syllable peak in the sign that would

[54] Sandler describes two sign errors in the Newkirk et al. (1980) dataset that are claimed to support a segmental model (1989: 32-38), but these can also be accounted for in the PM and DPM models without requiring an appeal to L- and M-segments.

be oriented to the M-segment, analogous to a vocalic segment in spoken languages. Proponents of sequential segmental models have advanced the idea that the LML syllable (or equivalent in other models) is the sign modality analogue of a canonical CVC syllable in spoken languages. However, these results don't provide support for a strict correspondence between the modalities for this relationship of segments and syllables.

For all these reasons, the LML segmental structure of the Hand Tier Model appears to not be an optimal fit for the structure and patterns of signed words, and is therefore set aside in the following discussion of features, segments, and syllables. Nevertheless, because this model has played a role in the development of theories about individual parameters and because of the goal in this thesis of maintaining "translatability" between models where possible (see §2.7), the HTM is therefore included in the background of the following chapters and in parts of the analysis.

3.3.2 Relationship between features, segments, and syllables

This thesis adopts the theory of sign segments used by van der Kooij (2002) in the Dependency Model and Brentari (1998) in the Prosodic Model; that is segments as two X-positions (DPM) or X-slots (PM) on a skeletal tier that dictates the linear organization of featural specifications. These two models differ in the details of how features align to segments, especially prosodic/dynamic features, with the Prosodic Model having more thoroughly worked out the realization of featural content in syllabic structure. For example, the PM specifies that the skeletal tier is a **timing tier**, and that the X-position represents the abstract duration of a single segment, while the structure of the DPM is fully compatible with a timing tier, but has not explicitly worked out types of prosodic structure.[55] At the same time, a key advantage of the

[55] In fact, it is assumed by other sign phonologists that the X-positions in the Dependency Model are on a timing tier (Brentari 1998: 90; Wilbur 2011: 1321), but van der Kooij (2002) remains circumspect about

Dependency Model is that it has a more parsimonious representation for the internal structure of the sign—particularly for Movement, which is separated into two types of movement features, as previously mentioned.

This current thesis adopts the basic phonological structure proposed by the Dependency Model, but finds that it has some gaps in how phonological features are related to prosodic outputs, which are best addressed by Brentari's implementation of prosodic structure in the Prosodic Model. This has led me to propose modifications and clarifications to the DPM that borrow from aspects of the PM, which are described in Chapter 7 (§7.2). Accordingly, what is presented in this section is primarily from the DPM, with some of the prosodic structure clarified by Brentari, but compatible between both models.

To define the units of phonological information in the sign, I find that the terminology from spoken language phonology can be confusing when trying to translate a term directly from one modality to the other. As both Brentari and van der Kooij have noted, there is a fundamental difference between the modalities that is not straightforward to reconcile in a one-to-one mapping. Therefore, I will begin with a very simple representation of the sign, give two examples, discuss the phonological units in the representation, and then provide a comparison with spoken language.

The relationship of phonological units in the signed word is shown in the schematic in Figure 21, using a simplified and slightly modified version of the Dependency Model and with minimal labels. Circles represent nodes, with the **root** node at the topmost level being typically isomorphic with the **word** (except for some words like unreduced compounds). In this way, the signed word is sometimes viewed as analogous to a single segment, since the root in spoken

this for reasons that are not clarified: "the model proposed here has no specific claims with respect to timing" (van der Kooij 2002: 65).

language phonology is typically the topmost node of the segment. However, as explained later in this section, there is an 'inverse dominance relation' of segment to syllable in sign language compared to spoken language, and the root, which is the topmost level of organization required to synchronize all features in the sign, is one of those structures that is not directly analogous between the modalities.

Three feature class nodes are dependents on the root: **handshape**, **orientation**, and **location**, and a fourth feature class is attached directly to the root in the "specifier" position: **manner** features. Manner features are in this position because they dominate the class nodes and therefore can dictate how the features in the class nodes manifest in the prosodic output. Each of the three dependent classes can have a minimum of one branch and a maximum of two branches. These branches contain **features** that associate to the two skeletal positions, shown here as left-to-right associations à la Brentari, but argued by van der Kooij to be head-dependent relations, where heads are right-branching (i.e., heads are on the left). In this way, the DPM uses the same head-dependency relations as in Dependency Phonology developed for spoken languages (van der Hulst 2006), and which will be familiar from other levels of the grammar, such as syntax and morphology.

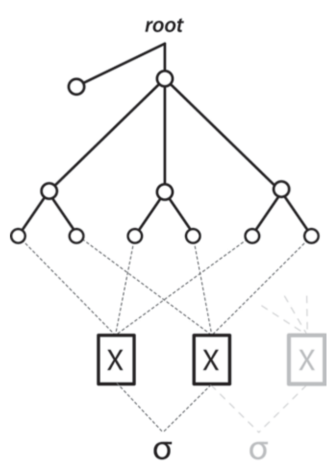


Figure 21. Schematic of sign structure with maximal possibilities realized (i.e., complex disyllabic sign)

A monosyllabic KSL sign with one path movement, HARD, is shown in Figure 22a, with its schematic somewhat more filled in, in 22b. The path movement is depicted as a change in location, so that the Location node has two branches for the beginning and end features, which associate to each X-position. The Handshape (HS) and Orientation (ORI) features are unchanging, and spread to both X-positions. That is, attachment to both nodes by the same HS and ORI features represent the fact that they remain constant throughout the sign. Location (LOC), however, changes during the sign and this is represented by each of the two branching end nodes of Location associating to different skeletal slots, representing the beginning and end points of the path movement—i.e., [high]>[low] in the case of HARD.

a. b.

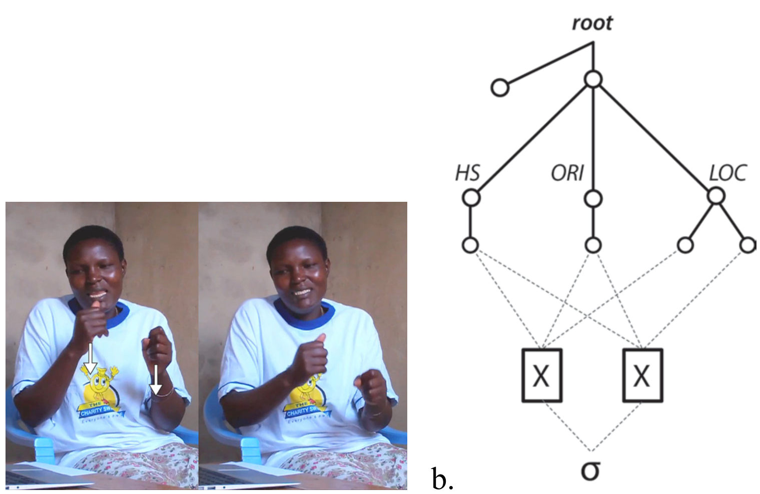


Figure 22. Representation of a simple monosyllabic sign: a. HARD, b. a single path movement downward (e.g., change in location)

A more complex KSL sign, MITUMBA (‘*used clothes*’), is shown in Figure 23 with both a handshape and location change, and is a disyllabic form because the first syllable is repeated. Note that [repeated] is a manner feature that licenses two identical syllables ([—],[—]), following Brentari’s implementation of [repeated]. The representation in Figure 23 reflects the structure of the DPM with the exception of the [—, —] disyllabic structure, which is borrowed from Brentari (1998) (described further in §7.2).

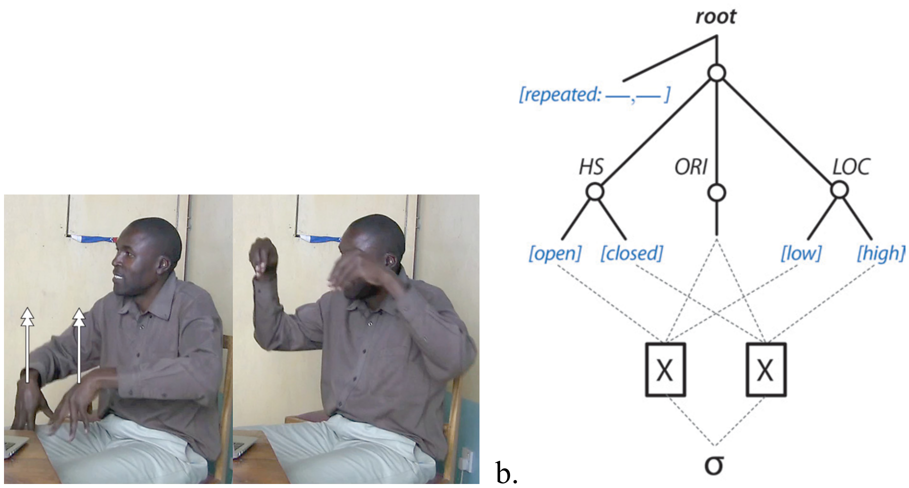
a.  b.

Figure 23. Representation of a more complex disyllabic sign: a. MITUMBA (‘*used clothes*’), b. a repeated path movement with handshape change; repetition copies the entire previous syllable

With these examples in place, it is possible to address some of the types of phonological units found in the sign. First, **features** are the smallest distinctive units in the sign, for which minimal pair evidence exists. For example, if the *fist* handshape in HARD were replaced with a *flat* handshape, it could result in a different sign, PERSON. Second, **X-slots** are the “minimal, concatenative units of timing” (Brentari 1998: 183), interpreted by Brentari as **segments**, though this term is probably the most confusing to analogize with spoken languages. This is because, as van der Kooij observes, there is an “inverse dominance relation between the linear order (the syllable) and the feature content (the segment)” between the two modalities (2002: 293). That is, “the syllable is supra-segmental in spoken languages,” while “the segment is supra-syllabic in sign languages” (2002: 293). An illustration of this difference between the modalities is shown in Figure 24 (modified from van der Kooij).

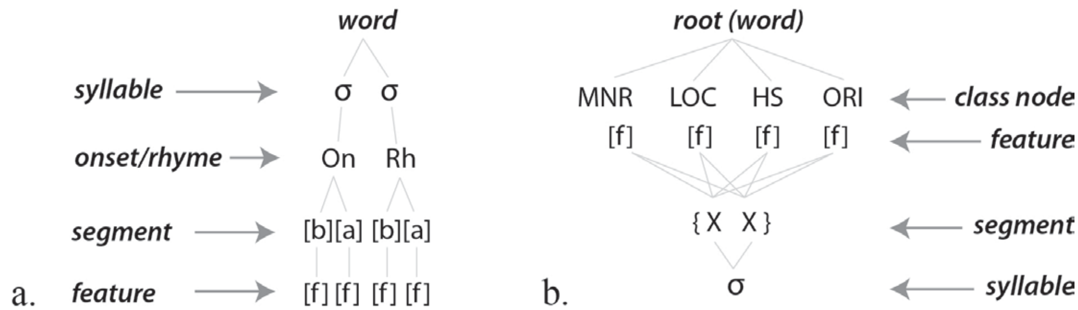


Figure 24. Inverse dominance of segment and syllable in (a) spoken and (b) signed words (modified from van der Kooij 2002: 293)

Segments in both modalities coordinate the timing of phonological material, but the segment in spoken language is essentially syntagmatically independent, while the X-slot segments (the "bipositional skeleton" in van der Kooij's parlance) in the signed modality are (i) dependents on the featural specifications in each sign and (ii) share most of their featural content with each other. In fact, in the Dependency Model, the features in the binary branching class nodes (e.g., HS and LOC in MITUMBA) are not themselves unary features, but are "split coordinate values" (van der Hulst 1995: 17) that signal a change in state. For example, the handshape feature in MITUMBA is [open] in the first X-slot and [closed] in the second slot, but while their order can change (i.e., [closed]>[open]), they do not freely combine with other handshape features (e.g., [spread] or [bent]); their values are always a dual matched set.

Lastly, with regard to the **syllable**, I adopt Brentari's definitions, both functional and formal, though with some modification to the formal definition. The functional definitions are quoted as follows (1998: 205):

a. The number of sequential phonological movements in a string equals the number of syllables in that string. When several shorter dynamic elements co-occur with a single dynamic element of longer duration, the single movement defines the syllable.
b. If a structure is a well-formed syllable as an independent word, it must be counted as a syllable word-internally.

This functional definition was used in coding the number of syllables in the KSL Lexical Database, and was relatively straightforward to implement. The few exceptions tended to be signs with curving paths and/or orientation changes on paths. These are discussed more in Chapters 6 and 7. Note that the term “phonological movements” intentionally leaves out transitional movements, which are usually evident in a sign, though there are a few exceptions in the KSL data (e.g., ambiguity about whether a path movement is bidirectional or is unidirectional and repeated with a transitional return movement in between).

Brentari’s formal definition for the syllable is: “*a syllable must contain at least one weight unit*” (1998: 205). For Brentari, a **weight unit** contains two types of properties: durational properties and prosodic weight properties (1998: 246). These weight properties are related to the sonority of different articulatory movements and limits on having more than two movements in a syllable—i.e., a syllable that is too heavy. However, I believe it is sufficient to refer only to a **timing unit**. That is, a syllable can be defined as containing at least one timing unit, where a timing unit is a unit of abstract duration. One reason for this conclusion is that there are at least a couple dozen signs identified in KSL that lack active movement throughout the duration of the sign. Instead, the hands move into a position and remain there for a period of time matched to the duration of a typical lexical sign; often, but not always, mouthing is timed to this duration. These are called “hold” signs in this project (described in §6.6) and have also been documented in Hong Kong Sign Language (Mak & Tang 2011) and Hausa Sign Language (Schmaling 2000). They appear to require a definition of the syllable that (i) involves timing units and, (ii) abstracts away to some degree from movement.

Another reason to prefer ‘timing units’ to ‘weight units’ is that one function that weight units serve in the Prosodic Model is accounted for in another way in the Dependency Model.

Brentari uses weight units to explain limits on simultaneous movements in a syllable by positing constraints against syllables with too much prosodic weight—i.e., too many simultaneous movements. However, the Dependency Model provides a separate means of explaining this constraint by way of the structural representation. Because each type of movement in a sign (i.e., path, handshape movement, orientation movement) is represented by a binary branch off the class node in the DPM, the more movements in a sign, the more complex the representation is. Indeed, the concept of "weight" itself in the Prosodic Model already conflates complexity and sonority in a way that may obscure the separate role of each. Thus, the DPM's structural representation is the locus for limits on complexity, allowing prosodic units to be exclusively defined as *timing units*.

What does this treatment of the sign syllable and its featural/segmental structure mean for an analysis of minimal pairs? The results of the KSL minimal pair analysis, presented in §3.6 show that handshape and location **primes** that cannot be further decomposed into features are the most frequent basis for lexical contrast, followed by individual **features** in all class nodes—and including some featural types that don't fit into the usual types (e.g., mouth gestures, body leaning, number of hands, path size, etc.). Finally there are four minimal pairs whose contrast at first appear to involve syntagmatic contrast, but are shown to be syllabically complex signs that contrast on the basis of paradigmatic replacement. These are investigated in §3.7

3.4 Why minimal pairs?

Minimal pairs are fundamental tools in both modalities for determining the phonological units in language—the language-specific inventory of sounds or forms. However, in spoken languages, minimal pairs are used in conjunction with other types of linguistic patterning to elucidate phonological structure, while in sign languages, this other evidence for formational structure is much reduced. As van der Kooij writes, one

> "source…for compositionality in the phonology of spoken language are phonological processes or rules that make reference to a whole class of phonemes in terms of a property, or set of properties that they share. Unfortunately, sign languages do not provide us with abundant evidence of this sort. Phonological rules typically account for distributional regularities in polysyllabic and polymorphemic units, involving assimilation at syllable boundaries, or phenomena like vowel harmony. The pervasive monosyllabicity of sign languages explains the absence of such rules" (2002: 14).

Similarly, Eccarius and Brentari note that in ASL, "almost all rules/constraints are optional. To our knowledge, the example of handshape change within monomorphemic lexical items is the only example of purely allophonic alternation" (2010: 164).[56] Notably, this appears to be a modification from Brentari (1998), in which she sought to compensate for the difficulty in finding minimal pairs by relying on "morphological and phonological operations in…various types of signs" (1998: 4). The lack of phonological processes in sign phonology relative to spoken language phonology thus has the practical consequence of placing more emphasis in a sign language grammar on minimal pair data as the central source of information about phonological structure. This is one reason for the measures this thesis takes in being careful and thorough about what counts as a minimal pair.

However, there are other ways of determining phonological categories, which have been used in this thesis to varying degrees. First, evaluating **phonetic variants** can be very informative for understanding the acceptable boundaries of a category (e.g., locations), or the way that a category changes in certain environments (e.g., handshapes with variable aperture). Also, **substitutability** can be employed to see whether a potentially allophonic prime would

[56] This refers to the Handshape Sequencing Constraint (Sandler 1989), which states that when a handshape change occurs in a monomorphemic sign, one shape must be open and the other must be closed, and the value of one of those handshapes is predictable from the (only) one that is lexically specified (Eccarius & Brentari 2010: 164).

result in a change in meaning (a different category), or be interpreted as a phonetic variant (same category). And **morphological patterns** can also elucidate formational categories**,** though these are not often used in this thesis because independent studies of KSL morphology are not available. The use of these types of evidence are discussed at relevant points in the following chapters. It should also be mentioned that a specific suite of methodological criteria were developed for the analysis of Location, and are described in §5.5.

The main work of this grammar has been to understand the distinctive components of (SoNy)KSL—and doing so has been enough of a project in itself. Yet there is more than just lexical contrast and the phonemic inventory to be studied in KSL and other sign languages, and which would make for an even more complete grammar. This includes such linguistic phenomena as Weak Drop, various morpho-phonological patterns, phonological mutations and reductions in blended forms (including "reduced compounds"), etc. As the tradition of writing phonological grammars of sign languages becomes more refined, these phenomena can be added as expected objects of study.

Now we turn to the procedure for discovering minimal pairs in (SoNy)KSL, and some of the issues that arose during the analysis.

3.5 Methodology for determining minimal pairs

A goal of focusing on "true" or "strict" minimal pairs was not assumed at the outset of this project because it was initially assumed that minimal pairs might not be a reliable source of data for a phonemic analysis. Two reasons for this assumption were that (i) sign phonologists have reported difficulty in being able to find minimal pairs in other languages (see §3.6.1), and (ii) KSL is relatively young, around 55 years old. The hypothesis that lexical contrast only develops over time got some support from the case of Al-Sayyid Bedouin Sign Language

(ABSL), which is around 75 years old, but has no documented minimal pairs (Sandler et al. 2011).[57] While it was known at the start that KSL had *some* minimal pairs, it was not clear just how abundant they were.

This section is in some ways an extension of Chapter 2, *Methodology*, in that it provides background information on how the analysis was done. Specifically, I will explain here how minimal pairs became a reliable source of data once a methodology for dealing with them was established; i.e., keeping a separate dataset of minimal and near-minimal pairs; revising what counts as minimal periodically based on new data; avoiding near-minimal pairs (§3.5.2); only using pairs from the same signer (§3.5.1); and deciding that the degree of iconicity in a sign is irrelevant for whether it is included in the phonological analysis (§3.5.3). The reason to include such detail about the process is because it has never fully been explicated in the literature before, and may be useful for other researchers undertaking similar projects.

The previous literature has not provided an adequate model for dealing with minimal pairs. First, no source that I can find has discussed methods for how minimal pairs were determined. Second, visual representations of the signs in a pair are rarely provided. In most cases where minimal pairs are named, glosses from spoken languages serve to represent the signs, which is a less-than-ideal situation when the subject of analysis is the categorical units of form. And third, when glossed minimal pairs are listed, their minimality is not always self-evident. For example, Sandler (1989: 68) mentions the ASL signs EAT and MENSTRUATION, shown in Figure 25, as true minimal pairs for handshape; yet they at least also differ by a center

[57] Age alone is unlikely to be the factor that explains a lack of minimal pairs in ABSL because lexical contrast is found in other sign languages that are younger, including KSL.

vs. ipsilateral position, which Sandler's model is set up to encode.[58] There are several other dubious 'true' minimal pairs in the ASL literature that would be considered near-minimals in this current analysis;[59] these include LIMIT vs. SATISFY (Sandler 1989: 27), SEE vs. INNOCENT (Brentari 1990: 66), and SCREWDRIVER vs. MEANING (Brentari & Eccarius 2009: 6). In general, there is a need for greater transparency regarding minimal pairs in the sign phonology literature.

a. b.

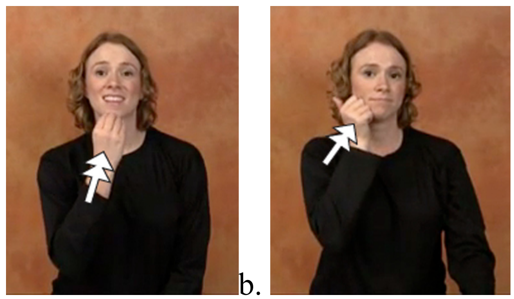


Figure 25. Signs noted as a full minimal pair for handshape in ASL by Sandler (1989: 68): a. EAT (*flat-o* handshape), b. MENSTRUATION (*fist* handshape) (Images from video in Spreadthesign.com)

One positive exception is Schmaling's more transparent phonological description of Hausa Sign Language, in which she uses the Hamburg Notation System (HamNoSys) to represent minimal pairs. As shown in Figure 26, this notation allows her to locate just the unit that is responsible for the minimal difference. In this case, the signs GUMI and SAURAYI differ only by location, *forehead* vs. *chin*, while all other aspects are the same. While no images of the signs are provided, her approach at least puts this description on a par with phonological grammars of spoken languages.[60]

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[58] The Hand Tier model only lists the major area *head* as the location, with setting features to further distinguish locations on the head. By contrast, this grammar finds that *chin* and *cheek* are distinct phonological locations in KSL.

[59] In principle this could be due to different categories in ASL itself, or in different theoretical categories, but some pairs are simply too different no matter what the categories; e.g, LIMIT is produced in neutral space, while SATISFY lands on the torso (they also differ by at least the direction of movement / setting features).

[60] In the present grammar of KSL, the decision was made to use screenshots of videos to represent signs instead of notation systems for the purpose of greater accessibility to a wider audience. See Figure 13 for an explanation of how to read the format used by Schmaling 2000.

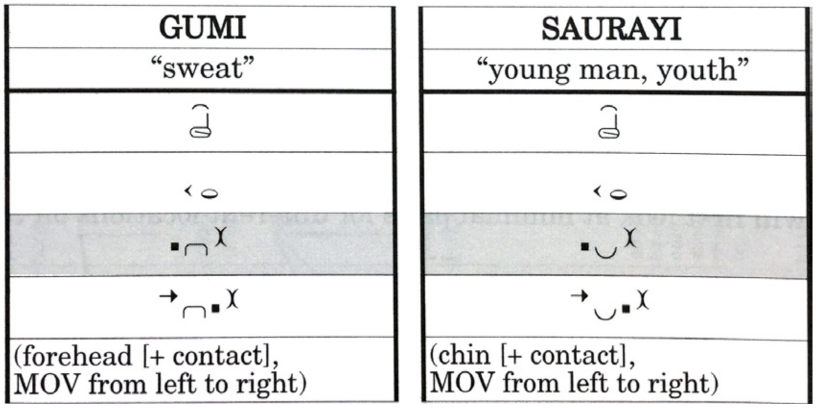
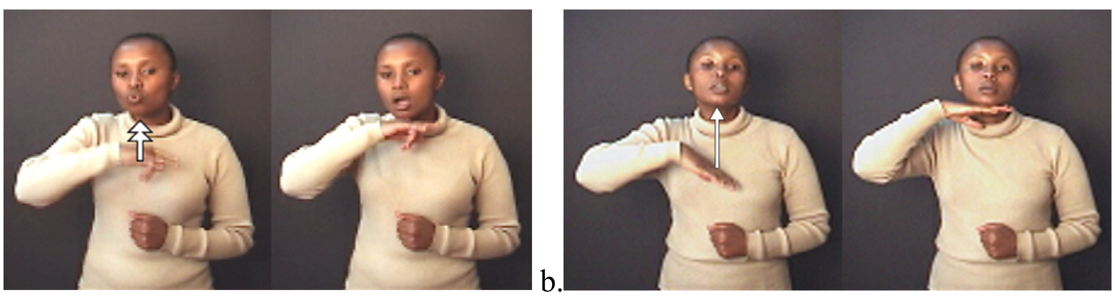


Figure 26. Minimal pair for location in Hausa Sign Language: GUMI (*forehead*) vs. SAURIAY (*chin*) (Reprinted from Schmaling 2000: 94)

With regard to the procedure for collecting minimal pairs, it was assumed at the start of the project that the phonemic analysis—including finding minimal pairs—would come after the phonetic coding was completed. However, even before the first round of coding was underway, I started to find pairs in video clips and write them down in scattered notes. As the database was constructed and the coding process began in earnest, I encountered more minimal, near-minimal, and some 'unsure' pairs, and therefore created an Excel spreadsheet to record them. Also, having become very familiar with the exact sign tokens in the database, minimal pairs would occur to me out of the blue over the 20+ months of coding, and those would get visually verified and added as well. Next, during the clean-up phase of standardizing the phonetic coding (see §2.7), the potential of the database to search across multiple signs with similar formational properties was more fully realized, and another round of candidate pairs were found.

An early concern for the phonemic analysis was the amount of variation used in this area of Kenya (see description of different types of variation in §2.5.2 and Morgan 2015a), but as the coding proceeded, I began to see evidence that phonological patterns were consistent within signer idiolects despite the 'dialect-level' variation. This is described more in the following sub-section, but here it suffices to say that I applied a new criterion to the list of minimal pairs: only those from the same person would be used in the final analysis. Note: pairs that do not fit the criteria have been retained in the Excel spreadsheet, but not included in the final analysis.

Another important step was that midway through the phonetic coding, I began to double-check pairs that I initially thought were minimal, and these often turned out to differ by more than one feature. For example, I initially did not know whether reduplication was contrastive in KSL (it is), so some pairs were included that differed by reduplication as well as some other feature/prime. For example, TO-DIE and UGANDA-1 in Figure 27 differ by handshape, but also a single (TO-DIE) versus a reduplicated (UGANDA-1) path movement. Such pairs were subsequently labeled in the spreadsheet as 'near-minimal." Reasons for why near-minimal pairs in sign language are problematic as phonological evidence for distinct phonemes is discussed more in §3.5.2.



a. b.

Figure 27. Near minimal pair differing by handshape and movement: a. TO-DIE, b. UGANDA-1

Finally, after the coding was complete and the phonological analysis was underway, I was able to use the flexible search capability of the database to select only a specific sub-set of signs and more systematically search for minimal pairs for each feature or prime under investigation. For location and handshape, I started with the least frequent primes, which were easiest to treat as a group, and moved gradually to the most frequent. In this way, the final step in the collection of minimal pairs was done in a systematic manner, which increased the certainty that I had found as many as possible.[61] It is assumed that some pairs from the lexicon of 1,880 signs are probably still not accounted for, but this number is probably not very large—perhaps no more than one or two dozen—and would not change the overall picture of phonological contrast in (SoNy)KSL. Also, minimal pairs were visually double-checked during the final analyses described in each chapter, resulting in a few more being demoted to the near-minimal category. The final count of true minimal pairs is 461 out of the total dataset of 912 potential minimal pairs, including those both minimal and near-minimal.

The ideal situation for a methodology of sign phonology would be to have a phonetic coding system that—like in spoken languages—is at once inclusive enough and yet narrow enough to encode just the right formational detail to find minimal pairs, especially via a computer script. The amount of time and effort expended for this current 'hand selected' set shows how surprisingly inefficient it is to determine lexical contrast in sign languages, compared to spoken languages. The central reason for this appears to originate from the difference in how phonological information is organized in the sign, as illustrated in Figure 24. However, having this set of true minimal pairs also presents a unique opportunity: it can facilitate the writing and calibration of a computer script to pick out just the set of minimal pairs—no more, no less—because it represents the target output for such a script. This is one direction for future research.

In the next sections, I address three potential complications for establishing true minimal pairs and how they were resolved: (i) the problem of abundant lexical variation and the role of idiolects (§3.5.1), (ii) the lack of informativity in near-minimal pairs and false equivalence with

[61] Also, when minimal pairs could not be found for a prime or feature coded in the database, I double- and triple-checked for contrasts; for example, in the case of handshape features like joint configuration, finger spreading and thumb position.

such pairs in spoken languages (§3.5.2), and (iii) the possible effects of iconicity on phonological structure (§3.5.3).

3.5.1 The importance of idiolects in evaluating minimal pairs

The previous section explained that minimal pairs were limited to those produced by the same signer, a decision prompted by the relatively high degree of sign variation in (SoNy)KSL. There is nothing unnatural or dysfunctional about the variation in usage; signers appear to simply accept many synonymous terms[62] with little difficulty in communication. Yet some of this variation, especially phonological and phonetic variants (§2.5.2), pose a challenge for a phonological analysis. As both descriptive/typological linguists (Rice 2005) and generative linguists (de Lacey 2009) have observed, if a phonological analysis is based on a dataset with words from multiple speakers/signers, it can result in the creation of a pseudo-grammar that no one speaks/signs. de Lacy writes, "the only legitimate source of evidence identified by the theory is the output of an individual grammar in an individual speaker" (2009: 4).

The data suggests this is a principle that applies in (soNy)KSL. During the phonetic coding, I began to find traces of evidence that idiolectal patterns (i.e., in the productions of one signer) seemed to be internally consistent, while a comparison of signs across signers might actually obscure phonological patterns.

The situation is exemplified here by a cluster of morpho-phonological signs: TOWN, CITY, HILL, and MOUNTAIN. Importantly, all signs and variants in this cluster except one (CITY for signer 4)[63] share several phonological features: *curved* handshape, *arc* path movement in neutral space, and *ulnar* relative orientation (the ulnar/pinky-side of the hand is the leading edge of the

[62] Also, as pointed out in the previous chapter, some synonymous terms may actually be different words, and the use of glosses from a spoken language can impose groupings that don't fully respect the semantic boundaries of signs. More lexical semantic work is needed.

[63] Also, signs for CITY were not collected for signers 2 and 3.

path movement). Each of these five signs have "phonological variants." That is, when the same sign is grouped together from multiple signers, there are categorical (not phonetic) formational differences between them, but enough formational and semantic overlap to consider them essentially the same word. For example, Figure 28 shows the signs for TOWN for five signers.[64]

Looking just at productions for TOWN, it seems as if there may be only two variants: a horizontal arc for signers 1, 2, 4 and a midsagittal arc for signers 3, 5.[65] At first, the different sizes of the paths (small for signer 1, 2) and spread fingers (signer 2) are not necessarily considered to be distinctive. This is because in the first case path size has not been listed as a distinctive feature for other sign languages, and in the second case because signer 2 shows a stylistic preference for spread fingers in general.

a. 

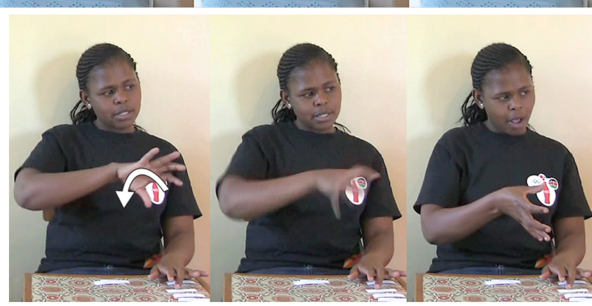
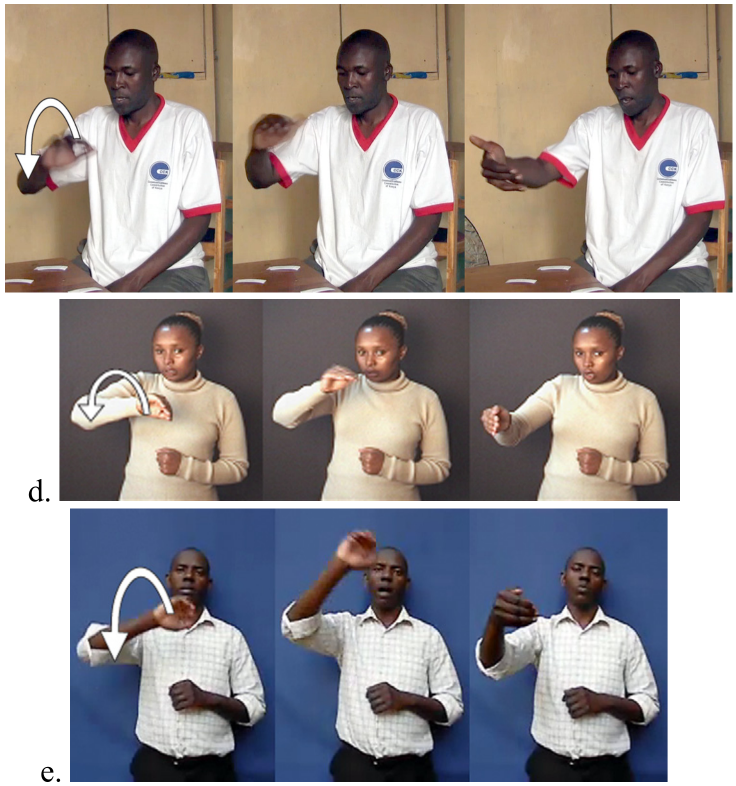
b. 

Figure 28. KSL signs for TOWN: a. signer 1 (2004 Dictionary), b. signer 2, c. signer 3, d. signer 4, e. signer 5 (ksldictionary.com)

[64] Signers 1-3 are from southwestern Kenya. Signers 4 and 5 in Figures 28d and 28e are both from dictionary projects filmed in Nairobi (Mjitoleaji Productions 2004 & ksldictionary.com, respectively). The dictionary signs were included because: (i) they better elucidate the overall pattern in the cluster, and (ii) they share properties with signs from the southwestern region in a way that seems to prioritize individual differences over dialectal ones.

[65] The midsagittal arc is easy to see in video, but hard to detect in a two-dimensional picture. It can be seen by looking at which way the palm is facing in the final position/picture: toward the signer (midsagittal arc) or toward the contralateral side (horizontal arc).



c. d. e.

Figure 28 (cont'd). KSL signs for TOWN: a. signer 1 (2004 Dictionary), b. signer 2, c. signer 3, d. signer 4, e. signer 5 (ksldictionary.com)

When each signers' words in the cluster are compared to each other, interesting patterns emerge. Figure 29 depicts the contrastive features between the words (columns) for each signer (rows) by listing only features that differ between signs, with a box around minimal pairs and the type of lexical contrast in capital letters below the box.

This collective data reveals several things. First, *path size* is used as the basis for contrast in three signers: signers 1 and 2 have a two-way distinction (small, large) and signer 5 has a three-way distinction (small, medium, large)—or something at least more gradient than two categories. Second, the same three types of lexical contrast (*path size*, *repetition*, *path direction*) appear repeatedly for different signers, despite the fact that those features are not used to contrast the same words. Thus, signers are using the same features, just for different words in the cluster.

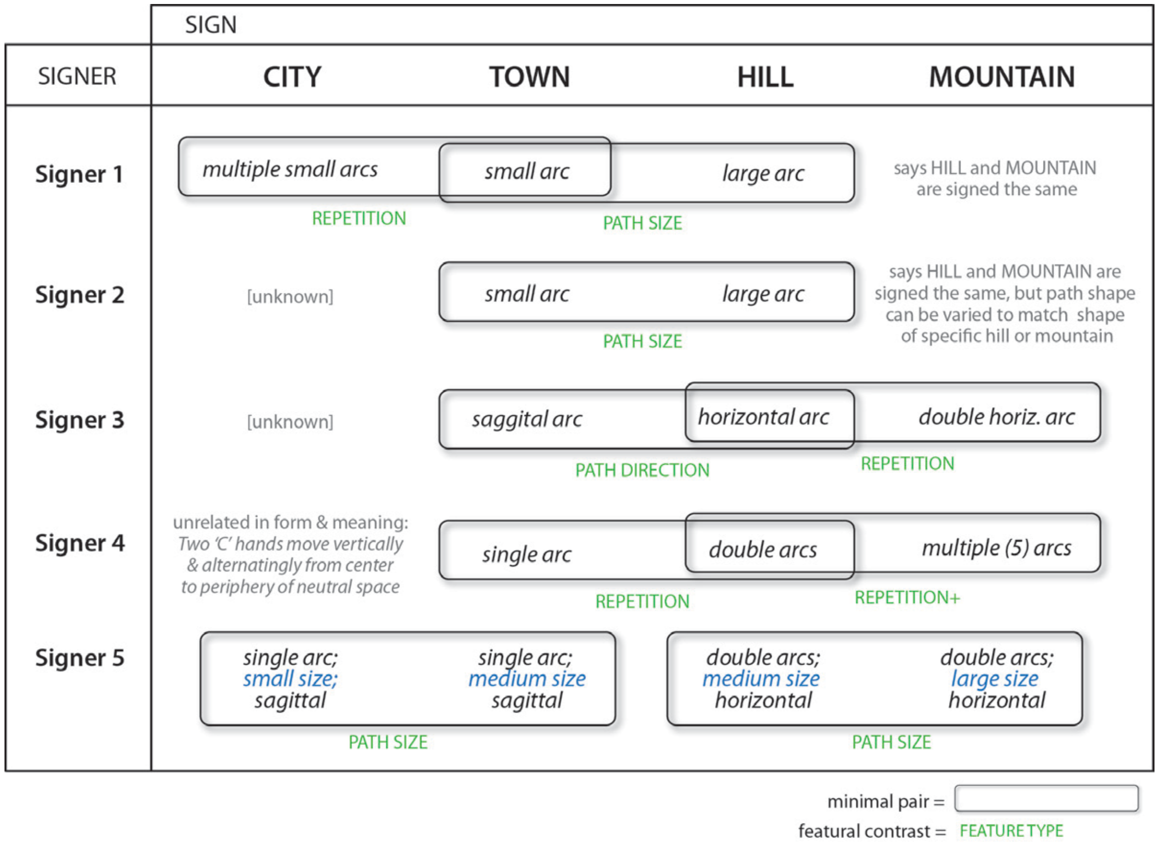


Figure 29. Intra-signer (idiolectal) consistency and cross-signer variation in a morpho-phonological cluster: CITY, TOWN, HILL, MOUNTAIN

The situation to be avoided is comparing two signs from different signers that either overlooks a contrast like *path size,* or creates a new contrast where one is not attested, such as *finger spread* in a cupped handshape (there is still no evidence that this is contrastive in KSL).

This data leads to a hypothesis—tentatively accepted in this thesis for now, but warranting further research—that idiolectal contrasts in a language with a high degree of lexical variation should nonetheless reflect the allowable contrasts and inventory of distinctive features and primes in the dialect as a whole. Thus, as shown in Table 4, there is phonological structure at the idiolectal level that reflects structure in the abstract construct of the 'shared lect'—(SoNy)KSL in this case. Variation at the sign/word level may yield important data about phonetic patterns (e.g., it is helpful evidence for determining phonological location, for example) or such things as semantic motivation in signs, but should be treated with caution when determining phonological contrast.

Table 4. Types of formational information at different levels/domains of analysis

Signer/idiolect level	**Sign/word level**	**Shared lect level**
Phonological structure (minimal pairs, features), phonetic gradience & predictability	Variation (lexical, phonological, phonetic); phonetic gradience & predictability	Phonological structure (features); lexical patterns; phonetic predictability

For the 461 minimal pairs found in this project, all but a few are from the same signer. That is, nearly each pair is from the same signer, but not all 461 pairs are from a single signer. Most pairs are from one of four signers (see §2.4.2). The few exceptions are for signs that are highly standardized, but lacked a video representation from the same individual for both signs.

This suggests that the more standardization of signs within a signing population, the less reliance is needed on idiolects to determine lexical contrast—however, it should be said that the degree of phonological variation in signing communities is not well established for most languages, including major ones like ASL.[66] Therefore, this rule of thumb about idiolects could be broadly applicable.

3.5.2 Near-minimal pairs

The previous section demonstrated the efficacy of the principle that the idiolect is the correct domain for finding phonological contrast. Another methodological issue for a phonological grammar of sign language is the use of near-minimal pairs to determine lexical contrast. In this section, I argue that near-minimal pairs in sign language are an as-yet-unproven metric for determining phonological structure and should be avoided until we develop a more controlled way of evaluating them. An example of a near-minimal pair in KSL that comes from

[66] Such variation across regions—and even over time—also makes the reliance in the literature on glosses (from spoken language translation & orthography) for minimal pairs unhelpful.

the cluster just presented is signer 1's words for CITY vs. HILL, shown in Figure 30. While each is minimal with the sign TOWN, these two pairs differ by both *repetition* and *path size*.

a.

b.

Figure 30. Near-minimal pair for *path size* and *repetition* (signer 1 in Figure 28a): a. CITY, b. HILL

In previous phonological descriptions of sign languages, near-minimal pairs are commonly used as evidence for the distinctiveness of a prime or feature. The reason, if stated, is usually that true minimal pairs are hard to find, a claim addressed in §3.6.1. One potential problem with the use of near-minimal pairs is that sign languages may actually avoid certain contrasts for telling reasons that are being obscured by use of near-minimal pairs. For example, this project has found no minimal pairs in KSL solely on the basis of finger spreading, and searches through phonological descriptions for other sign languages show that they either list no minimal pairs or provide only near-minimal pairs for finger spreading (e.g., near-min. pairs FOURTH vs. BLUE, SEE vs. INNOCENT in ASL; Brentari 1990: 66). Only Hausa Sign Language lists a pair that appears to be truly minimal (Schmaling 2000: 76).[67] If this tendency holds across sign languages, then we might conclude that there are phonetic reasons preventing finger spreading

[67] Note, however, Schmaling indicates that lexical variants in Hausa SL were collected (2000: 53), so this pair could be an instance of a "pseudo-grammar" if the signs in the pair came from two different signers.

from being sufficient to carry lexical contrast. By treating inventories gained by minimal and near-minimal pairs equally, important facts about degrees of allowable formational contrast may be missed.

A second set of problems arises out of making a false equivalence with near-minimal pairs in spoken languages, and involves modality differences in informational content of phonological units. In spoken languages, minimal pairs nearly always[68] involve "syntagmatic contrast," which refers to the paradigmatic (simultaneous, in kind) replacement of a phonemic unit in the environment of an unchanging sequential string of segments; i.e., the -*at* string in *cat* vs. *pat*. The syntagmatic structure between the modalities are strikingly different from an information-theoretic standpoint. First, the arrangement of the unchanging segments in a spoken word minimal pair are highly informative because phonotactic rules in spoken languages confer much predictability about which segments/features occur in which positions: is the segment/feature that is being replaced positioned word-initially, -finally, -medially, between vowels, next to a highly sonorous consonant, etc.? By comparison, there isn't an analogous "environment" in signed words because phonological information occurs simultaneously, with some few exceptions (discussed in §3.7). Thus, the predictability that environment confers in spoken languages is missing in sign languages.[69]

The third and last potential problem with near-minimal pairs is that their use is predicated on an untested—and possibly even unacknowledged—assumption that signs in a lexicon tend to differ by more than two or three features/primes. However, what if a large proportion of the signs

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[68] One might argue that single-segment words in spoken languages can be minimal pairs; e.g. Spanish *e* ('and') and *o* ('or').

[69] Near-minimal pairs can also be problematic for spoken languages, of course—and to some extent can be completely useless in either modality. My point here is that the predictability of individual phonological units appears to be different in the two modalities on the basis of sequential vs. simultaneous environments. To make this case more conclusively, however, it should be ideally worked out mathematically.

in a lexicon have only two or three degrees of difference? In that case, a near-minimal pair would be of little value for determining which forms can cause a change in meaning; any change would be significant.

An illustration of how a sign can have many neighbors is shown in Figure 31 for the sign FALSE (Fig. 32). Here, the target sign is in a rounded blue box in the center, with its associated distinctive features/primes attached in blue ovals. If one of those values is changed (grayed-out ovals), this can form a new sign (gray rounded boxes on periphery). Those new signs can be minimal pairs (e.g., TRUE, WET, GOOD), or near-minimal, which are shown with a single protruding line (e.g., PERSON, TOUCH, DAY, IMPROVE, EFFECT-2, AFTER, BUSIA). Those with two protruding lines differ by three feature/prime values. FALSE has three true minimal pairs, at least seven near-minimals, and an uncounted number of 3-difference pairs. If every sign has a dense cluster of near-minimal pairs, how meaningful are the two differences combined? Put another way, given such a rich network of simultaneous contrasts, how can we say any two are equally as distinctive?

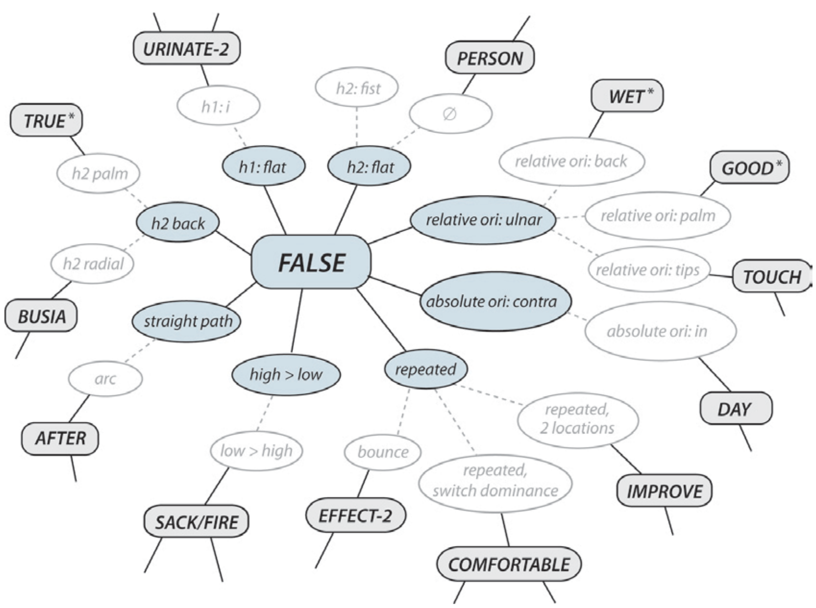


Figure 31. Depiction of minimal pairs (*), near-minimal pairs, and some other neighbors for the KSL sign FALSE

Figure 32. KSL sign FALSE

There is a lot we don't yet know about neighborhood density in sign languages, but at least we can say that the density of neighbors should affect the relative fitness of a near-minimal pair. Having undertaken the present analysis, I can attest to a sense that some near-minimal pairs just seem better, more minimal than others, which probably helps to explain the large number of potential minimal pairs that were eventually found to not be strictly minimal. Yet it is still unclear how to accurately match this sense of relative closeness (or distance) with an objective measurement of form. One direction for future research is to use the results of this grammar with the encoded lexical database to obtain neighborhood density information about the (SoNy)KSL signs, as in the on-going ASL-LEX project for ASL (Caselli et al. 2016), and then try to test this with signer judgments about relative similarity.

To summarize, there are several outstanding questions and concerns about near-minimal pairs and their reliability for determining lexical contrast. First, I suggested that near-minimal pairs might be obscuring an avoidance of contrast for some putative features. Second, I pointed out that a lack of syntagmatic environments in signed words means that whatever parallel is made to near-minimal pairs in spoken languages is unreliable, and that overwhelming simultaneity in sign languages completely changes the amount of "information" carried by any feature/prime—and so does the different set values for features/primes in the different modalities. Finally, I considered the possibility that all or most signs in a lexicon could exist in relatively dense networks of simultaneous phonological neighborhoods, further calling into question the utility of a near-minimal pair in sign language. For all these reasons, near-minimal pairs were avoided in the analysis, with only a couple exceptions that are explicitly mentioned, and whose phonemic structure is reinforced by other evidence.

3.5.3 Relevance of iconicity

The last methodological issue to address involves the relevance of iconicity for a phonological grammar and how iconic signs were treated in this project. While the issue is inherently grounded in theoretical considerations, previous phonological analyses have employed different methods for dealing with iconic signs (van der Kooij 2002; Occhino 2016); therefore, it is important to make clear the approach taken in this analysis. Here, I first give an overview of past approaches and then explain my theoretical position on the topic and how iconicity was handled in this project.

In truth, there are almost as many positions on the relationship between iconicity and phonology as there are linguists who broach the topic, yet for the purposes of this summary, I will classify them in very three broad groups: a "separation" group, a "gestalt" group, and a "neutral" group.

The separation position comes out of the Saussurean tradition in which phonology is the level of patterning below the word that involves the combination of discrete, meaningless units to create units of meaning (morphemes, words). As mentioned in §3.2, this notion of the units being both discrete and meaningless has been seen as a key design feature of human language (i.e., *duality of patterning*; Hockett 1960); therefore, when Stokoe—in the separation camp—published his dictionary of ASL demonstrating that this 'newly discovered' language of signs had minimal pairs and inventories of recombinable units, he also demonstrated that sign languages were equal to spoken languages. Over the history of sign linguistics, especially in the beginning, most linguists aligned with this view, and have seen iconicity in the lexicon as presenting a predicament for phonology:

> "The problem with iconicity is that its demands seem in conflict with the demands of phonological compositionality because compositionality is based on having a limited list of discrete (digital) building blocks and combination rules, while iconicity is based on having holistic and essentially non-discrete (analog) forms that represent a concept or meaning. In this section, … we wish to argue that the phenomenon of iconicity can quite easily lead to an undesirable increase of phonological building blocks" (Crasborn, et al. 2000: 15).

Sandler refers to the same "conflict" when she writes, "(i)t is often difficult to find true minimal pairs in sign language. The reason for this, I believe is the iconic foundation for some signs in these languages, which results in idiosyncratic details. Many of these details are phonologically irrelevant because no constraints or rules of the language require reference to them" (Sandler 1996a: 202, footnote 2). Research that may have contributed to idea of a tension between iconicity and phonology come from Frishberg's analysis of diachronic changes in ASL signs over several generations. She shows that signs change in ways that respect purely formational considerations (i.e., "toward symmetry, fluidity, locational displacement, and assimilation" [1975: 700]) and "away from pantomimic or imitative origins toward more arbitrary shapes" (700). Though it was not necessarily Frishberg's intention,[70] this diachronic data has contributed to the impression that iconic signs are somehow more primitive linguistic objects compared to arbitrary signs (Sandler et al. 2011), and "iconicity tends to be minimized in favor of arbitrariness over time" (Sandler & Lillo-Martin 2006: 117). Another view that roughly

[70] Indeed, she sees iconic forms as potentially becoming integrated into the linguistic system: "where some iconicity remains, we have seen that it is often language-specific, morphologically manipulable symbolism" (1975: 717).

fits in the separation camp is that iconic signs form their own domain within the native lexicon (Brentari & Padden 2001: 98), implying that they should be considered separately.

For those subscribing to the separation approach, a reasonable response is to set aside iconic forms during the phonological analysis. Sandler implies that has been her methodology, and Brentari & Padden's core-periphery approach suggests that different rules might apply to different lexicon domains. However, van der Kooij goes much further in formalizing this separation by proposing "semantic pre-specification rules" that dictate how iconicity governs surface forms. This allows van der Kooij (2002) to remove iconic forms from consideration when analyzing the abstract system of phonology in NGT, thus establishing a smaller set of "building blocks" than has been proposed for other sign languages, as well as identifying predictable patterns in the lexicon.

A very different position is taken by the 'gestalt' group who argue that iconicity is a critical aspect of sign formation and that a phonological analysis only makes sense when the conceptual motivation for the choice of forms is taken into account. An early proponent of this approach is Friedman who writes, "(i)f we fail to consider the role of iconicity and insist on analyzing ASL only with reference to its arbitrary elements, then we will fail to grasp the essential nature of its formational properties" (Friedman 1976: 79), and that "(t)he iconic value of a sign appears to have a considerable impact on its phonological structure" (25-26). Subsequent proponents of this approach have been cognitive linguists for whom linguistic data must be contextualized as the manifestation of conceptual space. Thus, when it comes to iconicity in sign languages, "(c)ognitive iconicity thus is defined not as a relation between the form of a sign and real world referent, but as a relation between two conceptual spaces" (Wilcox, et al. 2003: 142). In a recent approach to sign language phonology from a cognitive linguistics perspective, Occhino (2016) uses a methodology that fits this paradigm: eliciting conceptual schemas for individual phonological units (e.g., the *claw* handshape) from fluent signers, and building up schematic representations for various forms.

Finally, the overall approach in the neutral camp is to not treat highly iconic signs any differently than highly arbitrary signs; that is, assume that they can be accommodated with the same theoretical approach. One example is Eccarius & Brentari (2010), who demonstrate that handshape iconicity can be accounted for using Optimality Theory; in particular, FAITHFULNESS constraints help preserve iconic mappings between the shape of the hand and the shape of a referent, and this should apply uniformly across the lexicon. Finally, somewhat by default, another neutral approach is Brentari's relatively thorough 330+ page treatment of ASL phonology via her Prosodic Model (1998). This book does not once mention iconicity, which can presumably be taken to mean that it was not relevant at any point for the phonological analysis.

My own approach to iconicity, as it pertains to phonology, fits best in the neutral camp. This is because the separation camp fails to account for the pervasiveness and stability of iconicity in the lexicon over time, as well as the growing acknowledgment that language-specific form-meaning mappings readily occur at the level of individual features and primes (Johnston & Schembri 1999, Frishberg & Gough 2000; Fernald & Napoli 2000, Meir 2012, Lepic 2015, van der Kooij & Zwitserlood 2015). This calls into question the principle that the smallest units of form are truly meaningless and thus arbitrary (though the nature of this form-meaning mapping is still a topic of debate).

The gestalt group has a unifying theory that explains much of the semantic underpinnings of language, but does not possess a compelling account for purely *form-form* relationships in sign language. That is, one of the core tenets of Cognitive Grammar is that "a unit of language consists of three structures: the phonological pole, the semantic pole, and the symbolic structure" (Occhino 2016: 62); however, it is not clear how to reconcile this tripartite coupling with phenomena that seem to only implicate form-based relationships that don't involve meaning. In this way Cognitive Grammar would seem to stand in contradiction to recent compelling research that phonologies are self-organizing systems with emergent structure (Wedel 2004, de Boer 2005, Mielke 2008, Wedel 2011). It also is not well-reconciled with psycholinguistic experiments that show signers attending to purely form-level distinctions (Klima & Bellugi 1979, Wilson & Emmorey 1997). And finally, for practical reasons, Cognitive Phonology as a newer field has not yet worked out a format and methodology that would be able to meet the demands of a phonological grammar; i.e., to comprehensively but concisely explain the form-patterning in a specific language.

For all these reasons, I have taken a neutral approach to the role of iconicity in this phonological grammar, which means that I included iconic signs in the phonological analysis. Yet I have also positioned the data to be open to empirical questions in the future about sub-lexical form-meaning mappings. For example, I created several fields in the KSL Lexical Database related to iconic patterns, and coded a couple hundred signs (during the phonetic coding) to get a snapshot of iconicity. I also analyzed motivated forms in handshapes (e.g., numbers, letters, size/shape, handling, embodied action) and some locations; this information on can be found in Appendices 3, 6, and 9.

A neutral position also means continuing to search for examples in KSL that could demonstrate the type of conflict referred to by Crasborn, et al. and Sandler in which idiosyncratic iconicity subverts the abstract patterning of the language, but I have yet to find an example of this type of problem in KSL. I ran across two sets of data that could have produced this conflict, but the evidence suggests that iconicity and phonology do not "get in each other's way"—although *morphology* and phonology might.

The first instance when idiosyncratic iconicity might have subverted phonology is presented in §2.5.1, Chapter 2 (and in Morgan 2015a). There, I show how nine KSL signers produced similar, but discretely different signs for GUAVA. All of the signs used the same semantic motivation (eating a small, round fruit by taking chunks off with your teeth), but no two signers—who are all from in the same local community—produced perfectly identical signs. The crucial point from a phonological standpoint is that each sign variant/token is a perfectly well-formed KSL sign, with discrete phonological features and appropriate lexical prosody. Any one the nine versions of GUAVA could become the standardized form. This shows that phonology can actually be very flexible in accommodating iconicity, and casts some doubt on the notion that there is an inherent tension between iconicity and phonology.

The second instance is a semantic cluster of signs with a *flat* handshape that "cuts" metaphorical objects of all sorts with the ulnar edge of the hand. This cluster contains one sign, HARD-OF-HEARING, shown in Figure 33a, with its semantic mapping in 33b. The semantics of this sign reference several other KSL signs that involve cutting with the ulnar (pinky) side of the hand as the metaphorical blade edge, including the sign HALF (signed on the palm of the non-dominant hand). In order to preserve the connection to the sign HALF and other signs involving cutting, the orientation of the hand moves along the face and down to the chest in a way that is articulatorily awkward, but preserves the original semantic mapping of cutting with the ulnar edge. Is the phonetically aberrant form due to iconicity? It seems to be at first glance, but after much reflection, I have concluded that this construction is more properly considered "morphological" than "iconic" because its form-meaning mappings derive as much—or more—

from analogical relations in a network of other language-specific KSL words with the flat hand as a blade (e.g., KNIFE, MACHETE, BLOOD-1, MEAT-2, SHRED-KALE, TILAPIA, HALF, FEMALE-CIRCUMCISION-2, PUMPKIN, etc.) as it does from the original iconic mapping. That is, while some of its meaning depends on an iconic depiction of the flat blade of a knife with the cutting surface on one edge, its specific linguistic identity is conferred through its relationships to other KSL words. Further evidence is that a very similar word for HARD-OF-HEARING occurs in several other sign languages (see www.spreadthesign.com), but KSL is the only language that has the awkward hand orientation to preserve ulnar contact on the face and chest; i.e., it is a language-specific choice based on a morphological paradigm. Indeed, morphological constructions such as numeral incorporation in sign languages may be just as likely to contravene phonotactic norms (Morgan 2013) as iconic forms.

a.

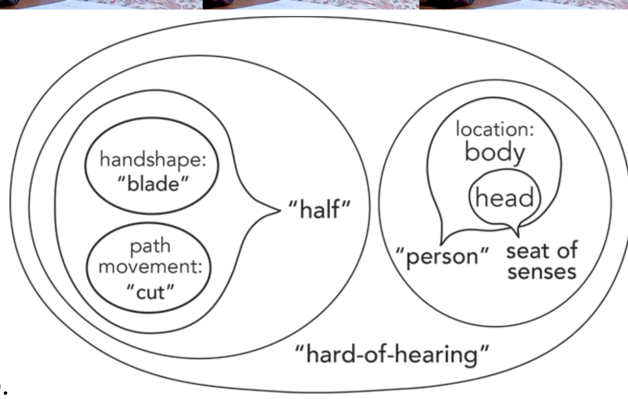

b.


Figure 33. The KSL sign HARD-OF-HEARING with ulnar contact on the body (a), and its semantic form-meaning mappings (b)

To summarize this section on the methodology for locating lexical contrasts, I first described the process of how true minimal pairs were collected in this project, then addressed three potential complications for the analysis involving (i) variation and idiolects, (ii) near-minimal pairs, and (iii) iconicity. I also described how each was addressed in this project. Next, I turn to the quantitative results from the dataset of minimal pairs.

3.6 Quantitative findings of minimal pairs in (SoNy)KSL

The methods described in the previous sections, in conjunction with the analyses that are documented in the following chapters, has yielded a total of 461 true minimal pairs that were found in the dataset of 1,880 signs. As shown in Figure 34, when clustered by parameter, the most contrasts were made in Location (191 pairs), followed by Handshape (148 pairs), Movement (84 pairs), Orientation (18 pairs), and 18 other types of contrast, such as in the number of hands, non-manuals, and others.

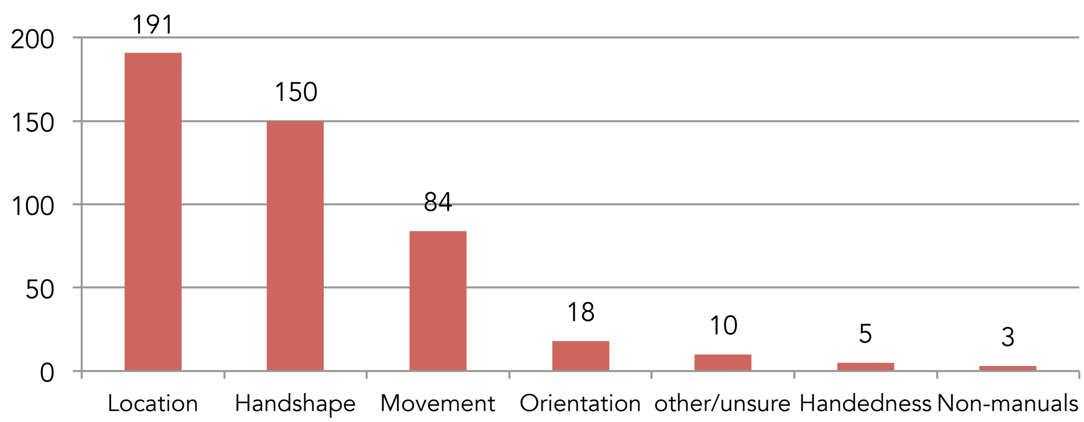


Figure 34. Number of minimal pairs in the KSL Lexical Database, by parameter or other contrast type (461 pairs total)

The first thing to mention about this distribution is that it is heavily weighted toward what Brentari refers to as *inherent features* (1989), which do not change during the sign, rather than *prosodic features* or *dynamic features* (van der Kooij 2002), which represent the movement in the sign. Altogether, 81% of the pairs involve features and primes that are unchanging during the sign. What might account for this difference? One possibility is that because locations, handshapes, and other inherent features (e.g., orientation, path size, number of hands, etc.) are unchanging[71] this makes them visually stable and salient enough to be able to carry lexical contrast.

Other insights come from the full list of minimal pair types, which enumerates sub-types within each parameter. As shown in Table 5, we can see that by far the biggest clusters are the location and handshape primes (i.e., those that can't be decomposed into smaller features) with 185 and 116 pairs respectively, while the most frequent sub-type in movement are minimal pairs made on the basis of repetition, 29 pairs. But what is remarkable is the sheer number of ways that contrasts are produced—the numerous degrees of freedom possible in a signed word. This further supports the greater simultaneity of signed versus spoken words. Note, too, that there are a handful of contrasts that entail sequential or linear structure; these are addressed in detail in §3.7.

[71] Path movement can be interpreted as a change in location, but as shown in Chapter 5, *Location*, path movements nearly always stay within the same phonological location.

Table 5. *Types and quantity of minimal pairs found in KSL*

	Parameter	Feature/prime	# pairs	% pairs
1	Movement	Alternating	4	0.9%
2	Movement	Bidirectional	2	0.4%
3	Movement	Complexity	7	1.5%
4	Movement	Dispersed	7	1.5%
5	Movement	HS movement	2	0.4%
6	Movement	Movement type	4	0.9%
7	Movement	Orient. movement	2	0.4%
8	Movement	Path axis	9	2.0%
9	Movement	Path direction	7	1.5%
10	Movement	Path shape	5	1.1%
11	Movement	Repetition	29	6.3%
12	Movement	Sequential	2	0.4%
13	Movement	Switch Dom.	3	0.7%
14	Movement	Unsure	1	0.2%
15	Location	Location prime	185	40.1%
16	Location	Lateral symmetry	5	1.1%
17	Location	Sequential	1	0.2%
18	Handshape	Handshape prime	116	25.2%
19	Handshape	Selected fingers	27	5.9%
20	Handshape	H2 handshape	4	0.9%
21	Handshape	Joint config.	1	0.2%
22	Handshape	Sel.Fing/h2 HS	1	0.2%
23	Handshape	Sequential	1	0.2%
24	Orientation	Absolute	7	1.5%
25	Orientation	Absolute & Relative	11	0.4%
26	Other	Handedness	5	1.1%
27	Other	Non-manual	3	0.7%
28	Other	Path size	3	0.7%
29	Other	Body movement	2	0.4%
30	Other	Connected	1	0.2%
31	Other	Handpart contact	1	0.2%
32	Unsure	unsure	3	0.7%
			461	*100%*

Another notable aspect of these results is that many of the features occur in only a few contrasts. This tendency is also observed in individual location and handshape primes. That is, many of the handshapes and locations only participate in a few minimal pairs.

Figure 35 shows the number of handshape minimal pairs by the frequency of that shape in the lexical database (see §4.3). This chart includes all 149 handshapes in contrasts with paradigmatic replacement. For instance, the *1* handshape has the most contrasts, 33 minimal pairs, and occurs in 15.5% of all signs in the database. There is a clear trend suggesting that the number of minimal pairs is explained in part by a handshape's frequency in the database. That is, the more frequent in the lexicon, the more likely to participate in a minimal pair.

Location minimal pairs are shown in Figure 36. In this case, the *mouth* location has the most contrasts, 35 minimal pairs, and occurs in 5.3% of all signs in the database. However, *neutral space*, which accounts for a sizeable 38.6% of all locations in the database, has only 23 minimal pairs, far outside of the trend for locations on the body. Here, the effect of frequency is not as evident as it is for handshapes, which may be due to the somewhat more evenly distributed frequency of locations in the lexicon (see §5.3).

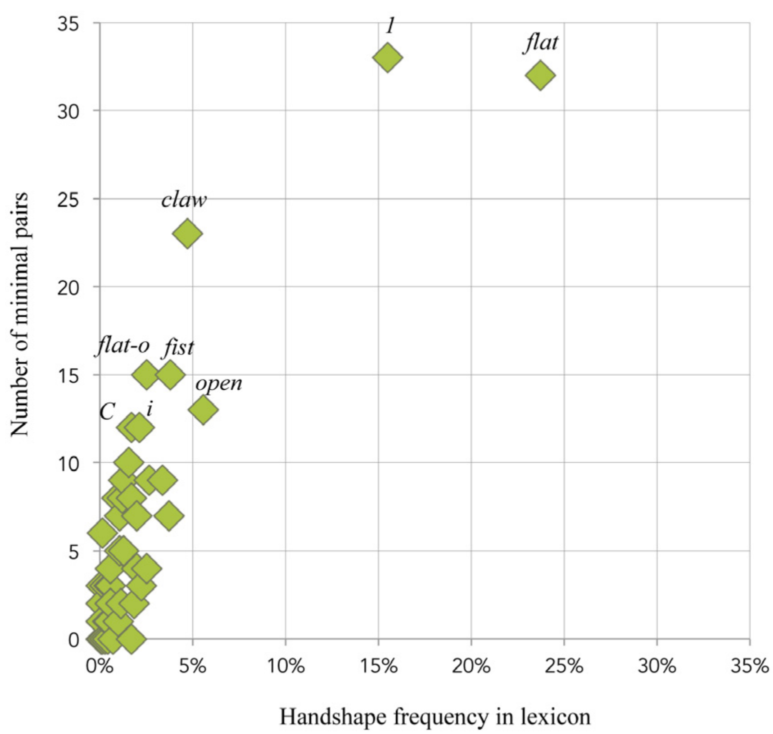


Figure 35. Relationship of the number of handshape minimal pairs with frequency in the lexicon

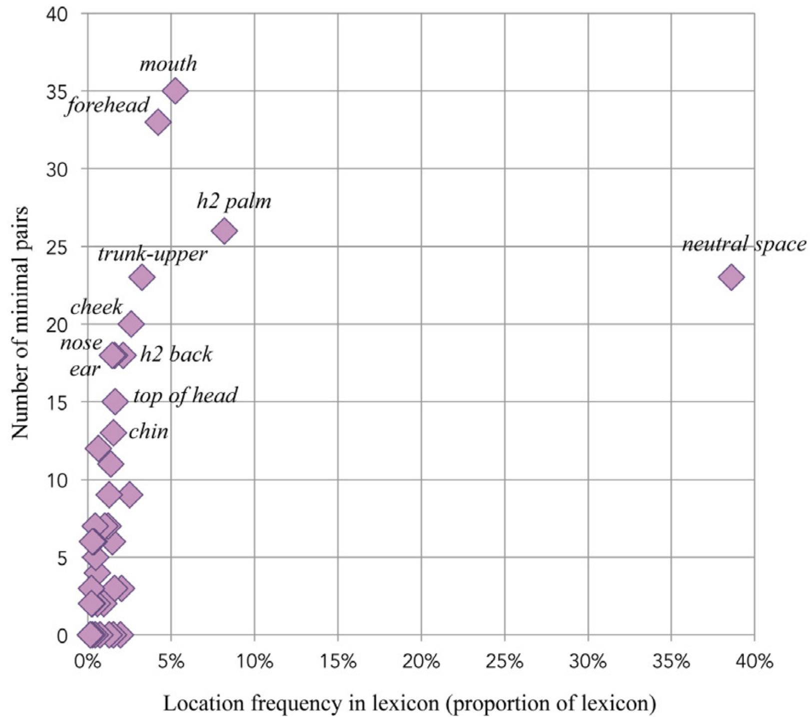


Figure 36. Relationship of the number of minimal pairs by location with frequency in the lexicon

In both charts, the frequency effect on minimal pairs appears to attenuate as a prime increases in the lexicon. Thus, there may be a countervailing structural factor that prevents any one feature or prime from being involved in more than a certain proportion of contrasts. More investigation is required. Otherwise, it should be noted that *neutral space* falls far outside of the trend. The status of *neutral space* as a phonological location is discussed in §5.11, including why it may be hard to find minimal pairs between NS and body locations.

Taken altogether, the distribution of minimal pair types in Table 5 and the primes in Figures 35 and 36 serve to reinforce the long-observed simultaneity of structure of sign language phonology. In addition, this data helps to clarify a longstanding observation from the sign phonology literature, discussed next.

3.6.1 Is there a paucity of minimal pairs in sign languages?

Sign phonologists who have done in-depth phonological analyses consistently mention trouble in finding minimal pairs. For ASL, Sandler writes, “it is often difficult to find true minimal pairs in sign language” (1996: 202), and Brentari similarly states, “(i)t is difficult to find minimal pairs” (1998: 4). In Sign Language of the Netherlands, van der Kooij reports that for some contrasts, “the minimal pair test is only of limited use” and that one dataset she used “contained too few signs to find minimal pairs” (2002: 160).

The exact nature of the “difficulty” has not been elaborated on in the literature—in fact, the quotations here are some of the only comments made on the subject. However, it has been attributed to a *paucity* of pairs, seemingly related to the sign modality itself. Specifically, van der Kooij writes that “it has often been noted in the sign phonology literature that there are only few minimal pairs in sign languages” (2002: 19); and Eccarius & Brentari write, “(p)honologists working on sign languages know that minimal pairs…are scarce” (2010: 163-164) (underlines added).

The present study sheds much more light on this “difficulty” and “scarcity.” First, as detailed in the procedure for finding minimal pairs in §3.5, the process itself is painstaking and is probably impossible to do well without a digitized record of the formational content of signs that is easy to query on demand (i.e., either a lexical database or a transcribed digital notation like HamNoSys used with computer scripting). Another related factor that certainly contributed to the sense of difficulty in the present study is that it is common, and sometimes frustrating to realize that a pair thought to be minimal turns out to have two (or more) distinctive differences. Third, a purely statistical factor is related to the number of tokens for features/primes in the lexicon. In spoken languages, a feature or segment can appear more than once in a word and lexicons are large. In sign languages, features and primes appear only once per sign and lexicons are relatively small. And finally, the impression of scarcity is real, but has not been attributed specifically enough. It turns out that there are indeed few minimal pairs—but, crucially, it is few pairs *per feature/prime* (as shown in Table 5 and Figures 35 and 36) that probably gives the impression of paucity, not necessarily an overall scarcity of minimal pairs in sign languages.

Indeed, this raises the more basic question of whether several hundred minimal pairs should be considered "few" in the first place. One way to address the question is to compare this amount to findings to spoken languages. In unpublished work with Abby Kaplan at the University of Utah, the count of KSL minimal pairs was compared to four datasets with multiple spoken languages: the *CHIRILA* database of ~300 Australian languages; the *POLLEX* database of ~67 Polynesian languages; the *CELEX+* database of eight major languages (English, French, Spanish, Korean, Japanese, & Turkish); and *The Tower of Babel* with words from ~800 languages. For all languages, including KSL, homophones were removed. This resulted in a dataset of 1,690 unique KSL signs, and a total of 405 minimal pairs, the number of pairs known at that stage of the analysis.

The findings show that KSL has somewhat fewer minimal pairs than expected for a language of its size, but is comfortably within the range of observed variation. With the update of several dozen more pairs, the result should lean even more toward the trendline. Figure 37 represents the effect of log vocabulary size on log minimal pairs for all languages. KSL is shown as a red dot, with spoken languages in gray symbols, by dataset. Purely from the perspective of absolute pairs, (SoNy)KSL is not remarkable.

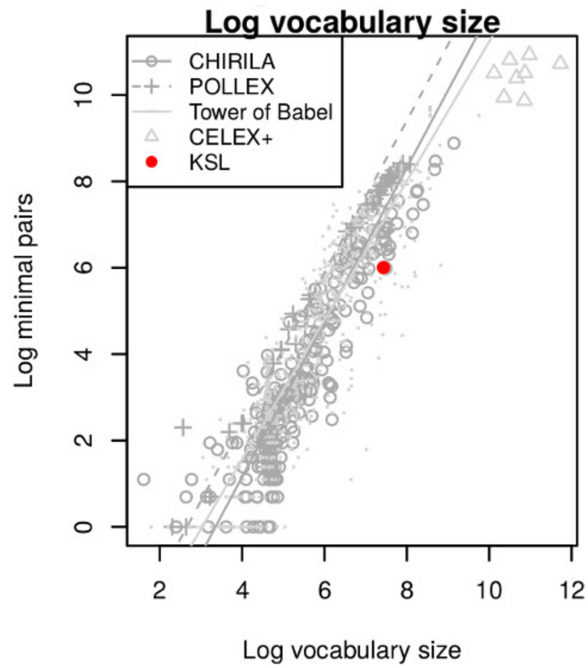


Figure 37. Effects of log vocabulary size on log minimal pairs (from Kaplan & Morgan 2017)

If we treat KSL as a proxy for sign languages in general, we can now better summarize the situation for minimal pairs. The absolute number of minimal pairs in sign language may not be less than in spoken languages, but because there are so many degrees of freedom for lexical contrast in a signed word, and because some primes and features are relatively infrequent (i.e., only occurring in a few signs), many distinctive features and primes may only have a couple or a few minimal pairs associated with them—or even one or none.

This quantitative data better clarifies the challenges that sign phonologists have faced in finding minimal pairs. When it is said that minimal pairs are "scarce" or "difficult to find," what is likely meant is that finding the few pairs for a feature or prime within the entire lexicon can be challenging. However, this project has shown that if done carefully, one can find lots of minimal pairs, which puts the onus on having better and more systematic analytic methods for finding such pairs. This novel dataset of KSL minimal pairs and its quantitative findings opens a new window onto the formational structure of sign languages by knowing where contrasts proliferate and where they are few or absent. It also establishes new and more grounded expectations about lexical contrast in sign languages that can guide future phonological descriptions.

In the next section, I return to the question of the phonological units of the sign and what the set of minimal pairs in KSL can tell us about them.

3.7 Simultaneity and sequentiality in lexical contrast

In §3.2, I discussed the difference between they typical case of *paradigmatic replacement* in a sign language minimal pair involving the replacement of a feature that is present throughout the entire sign and *syntagmatic contrast* in a spoken language minimal pair involving the replacement of a sequential unit in a string of distinct units. The results of the KSL analysis show that, as expected, minimal pairs are overwhelmingly the former type—that is, 99.1% of all contrasts. For example, SATURDAY-2 and AL-SHABAAB in Figure 38 both have repeated end-contact path movement, with a *cupped* handshape and the same palm orientation features; only the location is different, and this difference is expressed from the beginning to the end of the sign.

a. b.


Figure 38. Minimal pair for location with paradigmatic replacement: a. SATURDAY-2 (*eye*), b. AL-SHABAAB (*mouth*)

This also includes the replacement of one movement type for another, via prosodic/dynamic features; e.g., *repetition*, *alternating*, *dispersed*, etc. For example, LORRY and LITEIN (name of a Kenyan town) in Figure 39 are for handshape, orientation, location, and even core articulatory movement (midsagittal path movement [distal]>[proximal]), but differ in whether the hands move simultaneously (LORRY) or alternatingly (LITEIN).

a. 

b. 

Figure 39. Minimal pair for movement with paradigmatic replacement: a. LORRY [-alternating], b. LITEIN [+alternating]

Therefore, changes in linear structure to create lexical contrast are quite rare. However, there are four minimal pairs (0.9% of all pairs) in which we see something like syntagmatic contrast, where one linear part of the sign is identical in both signs while another linear part is different. Because of their unique status, I will evaluate them in some detail here. One pair involves a change in handshape (TO-COPY vs. TO-EXPLOIT, Fig. 40), one a change in location (TO-EAT-3 vs. TO-LEARN-1, Fig. 41), and two pairs have a sequential change in movement (TO-LIVE-3 vs. PROUD-2, Fig. 42); SIGNED-ENGLISH[72] vs. EXACT, Fig. 43).

[72] In the Kenyan context, Signed English refers to the use of a mode of KSL with signs for English function words and morphemes (e.g, "is", "am", "the", "-ing"), a sign for every spoken English word, and the use English word order. Also, in the area of data collection, a greater use of ASL signs is associated with this mode.

a. b.


Figure 40. Minimal pair for handshape in a sequential position: a. TO-COPY (ends in *flat-o*), b. TO-EXPLOIT (ends in *claw*)

Figure 41. Minimal pair for location in a sequential position: a. TO-EAT-3 (*h2+mouth*), b. TO-LEARN-1 (*h2+forehead*)

Figure 42. Possible minimal pair for movement in a sequential position: a. TO-LIVE-1 (*straight [long]*), b. PROUD-2 (*straight + ulnar rotation*)

Figure 43. Minimal pair for movement in a sequential position: a. SIGNED-ENGLISH (*path* + *path*), b. EXACT (*circle* + *path*)

In three of these pairs, the contrasting parts also contrast with each other in minimal pairs with full replacement; i.e., specifications extend throughout the entire sign. Specifically, *flat-o* and *claw* contrast with each other in two minimal pairs; *mouth* and *forehead* contrast in five minimal pairs; and *straight* and *circle* paths contrast in three pairs. No minimal pairs are documented for a path movement versus an ulnar rotation in TO-LIVE-1 VS. PROUD-2, though determining whether or how 'core articulatory movements' contrast with each other (e.g., handshape change, orientation change, path movement) is not straightforward (see §6.5 for discussion). These separate contrasts may lend some support to the idea that each sequential unit is distinct.

On the other hand, there is countervailing evidence against the conclusion that these pairs exhibit the same type of distinct, largely independent,[73] and recombinable segments like those that occur in spoken languages. First and foremost, the rest of the phonological specifications in these pairs remain the same throughout the sign; simultaneity still predominates in these four pairs. Second, two of these pairs have qualities that make them less compelling as perfect objects for sequential segmental structure.

For the pair TO-COPY and TO-EXPLOIT, instead of interpreting these as two separate adjacent handshapes (*open, flat-o*; *open, claw*), these can also be interpreted as handshape

[73] Notwithstanding phonotactics and co-articulation of features in spoken language segments.

contours that encode a simultaneous dynamic change; i.e., a closing aperture in TO-COPY and joint flexing in TO-EXPLOIT. And for TO-LIVE-3 and PROUD-2, this pair is the least certain for sequential structure, and requires follow-up to know how signers parse the path movement and ulnar rotation. Instead of a sequential difference, it may be perceived primarily as a difference in path shape (straight vs. arc) and/or pronation (ulnar rotation outward) that extends throughout the sign PROUD-2. Also, as mentioned, the contrast between different types of core articulatory movement is not fully worked out.

The sequential location pair TO-EAT-3 and TO-LEARN-1 is a well-formed minimal pair, although the palm location in TO-LEARN-1 is dropped in some variants. These two signs form a small set in KSL with two sequential locations, which are described in the *Location* chapter in §5.12. Finally, the pair SIGNED-ENGLISH and EXACT more perfectly resembles the ideal case of substitution of one distinct unit (of movement) for another in the context of aligned syntagms—i.e., the "syntagmatic contrast" that Johnson and Liddell elevate to true minimal pair status (2010). However, there is something curious about the circle+straight construction, which is that as far as I know, the reverse lexical movement, straight+circle, is not attested in any sign language. More research is needed to explain why this might be the case (e.g., articulatory ease and/or prosodic word length/weight constraints), but at the very least, this raises the possibility that the circle+straight sequence is a reoccurring collocation that may be treated by signers as a kind of unitary disyllabic type (similar to the path shape '7' in ASL) rather than the independent pairing of two distinct phonological units. Circle+straight path signs are described in §7.3.5.

The two examples of SIGNED-ENGLISH vs. EXACT and TO-EAT-3 vs. TO-LEARN-1, serve to illustrate how the syntagmatic structure of signed words is qualitatively different than in sign languages: sequences of sounds in spoken languages can be syntagmatically reordered, not just replaced, to create new meanings. Recall that in Hockett's description of *duality of patterning*, the exemplars he uses are not minimal pairs, but the English words '*cat*', '*act*', and '*tack*', which "are totally distinct as to meaning, and yet are composed of just three basic meaningless sounds in different permutations" (1960: 92). By comparison, there are no examples in KSL in which the changing the order of linear parts results in new (or even well-formed) words, and there are also pairs in which the re-ordering of locations produces variants of the same sign rather than different words. Further, the few examples of such reordering in ASL (e.g., SEND vs. TAKE) can be also interpreted as simultaneous dynamic features (e.g., a handshape that closes vs. opens). Thus, having linear structure does not entail sequential segmental structure.

What can we now say about the *minimal contrastive unit* in the sign modality? It seems safe to conclude that the feature or prime is the minimal contrastive unit, usually as a phonological unit the extends throughout the whole sign, though in a very limited number of cases, as a specification realized on the X-slot/segment (as in the EAT/LEARN location example) or a specification realized as a full {X X} syllable (as in the SIGNED-ENGLISH/EXACT *circle* vs. *straight* movement example).

There are a couple of other ways to look at these two pairs. First, they may be interpreted by signers as emergent unitary features. In the case of the movement pair, as already suggested, *circle+straight* may be its own prosodic featural type. And even in the case of two-sequential location pair, these may reflect a kind of emergent and complex two-part location in the inventory of KSL: *palm+mouth* and *palm+forehead*. The fact that lexical signs tend to create small paradigms around the same location groupings suggests that they may have a kind of morpho-phonological identity in the lexicon.

3.8 Conclusion and future directions

This chapter sets up the rest of the thesis by explaining the methodology used to determine minimal pairs, which are used throughout to identify the language-specific inventory of features and primes. It also establishes the theoretical approach to sign structure taken in this project, which is based on the Dependency Model (van der Kooij 2002) with clarifications about prosodic structure from Brentari (1998). This was described briefly in §3.3, and is worked out in more detail in Chapter 7. At the same time, a measure of translatability between theories is maintained in each of the subsequent chapters by providing a comparison of models with each other.

The research presented here also offers new information about the distribution and types of minimal pairs in a lexicon, and finds that the overall number of pairs is not categorically different than in spoken languages. It sheds light on the long-observed difficulty in finding minimal pairs reported by sign phonologists, explaining exactly why the difficulty exists (many degrees of freedom for contrast; primes that are infrequent in the lexicon). This distribution reinforces the abundant simultaneity found in sign languages, and also shows how lexical contrast is weighted toward inherent/unchanging features in the sign.

Here I have also shown how greater transparency and care is required in determining lexical contrast in both phonological grammars and in theoretical approaches to sign phonology. I argue that the study of sign phonology would benefit from (i) language-specific datasets of true minimal pairs in a language (or encoding phonological information in a lexicon in a way that allows true minimal pairs to be derived through computer scripts), (ii) using minimal pairs from the same idiolect, and (iii) studiously avoiding near-minimal pairs as evidence for phonemic status.

Indeed, the description of the problems with near-minimal pairs introduces both the challenges and opportunities in measuring the phonological distance between signs (e.g., neighborhood density effects). Contemporary linguistics makes the assumption that structures found in the analysis of a language correlate to the structure of the mental lexicon of speakers/signers. However, this correlation requires that the phonology accurately reflects the structure of a language (i.e., is phonemic) and is documented in a way that can be queried (i.e., digitized). In this respect, sign language phonology is far behind spoken language research in developing a productive tradition of laboratory phonology that brings together descriptive linguistics and psycholinguistic investigation for the benefit of each. The findings in this chapter and other parts of the thesis demonstrate how lexical contrast through strictly defined minimal pairs could forge a path to that connection and better elucidate the mental lexicon of signers.

Chapter 3 contains material on pages 114-115 as it appears in "Establishing the typical number of minimal pairs in signed and spoken language" by Kaplan, Abby and Morgan, Hope E. The dissertation author was a co-author of this manuscript.

Chapter 4:
Handshape

4.1 Introduction

Sherman Wilcox has observed that the components of signs can be viewed in terms of *what*, *where*, and *how*.[74] The *where* component naturally corresponds to Location features, the *how* corresponds to Movement features, while the *what* component typically corresponds to hand configuration features—i.e., handshape, palm/finger orientation, the number of hands, and the arrangement of hands in two-handed signs. In other words, what is it that is located in a particular area and undergoes movement? In the great majority of signs, it is the hands, though there can be articulators other than handshape—the tongue, mouth, head, torso, and leg (Brentari 1998; van der Kooij 2002; Nyst 2007). However, the main articulators are primarily the hands, and this chapter is dedicated exclusively to Handshape.

The first question this chapter addresses is what the smallest phonological unit for handshape is—the whole handshape, or individual features (§4.2)? I start by describing how the units of handshape have been classified in the literature and consider how different models have represented the handshape and its featural content (§4.2.1). Then, I describe how this question was investigated in the present analysis using minimal pairs (§4.2.2), and present the results by handshape featural types: selected fingers (§4.2.3), joint position (or finger configuration) (§4.2.4), finger spreading and crossing (§4.2.5), and thumb features (§4.2.6). I then contextualize these findings in §4.2.7. The results will show that handshapes in KSL are not fully decomposable by features in KSL.

[74] In remarks at the LabPhon 12 Conference (Albuquerque, New Mexico; July 2010)

Thus, the remainder of the chapter proceeds on the basis of the whole handshape as the unit of analysis with the primary question: which handshapes are distinctive phonemic units in KSL? In §4.3, I present the phonetic handshapes coded in the KSL Lexical Database and then in §4.4 I describe the methodology for determining which handshapes are distinctive. This entails finding minimal pairs (§4.4.1), determining allophonic variation (§4.4.2), and considering the origin of some handshapes (§4.4.3). In §4.5, I present a summary of the KSL handshape inventory (§4.5) and discuss some of the unresolved challenges for an analysis of handshape in KSL. These are exemplified by investigating two pairs of handshapes that could either be allophones or distinctively different—or both, but in different environments: *flat* and *open* in §4.6.1 and *flat* and *bent* in §4.6.2. The chapter closes with a summary and conclusion in §4.7.

4.2 What is the smallest phonological unit: *whole handshape* or *feature*?

In this thesis, the goal is to identify the component pieces that constitute the KSL phonological grammar. In previous analyses of handshape internal structure, several possible representations for the internal structure of handshapes have been proposed, with most accounts decomposing core handshapes[75] into features. The following quotes show how sign phonologists have approached the task of identifying handshape features.

> "We have considered evidence that hand configuration is comprised of the hierarchically organized constituent classes of selected fingers, position, and orientation. We now focus on the smallest components, the primitives that the class nodes dominate. At this lowest level of structure, we are confronted with the same questions that we asked at the higher level: Does a lower level of structure in fact exist? Or, do signers simply have an exhaustive list of selected finger combinations and finger positions in their minds? …(T)he possibility at the other extreme is that the mental representation consists of each individual finger, as well as every imaginable combination of fingers, and of each possible position."
> - Sandler (1996: 124)

> "Whether such data [slips-of-the-hands] support the phonological decomposition up to the finest details, is questionable, so the possibility that this fine structure only exists in the mind

[75] Non-core handshapes, such as those from fingerspelled letters or manual numbers, are not considered part of the phonological grammar in some models; e.g., Sandler (1996: 125); van der Kooij (2002).

> of the phonologist who proposes it, remains a real one. However, when such proposals make sense of the array of, for example distinctive handshapes, and replaces a brute force listing of them by an elegant analysis, based on a small set of primitives that follow from general categorization principles, we believe the analysis must be preferred over brute force listing. Listing should be a last resort."
> - Crasborn et al. (2002: 11)

These statements reflect an intention among sign phonologists to identify the "small set of primitives", and yet Crasborn et al. hint that the evidence for certain features may be not be so certain. While all recent models of sign structure decompose handshape into features (Brentari 1998; van der Kooij 2002; Sander & Lillo-Martin 2006), not every linguist has found it necessary to do so, such as Lynn Friedman in her phonological analysis of ASL (italics mine):

> "It would be possible to analyze the hand shape parameter in terms of features. We could, for example, describe hand shapes as having spread or unspread fingers, straight or bent fingers; there could be an n-ary feature which describes thumb position--e.g. drawn inward, at the side of the hand, extended forward, extended sideward. Various feature descriptions have been (informally) suggested for the analysis of the hand shape parameter. However, while the use of the diacritics ° (thumb extended to the side) and ••• (bent fingers) amount to a partial feature analysis, *there would appear to little or no motivation for taking on the trappings of a full feature analysis*. Except for a few cases (involving the spread thumb and finger bending, for example), *there would seem to be only arbitrary reasons for making specific choices of features*. Until it can be demonstrated that generalizations about variations in hand shapes, either historical or synchronic, can best be formulated in terms of recurring features—thereby giving the feature analysis explanatory value—I don't believe we need such an analysis."
> - Friedman (1976: 22-23)

The evidence from the present analysis of Kenyan Sign Language suggests a level of organization for handshape that falls between the exhaustive featural representation in current phonological models and Friedman's conclusions that an analysis based on features is not supported by the data. That is, like Friedman, I also don't find clear motivation in KSL for a full featural analysis. Handshapes appear to be only partly decomposable. Before moving to the KSL data and analysis, it is necessary to review what kind of handshape features have been proposed by looking at how handshape has been represented in models of sign phonology.

4.2.1 Handshape features

There have been numerous different proposals for the internal phonological structure of handshape, and while no two are exactly alike, there are also many similarities between them. I will summarize the similarities and differences between three of the most recent and complete models: Sandler's Hand Tier Model (Sandler 1989; handshape features updated in Sandler & Lillo-Martin 2006) and Brentari's Prosodic Model (1998), both based on ASL, and van der Kooij's Dependency Model (2002) based on Sign Language of the Netherlands (NGT).

All three proposals model the handshape as feature trees with branching nodes and hierarchical dependency such that higher nodes dominate lower nodes plus their branches (in all models, the sub-structure for handshape attaches to a larger branching structure representing the full range of phonological possibilities in the sign). And while these representations differ in a couple ways—i.e., precisely which features must be specified, and their exact tree structures—they nonetheless refer to the same basic featural dimensions: selected fingers, finger configuration/joint position, finger spreading/width, thumb position, and thumb contact or aperture, shown in Table 6.

The models sometimes use different terms for features (e.g., [spread] and [wide] are the same and the opposite of [joined]), or have more featural specifications than others. For example, Brentari includes more features because she incorporates handshapes from non-core sources, including fingerspelled letters like 'R' with crossed fingers (), while van der Kooij considers only core handshapes and also aims for maximum parsimony by not specifying default features.

Table 6. *Five types of handshape feature specifications in three phonological models*

		PHONOLOGICAL MODEL		
	FEATURE TYPE	**Brentari 1998**	**van der Kooij 2002**[76]	**Sandler & Lillo-Martin 2006; Sandler 1989**
1	Selected fingers	[all], [one], [middle], [ulnar]	[all], [one], [ulnar], /radial/	[all], [one], [ulnar]
2	Finger configuration/ Joint position	[flexed],[77] [stacked]	[curve], /straight/	[base], [flex]
3	Finger spreading	[spread], [crossed], [stacked]	[wide], /pointed/	[joined]
4	Aperture (thumb contact)	[open], [closed] (*in Prosodic branch*)	[open], [closed]	[open], [closed]
5	Thumb position	[opposed], [unopposed]	[out], /in/	[radial], [opposed]

For *selected fingers*, the most current versions of all three models have adopted the approach called 'all over one; one over all' or simply 'One-All' that was first proposed by van der Kooij (1996) and formalized at a workshop attended by a number of sign phonologists (Brentari, van der Hulst, van der Kooij, and Sandler 1996). This approach is guided by the occurrence and frequency of selected finger combinations cross-linguistically as well as aspects of handshape anatomy. There are two primary values, [all] and [one]; [all] refers to all four fingers and [one] refers to the index finger. These two features can be ordered to specify two other sets of fingers: [all=>one] is the selection of two fingers, while [one=>all] is the selection of three fingers. Because the default side of the hand is the radial or thumb side, these fingers are those on the radial side of the hand. Thus, [all=>one] includes handshapes like 'H' and 'V'. The inverted [one=>all] licenses three fingers, e.g., 'W' and 'M'. Any handshapes including

[76] In van der Kooij's model, the default feature settings are not specified in the grammar. They appear in Table 6 as phonetic defaults, represented by slash marks; e.g., /radial/.

[77] Brentari achieves the range of different joint positions in ASL handshapes through the feature [flexed] combined with different branching structure specifications not shown here (see Brentari 1998: 107).

the pinky have the added feature [ulnar], so that the calculation of fingers starts at the ulnar/pinky side. Thus, the features [one] and [ulnar] results in a ‘i’ handshape, . A full explanation of this approach is given in van der Kooij (2002). Note that a common way of representing handshapes prior to the One-All approach was to refer to individual selected fingers by their initial letters (Sandler 1989): T (thumb), I (index finger), M (middle fingers), R (ring finger), and P (pinky or little finger). This is the representation I use in the analysis that follows, for greater transparency.

Finger configuration or *joint position* refers to the amount of flexion in the finger joints and (in some models) which specific joints are flexed. Sandler (1989) and Brentari (1998) distinguish between base and non-base joint flexion, while van der Kooij determines that this difference is not distinctive in the core lexicon in NGT. Minimal differences in handshapes on the basis of joint flexion are shown in Figure 44.

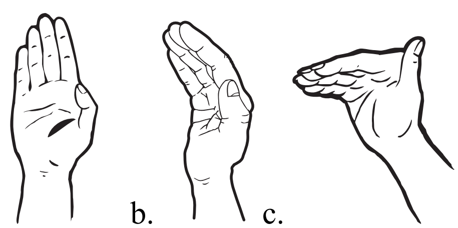

a. b. c.

Figure 44. Minimal featural difference for joint position: a. *flat* handshape with straight fingers, b. *curved* handshape with curved/flexed fingers in all joints, c. *bent* handshape with only flexed base joints (41a, 41c images courtesy of Gladys Tang)

Finger spreading refers to whether the fingers are closely adjacent to each other (i.e., unspread), or if they are spread laterally away from each other (spread), while *crossing* refers to only a small number of handshapes in which one finger crosses over another (e.g., *R* handshape).[78]

[78] The Dependency Model accounts for the phonology of the core native lexicon and therefore does not contain features for some of the more complex structures of handshapes in the fingerspelling alphabet, such as *R* with crossed fingers (see Appendix 3, #32).

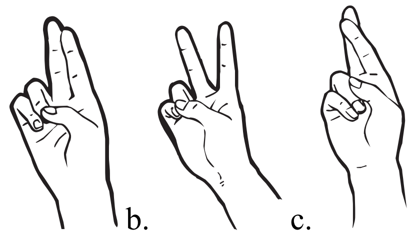

a. b. c.

Figure 45. Minimal featural difference for spreading/crossing: a. *H* handshape with unspread fingers, b. *V* handshape with spread fingers, c. *R* handshape with crossing (images courtesy of Gladys Tang)

Aperture refers to the whether the thumb contacts the other fingers or not. For example, the *O* and *C* handshapes in Figure 46 both have all curved fingers with thumb in an opposed position. Yet in the *O* handshape, the thumb contacts the other selected fingers with a [closed] aperture feature versus the [open] aperture of the *C* handshape.

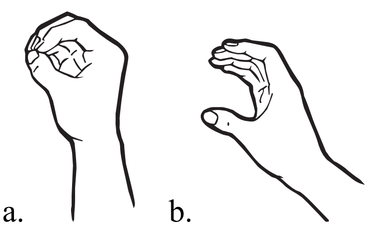

a. b.

Figure 46. Minimal featural difference for aperture: a. *O* handshape with [closed] aperture, b. *C* handshape with [open] aperture (images courtesy of Gladys Tang)

Finally, handshapes can also differ by the position of the thumb, which can be in an opposed position, as in *O* and *C* above, as well as *small-C* in Figure 47a. Or alternatively, the thumb can extend radially to the side of the hand as in *bent-L* in Figure 47b.

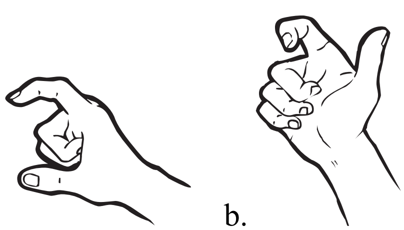

a. b.

Figure 47. Minimal featural difference for thumb position: a. *small-C* handshape with opposed position, b. *bent-L* handshape with adjacent position
(images courtesy of Gladys Tang)

There are phonetic handshapes that differ only by these individual features; however, this does not mean that such individual features are necessarily contrastive as the sole difference in sign minimal pairs. I will next look at whether each of these five feature types are contrastive in minimal pairs in Kenyan Sign Language.

4.2.2 Are handshape features contrastive in KSL?

As described in the previous chapter, this thesis emphasizes the use of strictly minimal pairs to determine whether features are relevant in the grammar of KSL. Based on the current models of sign phonology, it was expected that minimal contrasts would be found on the basis of all five feature types. The sub-sections that follow report on the minimal pairs found in these categories, and reveal that there is a striking disparity in the number of KSL minimal pairs in each feature group.

Before presenting the data, I will explain the process of the analysis. First, the coding of handshape in the database was done using names for whole handshapes; e.g., *flat*, *fist*, *R*, *flat-o,* etc.[79] A total of 71 phonetic handshapes with these 'nicknames' are found in the database (see §4.3). As described in the previous chapter, minimal pairs were gathered throughout coding and analysis, and these were determined on the basis of the handshape names. A total of 150 minimal pairs that differ by whole handshapes were gathered.

At the end of the database coding and after cleaning up and confirming the phonetic handshapes, all 71 phonetic handshapes were coded for individual features from the five categories (selected fingers, joint position, spreading, thumb aperture, thumb position). Next, all the *possible* minimal differences for each feature type among these 71 handshapes were found (solely between handshapes; not related to sign minimal pairs). For example, those in Figures 44 through 47, above. And finally, the actual attested minimal sign pairs in the KSL data were

[79] This coding decision was made for the sake of efficiency (considering how much data per sign had to be coded) and also to avoid categorization that would be too fine and would miss the phonemic categories. Another option would have been to use detailed phonetic codes per handshape, such as those by Eccarius & Brentari (2008) or Liddell & Johnson (2011a,b, 2012). Also, symbols could have been employed (e.g. Stokoe Notation, HamNoSys).

compared with this list of minimal handshape feature pairs, and those results are presented in the following sub-sections: selected fingers in §4.2.3, joint position in §4.2.4, finger spreading/crossing in §4.2.5, and thumb features (aperture and position combined) in §4.2.6.

What will be shown in these sections is that the amount of lexical contrast on the basis of *selected fingers* is much greater than for any of the other four feature groups. The consequences of this are considered in §4.2.7.

4.2.3 Minimal contrast for *selected fingers*

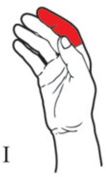
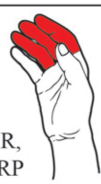
The first set of features to consider is *selected fingers*. Table 7 shows which minimal pairs were found that differ exclusively on the basis of different sets of selected fingers: all fingers (TIMRP),[80] index finger only (I), index and middle fingers (IM), three fingers (either IMR or MRP), the pinky (P), or only the thumb (T). Note that a minimal pair in this context means that all other handshape features as well as all other phonological specifications for location and movement are the same for both signs.

Out of 150 minimal pairs for handshapes, at least 23 pairs (15%) can be said to contrast by different sets of selected fingers, with all fingers, TIMRP [all], being involved in 16 pairs, the greatest number of contrasts. This includes such pairs as GOSSIP vs. TOMORROW, in Figure 48 as well as RECOMMEND vs. MIGORI, BEHAVIOR vs. ENJOY, and HOE vs. FORKED-HOE. This is followed by the index finger alone, [one], in 9 pairs; for example, TURKANA vs. TUESDAY, SIX vs. EIGHT, and YOURSELVES vs. THEMSELVES. The three-finger handshapes, IMR and RMP have 9 pairs together, but IMR accounts for 6 pairs (e.g., FORK-2 vs. SITUATION, FORK-2 vs. INVOLVE) and MRP accounts for two pairs (IF-1 vs. RUN-1 in Fig. 49, and FREE vs. TRY). The pinky, I, is

[80] T = thumb, I = index finger, M = middle finger, R = ring finger, P = pinky or little finger

also found in 9 pairs, most in contrast with all TIMRP fingers; e.g., ISIOLO vs. GOSSIP in Figure 47, THIN-2 vs. PERSON, and CLEAN vs. BASI.

Table 7. *KSL minimal pairs for different sets of selected fingers (23 total pairs)*[81]
(TIMRP = thumb, index, middle, ring, pinky)

	TIMRP 	I 	IM 	IMR, MRP 	P 	T 
 I	6					
 IM	0	1				
 IMR, MRP	4	2	1			
 P	6	0	1	2		
 T	0	0	0	0	0	
Total pairs per sel.fing.:	16 TIMRP	9 I	3 IM	9 IMR, MRP	9 P	0 T

[81] Note: the combined totals in the last row are 46, but this is halved to count each selected finger type only once per pair; otherwise they would be double-counted.

These results show that different specifications for selected fingers are unquestionably contrastive in KSL. Further, the distribution of contrast lends support to one of the crucial ideas of the One-All framework, which is that the primary division in selected fingers is between all fingers and only one finger. In KSL minimal pairs, the most pairs occur between all fingers and the index finger (6 pairs) and all fingers and the pinky finger (6 pairs).

Figure 48. Minimal pair for selected fingers: a. GOSSIP (*flat* handshape; TIMRP fingers), b. TOMORROW (*1* handshape; I finger)

a.
b.


Figure 49. Minimal pair for selected fingers: a. IF-1 (*F* handshape; MRP fingers), b. RUN-1 (*1* handshape; I finger)

a. b.

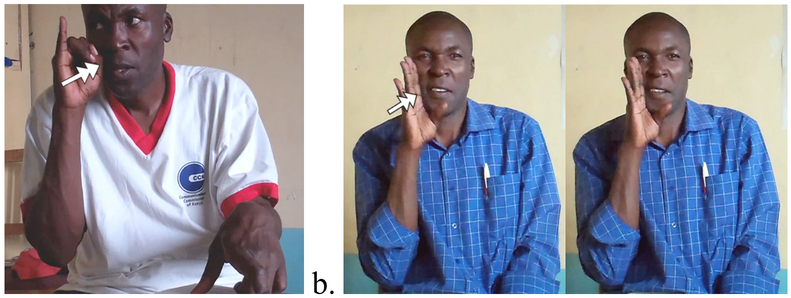


Figure 50. Minimal pair for selected fingers: a. ISIOLO-1 (*i* handshape; I fingers), b. GOSSIP (*flat* handshape; TIMRP fingers)

This data shows that *selected fingers* can be the basis of contrast in KSL. Turning next to features that encode the position of the finger joints, the results are quite different.

4.2.4 Minimal contrast for *joint position/finger configuration*

For joint position, the same method was used for selected fingers; i.e., cross-checking the possible minimal contrasts for handshape features against the attested handshape minimal pairs in KSL. The results in Table 8 shows that out of the 71 phonetic handshapes, there are 34 pairings of handshapes that differ by only one joint position feature specification (for visual representations of these handshapes, see Appendix 3). Of these possible pairings, only three handshape are found in attested minimal pairs, accounting for six minimal pairs: *open-spray* vs. *claw* (one minimal pair), *open-E* vs. *fist* (one minimal pair), and *flat* vs. *fist* (four minimal pairs).

However, five of these pairs contrast with a *fist* handshape. Because there is ambiguity regarding the selected fingers specification in the *fist* handshape, this poses a problem for determining minimal pair status. The issue is that when the *fist* handshape occurs in signs with handshape changes (e.g. *fist*>*1* in UNDERSTAND in ASL & KSL), it appears to have no status for selected fingers. That is, it can appear as either the beginning or ending handshape in a contour sign (see §6.4.3) where the other handshape can have any set of selected fingers. For this reason, van der Kooij proposes that *fist* in signs with both static and dynamic handshapes have a "headless representation" for selected fingers—essentially a null value (2002: 91).

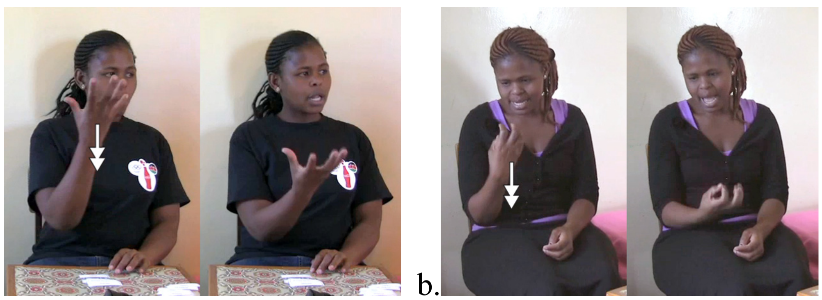
If this analysis is correct, then the *fist* shapes in Table 7 have two feature differences (joint position and selected fingers), not one, and are therefore not truly minimal. Note that signs with *fist* handshapes were also not considered in Figure 48 above for the same reason.

Table 8. *KSL minimal pairs for different joint positions (34 possible contrasts)*

Sign 1 handshape	**Sign 2 handshape**	**Joint difference (sorted)**	**# Min. pairs**
open-spray	claw	bent vs. hooked	**1**
1-bent	X	bent vs. hooked	0
fist	bent	closed vs. bent	0
open-E	bent	curved vs. bent	0
O	bent-thumb	curved vs. bent	0
1-curved	1-bent	curved vs. bent	0
open-E	fist	curved vs. closed	**1***
O	flat-O	curved vs. curved	0
C	E	curved vs. hooked	0
open-curved	claw	curved vs. hooked	0
1-curved	X	curved vs. hooked	0
flat	bent	extended vs. bent	0
open	open-spray	extended vs. bent	0
1	1-bent	extended vs. bent	0
open-G	G	extended vs. bent	0
H	N-straight	extended vs. bent	0
flat	fist	extended vs. closed	**4***
B	S	extended vs. closed	0
flat	curved	extended vs. curved	0
flat	open-E	extended vs. curved	0
flat-thumb	C	extended vs. curved	0
open	open-curved	extended vs. curved	0
1	1-curved	extended vs. curved	0
flat-thumb	E	extended vs. hooked	0
B	E	extended vs. hooked	0
open	claw	extended vs. hooked	0
1	X	extended vs. hooked	0
L	bent-L	extended vs. hooked	0
open-G	small-C	extended vs. hooked	0
I	bent-i	extended vs. hooked	0
H	bent-H	extended vs. hooked	0
V	bent-V	extended vs. hooked	0
W	bent-W	extended vs. hooked	0
small-C	G	hooked vs. bent	0

** These signs contrast with a 'fist' handshape, which is indeterminate for selected fingers*

This leaves one minimal pair for joint position in the KSL Lexical Database, contrasting ‘bent’ and ‘hooked’ joints. In Figure 51, the sign BOWL-2 has the handshape with all fingers and the thumb selected, the digits are all spread, and the joint flexion is at the metacarpal joints at the base of the fingers only; i.e., ‘bent’. In MANDAZI-2 (a fried dough bread), the handshape specifications are the same except for the joint position, in which the more distal knuckles are flexed; i.e., ‘hooked’.[82]



a. b.

Figure 51. Minimal pair for joint position: a. BOWL-2 (*open-spray* handshape; ‘bent’ joints), b. MANDAZI-2 (*claw* handshape; ‘hooked’ joints)

There is one other close near-minimal pair that bears mentioning in order to illustrate what does and doesn’t count as contrastive. In BANK-2 and KEEP/STORE, shown in Figure 52, both signs have the same location, primary path movement, and all the same handshape features except flexion of the fingers—i.e., the fingers in BANK-2 are extended and unflexed while the fingers in KEEP/STORE are curved. However, there are two secondary, but consistent differences: (i) all lexical variants of ‘bank’ are accompanied (in several tokens across signers) by the exaggerated mouthing “bay”, from English “bank”; and (ii) BANK-2 has a slight wrist nod that makes it look like the hands are closing on a hinge, whereas in KEEP/STORE there is no movement

[82] Note that the thumb is not touching the fingers in MANDAZI-2; the camera angle in the final position of the still picture is somewhat ambiguous, but it is clearer in the video.

in the wrist. Thus, one cannot say with certainty if finger flexion alone is the sole contrast in these two signs.[83]

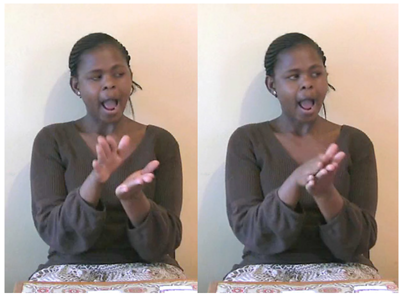
a.  b. 

Figure 52. Potential minimal pairs for joint position: a. BANK-2 (*flat* handshape; 'extended' joints), b. KEEP/STORE (*curved* handshape; 'curved' joints)[84]

It is striking that out of the 34 possible contrasts listed in Table 8, only one minimal pair is found, especially because joint position is so firmly established in theoretical models of sign structure as a feature of handshape, and is so clearly the basis for phonetic differences between handshapes. Is it possible to use only one minimal pair to argue for joint position features being a contrastive feature type in KSL? I will return to this question after the other handshape features are evaluated.

4.2.5 Minimal contrast for finger *spreading* and *crossing*

A third handshape feature in all models encodes whether the fingers are spread or not. In addition, I include the feature [crossing] here because it could be considered related to the distance between fingers; i.e., in crossed handshapes, the fingers overlay each other, in effect having the least amount of distance (e.g., 'R'). I found nine pairs of handshapes in KSL that could conceivably contrast for this feature. However, as shown in Table 9, none of them were found in minimal pairs.

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[83] Another pair was too questionable to include here, but warrants follow-up: a variant of TO-RETIRE with *open-spray* and TO-HAVE with a *claw*. However, they may also differ by movement and/or mouthing.

[84] The primary movement is a repeated, unidirectional straight path ending on the palm-side of the non-dominant hand. Arrows were not added in order to preserve visibility of hands.

Table 9. *KSL minimal pairs for finger spreading*

Sign 1 handshape	Sign 2 handshape	# Min. pairs
 flat	 open	0
 B	 four	0
 H	 V	0
 H	 R	0
 V	 R	0
 H-thumb	 V-L	0
 C	 claw	0
 flat-thumb	 spray	0

Is this lack of contrast in finger spreading specific to KSL? Some evidence suggests that it may be a more general characteristic of sign phonologies. In §4.6.1, I will discuss the evidence for contrast on the basis of finger spreading in other sign languages, via an investigation of whether the handshapes *flat* and *open* are distinctive in KSL. Next, I turn to the last two types of handshape features.

4.2.6 Minimal contrast for *thumb features*

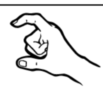
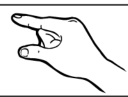
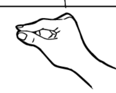
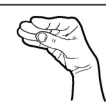
The remaining handshape features are related to the thumb. These include the position of the thumb and whether or not it contacts the selected fingers. The position of the thumb can vary, in descriptive terms, based on whether the thumb is in one of three positions: opposed (perpendicular to the plane of the palm), upright (parallel to other extended fingers), or outward/radial (extended in an 'L' shape, in the same plane as the palm). The five possible pairs in KSL are shown in Table 10, and no minimal pairs are found that contrast solely on the position of the thumb.

Table 10. *KSL minimal pairs for thumb position*

Sign 1 handshape		Sign 2 handshape		# Min. pairs
	flat		flat-thumb	0
	flat		B	0
	B		flat-thumb	0
	fist		A-thumb	0
	open-G		L	0

The other handshape feature related to the thumb is based on the thumb's contact with other selected fingers. Most models indicate this through two features, [close] and [open], though Brentari encodes this somewhat differently by using the feature [flexed]. In her model, a 'C' handshape without thumb contact and an 'O' handshape with thumb contact both have joint flexion at the base and non-base knuckles (reflected in the presence of both branches of the "joints" node; see Appendix 2), but 'O' adds an additional [flexed] feature, while 'C' does not. Table 11 shows those phonetic KSL handshapes that differ only on the basis of whether the thumb contacts the selected fingers, and shows that there are no minimal pairs that differ solely by thumb contact.

Table 11. *KSL minimal pairs for thumb contact*

Sign 1 handshape	Sign 2 handshape	# Min. pairs
 C	 O	0
 small-C	 baby-o	0
 small-C	 T	0
 G	 closed-G	0
 flat-thumb	 bent-thumb	0
 spray	 flat-o	0
 claw	 closed-claw	0

4.2.7 Handshape features in KSL: summary and future directions

This investigation of contrast in types of handshape features yields an unexpected result. Not all handshape features proposed in previous models are contrastive in KSL—or at least not all to the same degree—and most are not contrastive at all. In particular, minimal pair contrasts for selected fingers are categorically different than contrasts in the other handshape features. *Selected fingers* account for around 15% of all handshape minimal pairs found in the lexicon, so they are relatively well represented. In addition, all different types of selected fingers contrasts are attested. By comparison, only one minimal pair was found for any of the 33 potential pairs for *joint position* differences, and no minimal pairs were found for the combined 20 potential pairs for *finger spreading*, *thumb position*, and *thumb contact*.

Of immediate consequence for the present phonological grammar is what this data says about the decomposability of handshape in KSL and what counts as the basic phonological unit in the language. While handshape is at least partly decomposable by selected finger features, there is no evidence from minimal pairs that finger spreading or thumb features are referenced by the phonology, and only very limited evidence for joint flexion. The most conservative conclusion, therefore, is that the most complete basic unit in the phonology of KSL is the *whole handshape*.

This has consequences for how the data should be presented. Previous analyses have presented handshape data by feature types (van der Kooij 2002), but here I provide an elaborated inventory of whole KSL handshapes, in Appendix 3, which is discussed further in §4.5. In this way, I follow Friedman (1976) and Crasborn et al. (2002) in determining that although it is possible for phonologists to categorize handshapes by features, the evidence for these featural categories is not yet sufficiently supported by the phonological evidence.

Given a lack of minimal pairs between otherwise formationally similar handshapes, one reasonable possibility could be that the two shapes are allophones of the same underlying phoneme. I will evaluate this hypothesis in §4.6 using two handshape pairs that only differ by one feature, but are not contrastive in minimal pairs, and are also relatively frequent in the lexicon: *flat* and *open*, differing by finger spreading; and *flat* and *bent*, differing by joint position/flexion.

A second explanation for the lack of handshape feature minimal pairs is suggested here as a hypothesis to be tested in the future: does the phonology of KSL, and possibly other sign languages, avoid minimal contrasts based solely on a single feature (other than selected fingers) for reasons of perceptual confusability or articulatory constraints? That is, given the fact that minimal pairs must also be matched on all location, movement, orientation, and handedness[85]

[85] Handedness is the number of hands in the sign.

features, are the four non-contrastive categories of handshape features simply too fine to be maintained as minimal pairs in an idiolectal phonology (recalling that this thesis only considers minimal pairs from the same signer)? If this is the case, then the avoidance itself may indirectly point to the relevance of features in the grammar, since signers should be able to "compute" similarity on the basis of some kind of formational material.

To summarize, given the data available, I find that handshape is only partly decomposable in KSL, and that an analysis treating handshapes as permutations of fully phonologically specified features is not supported. The basic phonological unit in KSL is therefore assumed here to be the whole handshape.

Now that I have addressed the organization of features below the level of the whole handshape in KSL, I turn to the specific handshapes that are found in the lexicon, beginning with an overview of the 71 phonetic handshapes in §4.3. This is followed by a phonemic analysis in §4.4 that takes into account minimal pairs, phonetic regularities that produce allophones, and foreign sources of handshapes in the lexicon. Based on this analysis, I present the partially-phonemicized inventory of 44 KSL handshapes in §4.5 and then turn to the two test-case handshape pairs (*flat* vs. *open*; *flat* vs. *bent*) to explore whether, in the absence of minimal pairs and predictable allophones, multiple sources of data can be marshaled to conclusively determine the phonemic status of formationally similar handshapes.

4.3 Phonetic handshapes in KSL

As described in the Methodology (Chapter 2), the coding of phonetic forms in the database involved periodically revisiting coding categories—in this case, handshape names—which progressively refined the handshapes into formationally consistent categories. The result is 71 phonetic handshapes in the KSL Lexical Database for 1,562 signs representing static (unchanging) handshapes found on the dominant hand. For a visual representation of most of these signs, see Figure 71. Note that this count does not include: (i) 295 dynamic signs with a handshape change (see §6.4.3); (ii) two signs with mouth movement only and no manual component (CHEW-2, PIPE-2); (iii) four signs that are sequences of two fingerspelled letters; (iv) three signs in which signers vary the handshape (HYENA, EMBROIDERY, CHIPS)[86]; (v) two disyllabic signs with different handshapes in each syllable (MEMORY, UGALI-2); and (vi) two signs whose handshapes I could not categorize phonetically but are addressed in the analysis (PASSIONFRUIT, OLD-1).

The distribution of these phonetic handshapes in the lexicon is presented in Figure 53, sorted by their frequency in the lexicon. This distribution of phonetic handshapes conforms to the pattern found in other sign languages; that is, it closely approximates an exponential decay curve (Rozelle 2003), with the most frequent handshape being far more frequent than the next most common handshape, which is again far more frequent than the next one, and so on for a small cluster of the most frequent shapes. Then the frequencies gradually decrease, having a "long tail", with a large number of handshapes occurring in only a very few signs. For example, in this KSL data, 30 out of 71 phonetic handshapes appear in six or fewer words.

---

[86] Normally, these phonological variants would be split into different records because they had categorically different handshapes, or removed from consideration because no two signers had the same articulation (see Methodology, Chapter 2). However, these three signs were kept in pool of those considered for the phonological analysis because (i) other than handshape, they were identical, (ii) the handshapes appear to be categorically different; and (iii) they were related to other signs in similar lexical semantic categories (animals, clothing, food), illuminating phonological processes of word formation and expanding the possibility of finding minimal pairs for the same signer.

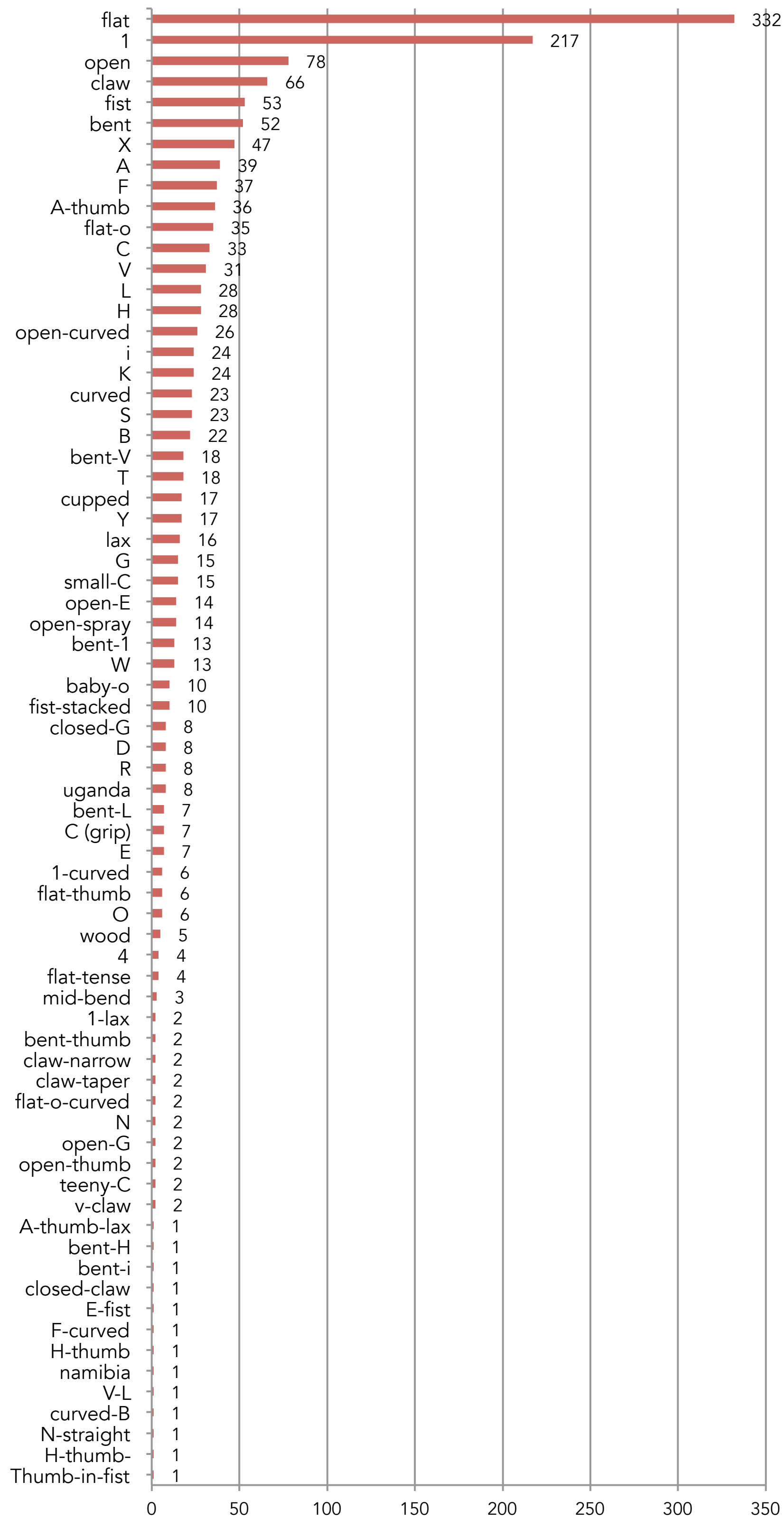


Figure 53. 71 phonetic KSL handshapes in 1,564 signs

Another similarity with other sign languages is the specific phonetic handshapes that are most frequent. As reported by Rozelle (2003), in ASL, Korean SL, New Zealand SL, and Finnish SL, *flat* and *1* are also the most frequent handshapes in the lexicon, followed by *open* in all but Korean SL, and then *fist*. Kenyan Sign Language stands out as somewhat unique in its relative frequency of the *claw* handshape, which is 4^{th} in KSL, but 7^{th} in NZSL, 8^{th} in Finnish SL, 13^{th} in Korean SL, and16^{th} in ASL.

Given this large set of phonetic handshapes, the question arises: are some of these handshapes modified forms of another handshape? That is, are some of these phonetic handshapes allophonic forms of an underlying phoneme whose surface form arises in a specific environment? This is addressed in the next section.

4.4 Phonemic analysis of handshape

In the approach to the phonological analysis outlined in Chapter 3, I explained that this thesis uses minimal pairs as the primary evidence for determining whether a feature/prime is distinctive in the language. Yet it is clear by now that minimal pairs alone will not suffice in determining whether all of the 71 phonetic handshapes are allophones of another handshape. This is because minimal pairs do not occur for the most highly similar handshapes—those differing by only one feature (except selected fingers)—and yet allophones are most likely to be found among primes (whether sounds, handshapes, locations, etc.) that are the closest in form. Thus, while minimal pairs are relied on to a great degree as primary evidence in this thesis, the analysis of handshape requires additional secondary evidence.

This secondary evidence is pursued by the following four questions. **First**, is there a conditioning environment that can account for the handshape? I.e., does the handshape in question only appear in predictable articulatory circumstances? If so, it occurs in complementary distribution and may be considered an allophonic variant of another shape. **Second**, is there free variation in handshape *between signers* and *within the same signer* (for the same sign)? In other words, is a sign produced with both handshapes in the video data without a change in meaning? If so, the variants are likely to be allophones. **Third**, are there signs produced by one handshape that would appear meaningfully wrong if produced with the other handshape? That is, can the handshapes be substituted for each other or not? If they cannot, this suggests that they are more likely to be separate phonemes. And **fourth**, are there morpho-semantic factors motivating the surface form? In particular, is the form of the handshape connected to its identity as a number, fingerspelled letter, or another recognizable symbol? If so, I take this as evidence that it should be considered as a separate phoneme. Note that if the handshape is only used in the motivated capacity (e.g., in an initialized sign or in numeral incorporation) in the lexicon, then it should be considered as a non-core element in the phonological system of KSL. All diagnostics for the phonemic analysis are listed in 4.

(4) *Diagnostics for determining the phonemic status of handshapes*

a. **Minimal pair**: if a minimal pair exits, the handshapes belong to separate phonemes
b. **Predictable environment**: if predictable environments can be found, they are likely allophones
c. **Variation**: if variation is found within the same sign, they are likely allophones
d. **Substitutability**: if they are substitutable, they are likely allophones
e. **Motivated symbols**: if the form is determined by its membership in a symbolic sub-system (letters, numbers), then it is a likely phoneme

Given these several types of evidence, it should be possible to identify the phonemic inventory of KSL. Yet not all diagnostics could be satisfactorily pursued in this study. In particular, substitutability tests were not performed beyond the initial elicitation sessions; i.e., in the later stages of analysis. Also, it is likely that more refined examinations of predictable environments—such as with a larger natural language corpus of KSL—as well as a more advanced understanding of processes in sign phonetics in general (still a very young field) would all contribute to a more accurate view of KSL phonology. In this grammar, therefore, some handshapes remain ambiguous as to their status. In some cases, there is contradictory evidence and no way to adjudicate between possible phonemes. I will return to this issue in §4.6 when comparing the relationship between two formationally similar handshape pairs.

The next sub-sections present the results of applying these diagnostics, beginning with the results of the minimal pair data in §4.4.1, followed by a description of three different allophonic environments in §4.4.2, and ending with a description of the types of motivated symbols found in KSL handshapes in §4.4.3.

4.4.1 Minimal pairs for handshape

150 handshape minimal pairs were found in the lexical database, out of 461 total minimal pairs (from a dataset of 1,1880 signs). As shown in Figure 54, 38 out of the 71 phonetic handshapes (Fig. 53) occur in a minimal pair. Note that the handshapes listed here are those in the final inventory, reflecting conclusions about allophones that are presented in the next section and all other diagnostics.

It was also found that the more frequent a handshape is, the more likely it is to be found in a minimal pair, which was also reported in the previous chapter. This can be seen from the distribution of handshapes above in Figure 54, which are listed in order of most to least frequent in the whole lexicon. Yet it can also be seen in Figure 55, which plots the number of minimal pairs by the frequency of that handshape in the lexicon.

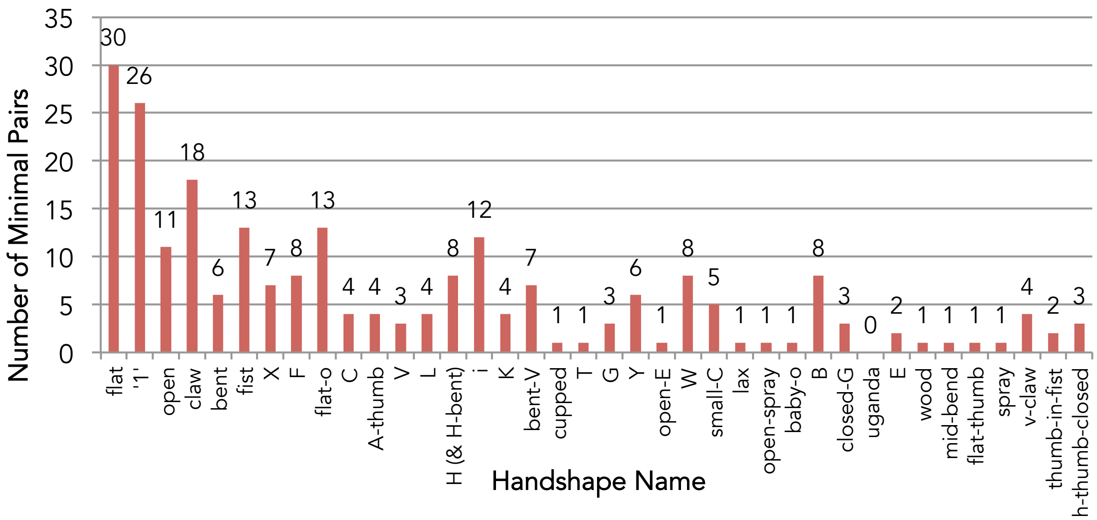


Figure 54. 38 KSL handshapes found in 150 minimal pairs; with the number of pairs for each handshape, shown in descending order by frequency in the full lexicon (see Fig. 53)

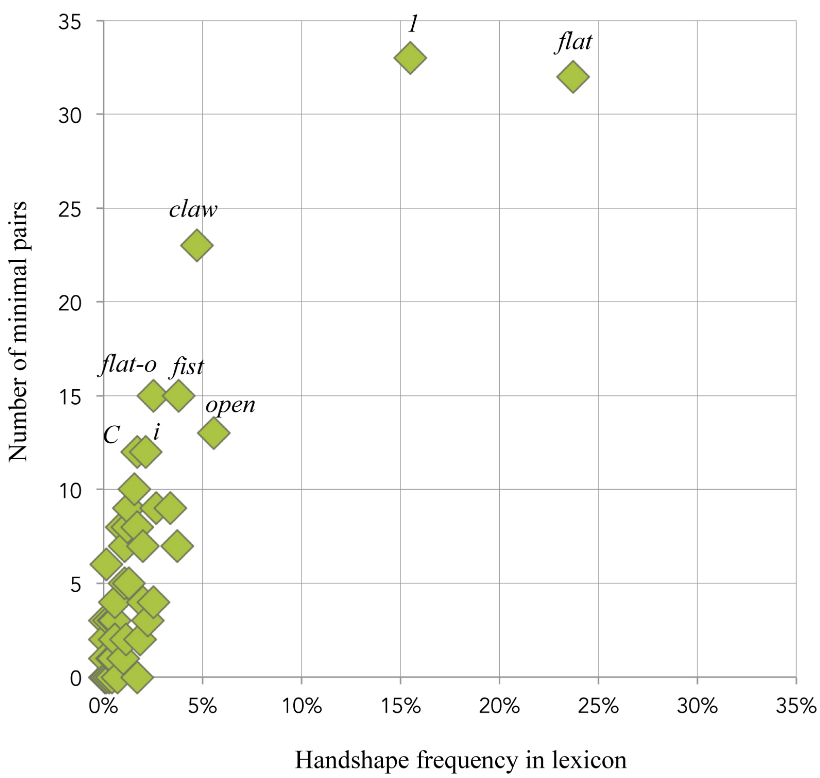


Figure 55. Relationship of handshape frequency in lexicon to number of minimal pairs

Thus, minimal pairs can account for a portion of the phonetic handshapes, but allophonic variants are needed to explain more of the handshape data.

4.4.2 Allophonic variation in KSL handshapes

Allophonic variation of handshape is driven by changes to handshapes for reasons related to modification of the hand in response to contacting the body and ease of articulation. Three types of changes observed in the KSL lexicon are described here: (1) changing the position of the thumb to avoid contact with the body or the non-dominant hand, (2) flexion of the fingers around body parts during contact in a sign, and (3) changing the aperture size of the fingers and thumb to accommodate the size of a phonemic body location. Each of these three types are addressed in turn.

4.4.2.1 Thumb position conditioned by contact with body

The first type of allophony is when the position of the thumb changes as a result of the hand contacting the body (including non-dominant hand). This generalization applies across all handshapes, but is especially common in two handshape clusters: in allophones of *fist* allophones and allophones of *flat*.

In the case of *A* () and *S* (), the only difference between the handshapes is the position of the thumb; in *A* it remains upright and in line with the other fingers, while in *S* the thumb crosses the closed fingers. The non-distinctiveness of these two handshapes has been proposed in many other sign languages, but is less straightforward in those languages that license each shape as a fingerspelled letter and incorporate that letter into initialized signs. For example, *A* and *S* appear to be contrastive in ASL with such minimal pairs as SOCIETY and ASSOCIATION. In Kenyan Sign Language, however, the case for allophony is much clearer. Even though these handshapes appear in the fingerspelling alphabet, the letter ‘S’ is produced with an added s-shaped movement, while ‘A’ is stationary.[87] In addition to the lack of minimal pairs for thumb position discussed in §4.2.6, the movement added to the letter ‘S’ is more evidence that thumb

[87] This is true for most signers in the south Nyanza region. It remains to be seen whether this holds as a strong tendency in other parts of Kenya.

position alone is not distinctive in KSL; i.e., it alone cannot indicate a difference in meaning, even for fingerspelled letters. And crucially, the occurrence of each handshape is also highly predictable based on articulatory conditions. That is, when the *fist* hand makes contact with the body or non-dominant hand on the palm-side, the handshape appears as *A* with thumb adjacent to the other fingers, as in RWANDA and FRIDAY (Figure 56). When the *fist* hand makes contact on the radial/thumb side of the hand, the handshape is *S* with thumb crossing the fingers, as in WORK and STUPID (Figure 57).

a.
b.


Figure 56. Signs with the *A* allophone of *fist*: a. RWANDA, b. FRIDAY

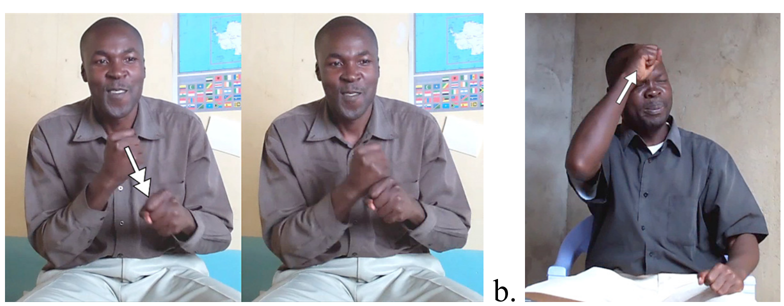
a.
b.


Figure 57. Signs with the *S* allophone of *fist*: a. WORK, b. STUPID-1

Another piece of evidence is the variation found between the *A* and *S* allophones outside of the conditioning environment. I.e., it is relatively free, such that either handshape can appear when no contact occurs. An example of this variability is found in one token of the sign for BOSS-1, shown in Figure 58a; in this instance, the *A* shape appears on one hand and the *S* shape on the other. Or the *fist* handshape can be somewhat intermediate between *A* and *S*, as in the token for WANDER-2 in Figure 58b.

a. b.

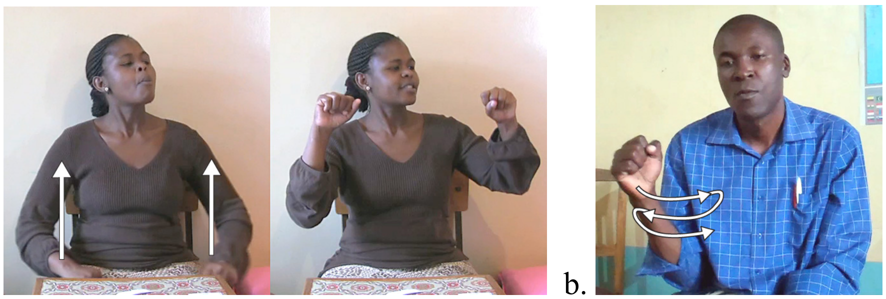


Figure 58. Variation between *A* and *S*: a. different thumb position on each hand in BOSS-1, b. *fist* handshape intermediate between *A* and *S* in WANDER-2

This same generalization is found for the *flat* handshape and its associated allophone, *B*. Consider the two signs in Figure 59. When the flat hand moves horizontally, but makes no contact in LAND-1 (Fig. 59a), the thumb is extended with the other fingers. In contrast, when the radial/thumb side of the hand comes into contact with the body in TO-CLOSE (Fig. 59b), the thumb moves into an opposed position so that the full radial side of the hand can make contact. This is a general rule in all *flat* handshapes that contact the body; e.g., GOSSIP, ENOUGH, MANGO-1, NYANG'OMA-PRIMARY-SCHOOL, etc.

While this generalization holds across all handshapes, it rarely has the opportunity to apply beyond *fist* and *flat* because few other handshapes are eligible in the same way. This is because the thumb in most other handshapes is already in either an opposed or in a crossing/restraining position, or it must be extended outward. If a handshape has a thumb that must be extended outward (e.g., *open, A-thumb*, *L, Y*) and contact is on the radial side of the hand, then contact is at the thumb tip, with no change in thumb position; e.g., COW, PEOPLE, SUNDAY, TO-LIE-1, PROUD-1, PROUD-2 [Fig. 42], BOSS-3, etc.

a. b.

Figure 59. Allophones of *flat*: a. basic *flat* phoneme in LAND-1, b. *B* allophone in TO-CLOSE

4.4.2.2 Finger flexion conditioned by contact with curved body part

The second generalization is that when the hand or fingers contact a curved body surface, the dominant hand will tend to curve to fit the shape of the surface. Thus, the handshape *flat* will become *curved* or *cupped* if the palm contacts a rounded surface; e.g., the top of the head (e.g., POLITE [Fig. 60b], MONDAY), or lower arm (e.g., BAD-1, BABY-3), or neck (MURANG'A, a deaf school), or non-dominant hand (GOOD, ENGLISH-3, CARE-1). If it contacts a flat surface like the torso (Fig. 60a) or appears in neutral space, it occur with a flat shape. Other evidence is that in individual sign tokens, the hand can sometimes be seen beginning in a less curved position than when it contacts the body, as shown in Figure 60b POLITE, 61a CHAIR, and 61b MARRY. Thus, many handshapes that were coded phonetically as *cupped* or *curved* in the database, can be considered as *flat* handshapes underlyingly under these articulatory conditions.

a.  b. 

Figure 60. Allophones of *flat*: a. contact with flat surface of the upper torso in FRIEND, b. contact with curved surface of head in POLITE

The same generalization holds for individual fingers. When the palm/interior side of an extended index finger or index+middle fingers or pinky finger contact individual fingers on the non-dominant hand, the fingers can curve or curl, as in MATHEMATICS-1, CHAIR (Fig. 61a), and MARRY (Fig. 61b). Based on this, the handshapes *bent-H* and *bent-i* are classified as the underlying phonemes *H* and *i*, respectively.

a.  b. 

Figure 61. Fingers on the dominant hand curl around fingers on non-dominant hand during contact: a. CHAIR, b. MARRY (this token from 2nd sign in compound for HUSBAND),

It should be noted that unlike the thumb position allophones described in in the previous section, this tendency of the hand to curve around the body is not applied as extensively; un-flexed allophones can sometimes be found in different tokens (e.g., a token of CHAIR by another signer has an *H* handshape).

Also, not all curving under these contact conditions is phonetic. A few signs with curved shapes that make contact on the palm/internal side of the hand appear to be underlyingly flexed. One indication of this is that the shapes that are specified for flexion have an initial shape prior to contact (in a "preparation" stage, to borrow a term from gesture studies) that is already flexed; e.g., TO-TOW and I.C.C.-3[88] (Fig. 62a) with an *X* handshape, and COACH with a *C* handshape (Fig. 62b). Another clue to the status of these potential allophones is whether the sign could be produced with an uncurved handshape and still be acceptable. In cases like I.C.C.-3 and COACH they would not be, while CHAIR, MARRY, and signs such as MONDAY, GOOD, and MURANG'A would be (and uncurved tokens for those signs are found in the video data and other sources of KSL signs[89]).

a.

b.

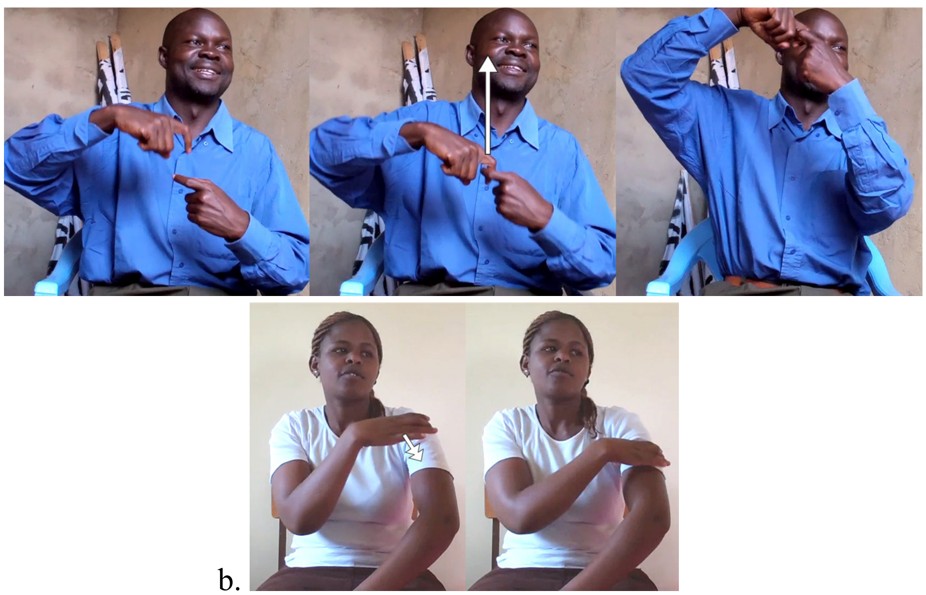


Figure 62. Signs whose handshapes are specified underlyingly for joint flexion: I.C.C.-3, showing *X* handshape formed prior to movement, b. COACH with *C* handshape

4.4.2.3 Aperture variation based on size of phonemic location

A third phonetic regularity is a change in aperture to fit the phonemic location that the fingers makes contact with. This applies to those handshapes with a thumb that is in an opposed position, but does not make contact with the fingers, creating a space—an aperture—between the

[88] One of several signs for the International Criminal Court. When this data was collected, officials in the Kenyan government were still under investigation by the ICC for election violence (in 2007), making the I.C.C. a current topic of discussion.

[89] E.g., MONDAY in *http://www.kslop.co.ke*

thumb and fingers. There are 11 phonetic handshapes that fit these criteria, though two of these never appear in signs in which the fingertips contact a body location—i.e., *C* and *open-thumb*—and three others can contact the body with fingertips, but don't appear to change aperture in relation to the bodypart contacted—i.e., *G*, *open-G*, and *wood* (see next section for motivations for aperture size in these signs) This leaves six phonetic handshapes, which fall into three phonemic clusters.

Before explaining how these allophones manifest, it is necessary to describe an interaction between properties of handshape and location that emerged during the investigation of phonemic locations (see Chapter 5, *Location*). It was discovered that a phonemic location could be discerned by noting which parts of the hand made contact on the body, and that this varied by the type of handshape. For example, a *flat* handshape will make full hand contact on the palm-side for a large location (like the head in POLITE [Fig. 60b] or torso in FRIEND [Fig. 60a]), but will contact only the interior of the fingers for a smaller location (e.g., temple in AWARE [Appendix 9, #4 *forehead*]), and only the finger pads for a particularly small location (e.g., chin in LUHYA). Handshapes that make contact only with the fingertips (e.g., *1*, *i*) will tend to contact roughly the center of a phonemic location. For the handshapes discussed in this section, the generalization is that the aperture widens to cover a large area and narrows for a smaller area.

In the cluster including *claw* and *claw-narrow*, this change in aperture can be seen as along a continuum, even for handshapes originally coded as *claw*. For example, the LAMU on the head and MBITA on the cheek (Fig. 63) were both coded with a *claw* handshape, but the difference in aperture size is discernably different. At the smallest end of the spectrum, WILLIAM-RUTO was coded as *claw-narrow* and makes contact with just the tip of the nose.

Given these predictable conditions and the otherwise identical specifications, it can be determined that these handshapes belong to one underlying handshape, *claw* ([illegible]).

a.  b. 

c. 

Figure 63. Aperture of *claw* handshape changing to the size of location being contacted: a. LAMU (town) b. MBITA (town), c. WILLIAM-RUTO (Kenyan vice-president)

The predictability of these apertures for *claw* parallel those in the other handshapes. The second group of handshapes is *small-C* and *teeny-C*, again differing by distance between the thumb and fingers—in this case, the index finger. In most signs with this handshape, there seems to be a default of around two inches between the thumb and index finger, which is found on most of *small-C* handshapes with no finger contact on the body, as in ADD-3 and MOON. (Fig. 64)

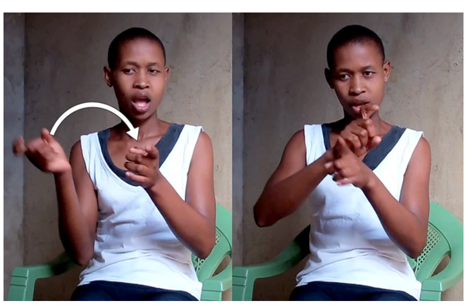
a.  b. 

Figure 64. Default aperture for *small-C* with no finger contact: a. ADD-3, a. MOON

When contacting the body, the aperture can appear as the default size when matching a similar size on the body, like the chin in LUO-1 (Fig. 65a), or narrow to the size of a smaller location, as in the upper lip in TANZANIA-1 (Fig. 65b) and DICTIONARY-2, or widen to a larger location, as in the side-of-the-head[90] in EXPENSIVE-3 (Fig. 65c). Thus, all of these are allophonic variations on the same *small-C* ( ). handshape.


a. b. c.

Figure 65. Aperture of *small-C* handshape changing to the size of location being contacted: a. LUO-1 (ethno-linguistic group), b. TANZANIA-1, c. EXPENSIVE-3

The third cluster includes *spray* and *open-spray*. Both handshapes have all fingers selected and spread, with the thumb in an opposed position, and bending at the base joints only. They differ in the size of the aperture, with *spray* having a smaller aperture than *open-spray*. The distribution of these two shapes is slightly different than the other two clusters because they occur in near-complementary distribution. That is, *spray* is found only in dynamic handshapes while *open-spray* is primarily found in static handshapes only (i.e., those that do not change shape during the sign). These predictable environments also provide evidence of their allophony, in addition to their aperture differences based on phonemic location.

First, in the signs with dynamic handshapes, the aperture of *spray* depends on the location it is associated with. In NILE-PERCH-2 (Fig. 66a), the location is the entire face and has a larger

[90] The side of the head is a distinct phonemic location in KSL; see discussion in Chapter 5, §5.7.2.

aperture than SULLEN/SULKY[91] (Fig. 66b) with only a mouth location; while WEIRD on the temple (Fig. 66c), has a similar aperture to SULLEN/SULKY.

a. b. c.

Figure 66. Aperture of *spray* handshape in signs with dynamic handshapes: a. NILE-PERCH-2 (large fish in Lake Victoria), b. SULLEN/SULKY, c. WEIRD

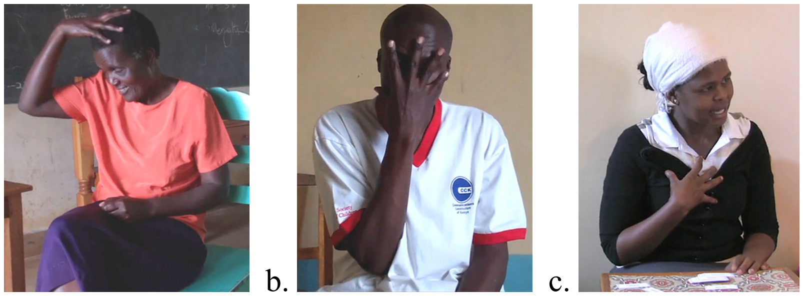
In contrast with *spray*, all *open-spray* signs contacting the body have a wider aperture. Figure 67 shows the only two dynamic signs that were coded as having an *open-spray* handshape, CONFIDENT and SUCKLE-1; and both are on the chest, a relatively large location.

a. b.

b. **Figure 67.** Aperture of *open-spray* handshape in dynamic signs: a. CONFIDENT, b. SUCKLE-1 (movement arrows not shown to prevent obscuring handshapes)

[91] This is the best token of this sign captured on video. It is a near-minimal pair with NILE-PERCH-2, having a straight path instead of a curved path. Note that I created the gloss given here, SULLEN/SULKY, but further investigation into the lexical semantics of the sign is warranted.

The static open-spray handshapes that contact the body all occur on large areas, such as the top of the head (HAT), whole face (SHAME), and chest (RETIRE), in Figure 68.



a. b. c.

Figure 68. Aperture of *open-spray* handshape on the body: a. HAT, b. SHAME, b. RETIRE

For *claw* and *small-C*, the size of the location was the primary determinant of aperture size, but for *spray/open-spray* we encounter an additional factor, which is the modification of aperture in dynamic handshapes, which can either exaggerate or minimize differences in aperture, depending on the type of change. In the case of signs that begin with *spray* and close to *flat-o*, the aperture is probably somewhat reduced, which is probably why there aren't more *open-spray* handshapes in the dynamic signs. There would appear to be a case, then, for *open-spray* as the more common, "basic" phoneme, but there is no conclusive evidence, so for the sake of simplicity, I will call the phoneme *spray,* stipulating that it has allophones varying in aperture.

To conclude, section §4.4.2 has described three phonological processes in Kenyan Sign Language that result in allophonic handshape variants and are all tied to characteristics of handshapes in contact with the body: thumb position to accommodate contact on the radial side of the hand, finger flexion around the curvature of body parts, and changes in aperture to fit a phonemic location. These observations inform decisions about the inventory of KSL handshapes in §4.5 (and Appendix 3).

4.4.3 Sources of handshapes in the lexicon

One of the diagnostics for determining phonemic status is whether a handshape participates in a symbolic sub-system that will dictate its specific form—e.g., numbers, letters, or other symbols. The KSL Lexical Database contains signs from multiple origins, both indigenous to Kenya and borrowed from other sign languages. The Venn diagram in Figure 69 shows the origins of phonetic handshapes from five sources of signs: handshapes from signs in the core lexicon, from gestural emblems, manual numbers, fingerspelled letters, and borrowings from other sign languages.

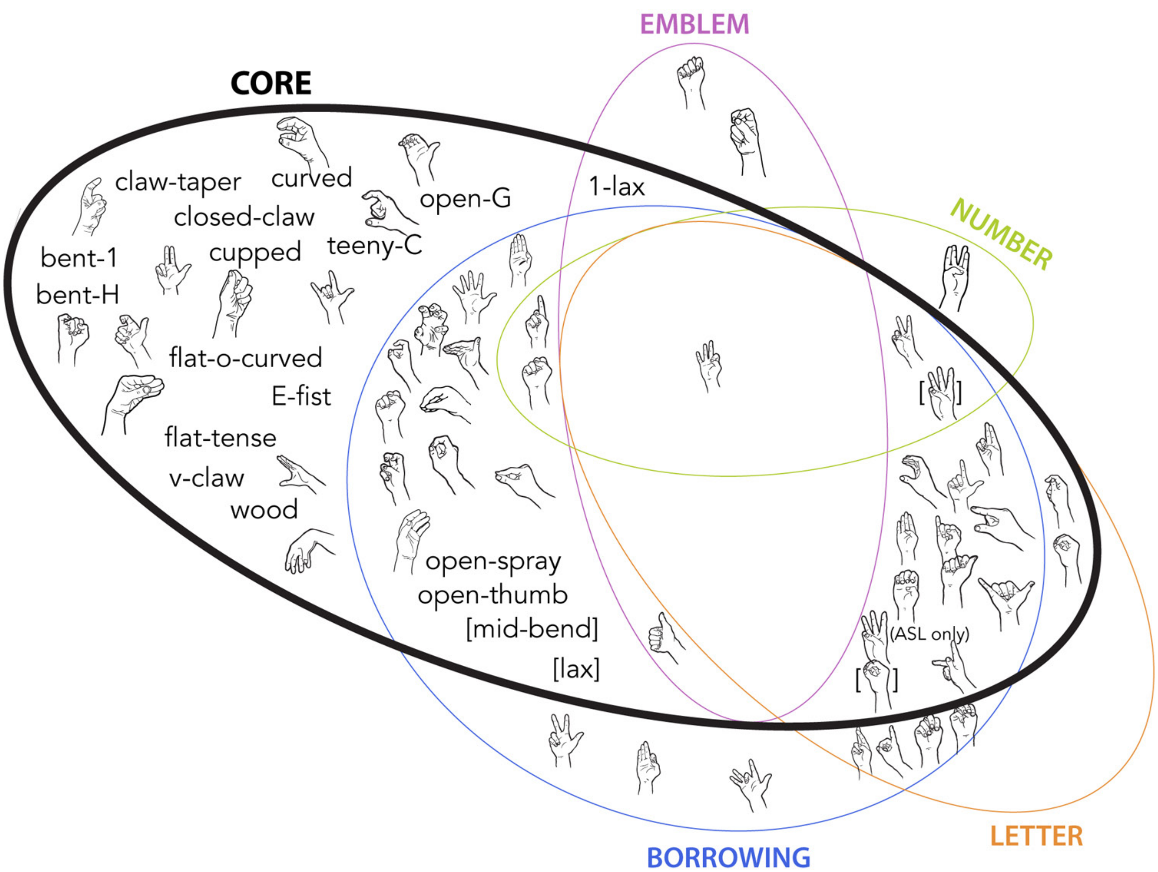


Figure 69. Venn diagram of handshape sources in KSL: core, borrowing from another sign language, fingerspelled letter, manual number, and gestural emblem

The **core** lexicon refers to signs of Kenyan or East African origin. Gestural **emblems** refer to "quotable gestures" used in the larger hearing community that have meanings that are easily translatable from their gestural forms. For example, in many—but not all—societies a ‘thumbs-up’ gesture (with an *A-thumb* handshape,) can be used to mean “good.” Handshapes from **numbers** come from the manual counting systems also used in the wider hearing community (Creider 1977). **Letters** originate from the fingerspelling alphabet (see Appendix 7). And finally, some KSL handshapes originate from signs that are **borrowed** from other sign languages. These borrowings were determined by comparisons with online and print dictionaries of multiple sign languages.

As shown in the Venn diagram in Figure 69, a few handshapes are only found in signs from only one origin. For example, the handshape V-L () is found only in the sign APPROVE, and probably originates from International Sign (though the sign languages of Italy and France also use this handshape). At the other extreme, one handshape is found in signs from all five origins: *F* (/). *F* appears in the core lexicon in signs such as MWAI-KIBAKI and PUMPKIN-LEAF. It occurs as a gestural emblem meaning “okay,” which is lexicalized in PERFECT-2 and in a compound sign meaning “handsome” (FACE^OKAY). *F* also has an origin in the manual numbering system in western Kenya; it denotes the number three and appears in signs with numeral incorporation; e.g., MARCH, AUGUST. In addition, the handshape represents the letter ‘f’ in the fingerspelling alphabet, and occurs in initialized signs such as FREE and FAMILY-2.[92] Finally, it occurs in borrowings from other sign languages, such as TO-INTERPRET and TO-JUDGE.

Some phonological analyses of handshapes have excluded those originating from the fingerspelled alphabet and manual numbering systems in their formal models (Sandler 1996b), or treated them as outside of regular phonological processes because they are semantically

[92] There are also a few signs with this handshape whose English translation begins with the letter ‘f’, but the handshape appears to have a different origin than the fingerspelled letter, or its origin is ambiguous; e.g., FASHION, FRESH.

motivated (van der Kooij 2002). In this description of KSL, letter and number handshapes are included in the analysis because they are considered part of the entire language system. They participate in word formation processes, thereby comprising a part of KSL morphology; and presumably whatever has a morphological component should have a form-based (phonological) exponent. In more functional terms, knowledge of KSL is incomplete without knowledge of those two sub-systems; and from a language processing view, a person communicating fluently in the language must be able to parse and interpret the fluid use of all forms of letters and numbers in discourse as well as be able to produce them. Finally, they participate in minimal pairs (with both core and motivated handshapes) and are therefore crucial to the present phonological analysis.

At the same time, handshapes that carry letters and numbers may operate somewhat differently in the lexicon, such as allowing greater complexity than would typically be allowed in elements from the "core lexicon" (Brentari & Padden 2001; Morgan 2013). They also carry meaning that is arguably morphological (Lepic 2015). Therefore, when a handshape represents a letter or number in a sign, I take this as evidence for independent phonemic status. I.e., its motivation requires that the handshape conforms to a specific form.

Another type of motivated form should also be mentioned here: handshapes that have an iconic origin. These handshapes, usually called **classifiers** in the literature (Emmorey 2003), refer to the shape of the hand while interacting with imaginary objects: holding or gripping objects, tracing either the outline or the three-dimensional surface of objects, and indicating the size and/or shape of an object. Like all other sign languages, KSL has an inventory of handshapes that are recruited for these semantic purposes; these are shown in Appendix 6. In other languages, these handshapes have been considered as part of the core lexicon, and in KSL the majority of signs with classifier handshapes also appear to be Kenyan in origin.

Interestingly, these classifiers show some of the same allophonic alternations described above in §4.4.2. For instance, the aperture of a handshape is modified to the size of an imagined object in the same way that it is modified to a phonemic location on the body. The *claw* handshape in BALL (Fig. 70a), like LAMU on the head (Fig. 63a), has a wider aperture to fit the "location"—a ball; while *claw* with a narrower aperture in GREEN-PEPPER fit the "location" of a pepper (Fig. 70b), which is similar to handshape in WILLIAM-RUTO on the nose (Fig. 63c)—though not quite as small because a green pepper is bigger than the tip of the nose.[93]

a. b.

Figure 70. Iconic handshapes varying in allophonic ways on the basis of the size of an imagined object: a. BALL, b. GREEN-PEPPER

While it is important to include classifiers in a complete description of a sign language, the issue of how to situate them within a phonological analysis is definitely not a settled matter. As described in Chapter 3, this thesis takes the approach that the purely formational level can be assessed in its own right. That is, because iconic form-meaning mappings thoroughly permeate the lexical morpho-semantics of all sign languages, they do not need be treated as exceptional in the lexicon.

[93] Note that these two signs are not minimal pairs because they differ in movement and possibly mouthing features GREEN-PEPPER is typically signed with the mouthing "ho" or "hoho" from the Swahili word for green pepper, *pilipili hoho*.

Another argument for studying form independently of meaning comes from the fact that individual handshapes can take a number of different meanings in the lexicon. For example, as shown in Appendix 6, the handshape *small-C* has at least four identities as a "classifier": it depicts handling in STOVE-2; traced shapes in MOON and REGIONS; gestalt shapes in AIDS (as sunken cheekbones) and TUSKER (for tusks; this is the brand name of a beer); and an abstract unit of size in ADD-2 and EXPENSIVE-4. Thus, the meaning of forms is not deterministic, but is instead dependent on utilization in a specific lexical context and derivational relationships between signs. See Lepic et al. 2016 for similar data regarding the multiple meanings of two-handed signs. An analysis of how forms are used for certain meanings is best situated in the domain of lexical morphology, while the analysis of forms and their patterns is the domain of phonology.

To summarize this section, the 71 phonetic handshapes coded in the KSL Lexical Database were evaluated for their participation in minimal pairs, finding that 38 handshapes participated in contrasting pairs. Three phonetic environments that yield predictable handshape forms were described; i.e., those that dictate allophonic variation in thumb position, flexed fingers around a body part, and the degree of finger aperture. And, finally, the origins of KSL handshapes were profiled, some of which come from external or auxiliary symbolic systems for numbers and fingerspelled letters that motivate specific handshape forms. The results of these analyses are a more circumscribed inventory of KSL handshapes, discussed next.

4.5 Inventory of KSL handshapes

The result of the previous analysis is an inventory of 44 distinctive handshapes in this southwestern dialect of Kenyan Sign Language, shown in Figure 71. This inventory is considered "partly-phonemicized" because although it draws upon multiple lines of phonological evidence, not every handshape can be conclusively determined to be phonemic. It is assumed that a follow-up elicitation with KSL signers would be able to address some of these issues. However, as will be seen in the comparison of *flat* and *open*, and *flat* and *bent* in §4.6, the possibility exists that some of these handshapes may maintain complex relationships with phonological neighbors, being variable in some signs and distinctly different in others.

The 44 handshapes below are numbered in order of most to least frequent in the database, and are detailed further in Appendix 3, *Inventory of KSL Handshapes*. This appendix provides information on each handshape and any allophones associated with it, including the name and HamNoSys symbol and drawings of all allophonic realizations. Also the number of signs in which it occurs in the database is provided, as is the number of minimal pairs (and their glosses) associated with the handshape. And a picture of at least one sign is presented. In addition, the known motivated origins for the handshape are listed, in the following categories: manual numbering, alphabetic numbers, size and shape, handling, and embodied actions. Possible borrowed origins from foreign sign languages are listed. And, finally, the handshape's occurrence as one shape in a dynamic handshape contour is provided.

1. *flat*	12. *A-thumb*	23. *small-C*	34. *O*
2. *1*	13. *V*	24. *Y*	35. *wood*
3. *fist*	14. *L*	25. *lax*	36. *bent-L*
4. *open*	15. *H*	26. *G*	37. *4*
5. *claw*	16. *T*	27. *open-spray*	38. *mid-bend*
6. *X*	17. *open-curved*	28. *W*	39. *N*
7. *bent*	18. *i*	29. *fist-stacked*	40. *flat-o-curved*
8. *curved*	19. *K*	30. *closed-G*	41. *H-thumb*
9. *C*	20. *B*	31. *D*	42. *H-thumb-closed*
10. *F*	21. *E*	32. *R*	43. *thumb-in-fist*
11. *flat-o*	22. *bent-V*	33. *uganda*	44. *V-L*

Figure 71. Inventory of KSL handshapes (partially-phonemicized; shown in order of most-to-least frequent)

With this basic inventory established, I return to some of the issues with determining the phonemic status of handshapes that differ by only one feature.

4.6 The distinctiveness of *flat* handshape and neighbors (*open*, *bent*)

As established in §4.2, handshape in KSL cannot be fully decomposed on the basis of minimal contrast for all of the five different types of handshape features, but one feature type—selected fingers—is contrastive in around two dozen minimal pairs. Taking this featural division to be the primary one in handshapes, Figure 72 shows the grouping of all 71 phonetic handshapes by different numbers of selected fingers. Also, those handshapes with the greatest visual differences are placed (in dashed lines) furthest from each other: *flat*, *1*, and *fist* (with its allophones *A*, *S*). This depiction illustrates the possible allophones for different handshapes; i.e., those that only differ by one feature. Some neighboring shapes also are distinguished by characteristics that are not necessarily featural, such as the amount of tension in the fingers (e.g., *flat-tense*, *lax*) or the degree of aperture closure (e.g., *claw*, *claw-narrow*).

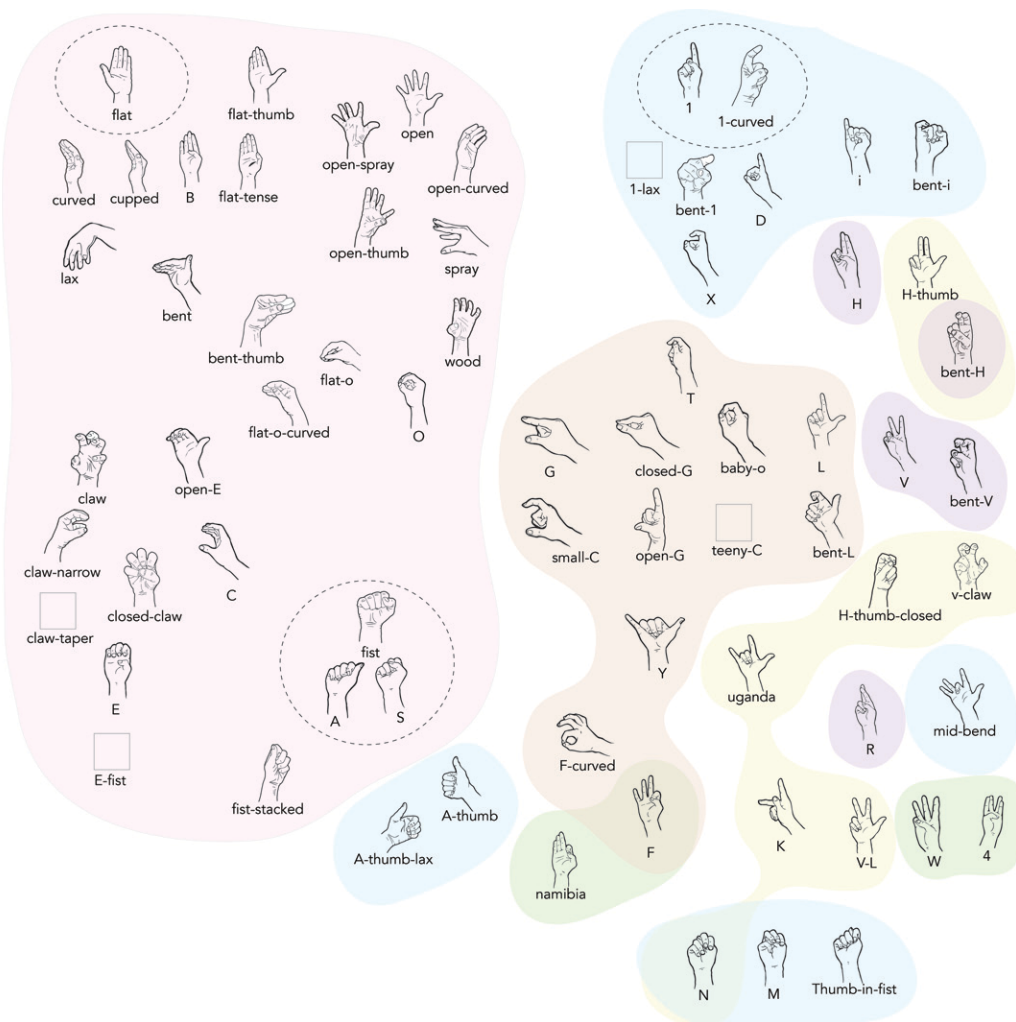


Figure 72. The 71 phonetic handshapes in KSL, grouped by selected fingers (the three most frequent shapes are in dashed lines): *pink* = all fingers; *blue* = one finger only; *orange* = one finger + thumb; *purple* = two fingers; *yellow* = two fingers + thumb; *green* = three or four fingers (shapes with squares lack drawings)

This illustration also shows how some handshapes have many neighbors, such as *flat* and *closed-G*, while others are more isolated, such as *mid-bend*. As explained previously, these neighbors pose challenges for determining phonemic status because of the lack of minimal pairs for forms that differ by only one feature. While predictable phonetic environments and motivated symbolic handshapes can account for some of these neighbors, it cannot account for them all.

In this section, I focus on the particularly tight cluster around the *flat* handshape and examine in detail the relationship between signs with flat and its two neighbors, *open* and *bent*. *Flat* is by far the most common handshape in the KSL lexical database, accounting for 21% of static phonetic handshapes (332 signs). This conforms to the cross-linguistic pattern, as it is the most common handshape in every sign language lexicon described to date.[94] Some examples of signs with the *flat* handshape are shown in Figure 73.


a. b. c. d.

Figure 73. Examples of *flat* ○ handshape: a. drawing of *flat*, b. FUNERAL-1, c. FOREVER-1, d. TODAY-2

In KSL, the *flat* handshape differs minimally from eight other phonetic handshapes, as depicted in Figure 74. Before investigating the relationship between *flat* vs. *open* and *flat* vs. *bent*, I will briefly describe the six other potential allophones of *flat*.

[94] The proportion of phonetic *flat/B* handshapes on the dominant hand in other sign languages: 13% in New Zealand SL, 15% in American SL, 20% in Korean SL, 20% in Finnish SL, and 32% in Old Finnish SL (Rozelle 2003). This shape is 23% of dominant handshapes in Japanese SL (Hara 2003), 18% in Sign Language of the Netherlands (van der Kooij 2002), and 36% (including ‘Lax-B’) in Adamorobe SL in Ghana (Nyst 2007).

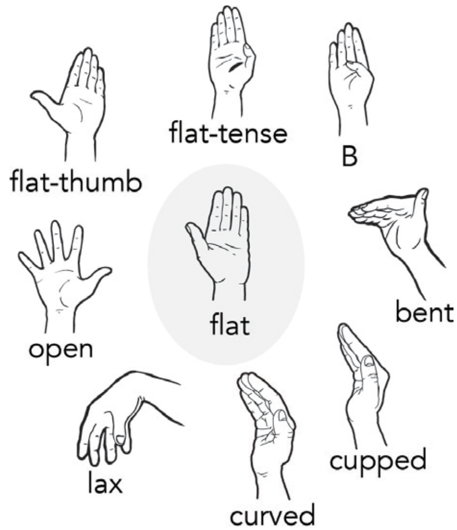


Figure 74. The cluster of handshapes neighbors minimally different from *flat*

First, *flat-thumb* and *flat-tense* differ from *flat* only by the distance of the thumb from the radial side of the hand; i.e., whether it is positioned tightly to the hand (*flat-tense*) or is extended outward (*flat-thumb*). Variation in the distance of the thumb in these shapes is found to be relatively free, and no consistent conditioning environments were found that reliably accounted for its position.[95] In NGT, one predictable condition that results in *flat* becoming *flat-thumb* is the extension of the thumb during lateral/horizontal movement (van der Kooij 2002: 113, 115). However, while this is reported as a strong tendency in NGT, it does not seem to have any discernable effect on the thumb position in KSL. Next, the handshape *B* is considered an allophone of *flat* on the basis of the phonetic rule regarding contact with the body in §4.4.2.1; however, when it occurs in an initialized sign representing the letter 'B', it is viewed as a distinct handshape; see Appendix 3, #20. *Cupped* and *curved* differ from each other only slightly and are also similar to *bent*. These handshapes are still uncertain with regard to their status; see Appendix 3, #8. Lastly, the handshape *lax* is listed as a distinct handshape in Appendix 3

[95] *Flat-thumb* is obligatory in the sign TO-VISIT (i.e., it cannot be replaced with *flat*), but it seems to derive originally from an *L* or *open-G* handshape and the rest of the fingers eventually extended to match the index finger.

because of contrast with *flat-tense* in one minimal pair (PLAY-2 VS. CLOTH/FABRIC) and because it is associated with a possible semantic cluster, in signs associated with indeterminacy. Note that the drawing of *lax* in Figure 74 is more pronounced than it usually appears in KSL signs; see sign examples in Appendix 3, #25.

In the next section, I turn to the handshape *open* and examine the evidence for whether it is an allophone of *flat*.

4.6.1 *Flat* vs. *open* handshapes

The *open* handshape, shown in Figure 75, is the third most frequent phonetic handshape in the database, occurring in 78 signs with static handshapes, and 100 total signs when dynamic handshapes are included (i.e., those with finger wiggling; see §6.8 and Figure 77). Due to the tendency for more frequent handshapes to appear in more minimal pairs, as shown in Figure 55, it is expected that *flat* and *open* would be contrastive in several pairs, but there are surprisingly none. It would therefore reasonable to hypothesize that they are allophones of the same underlying phoneme; however there is conflicting evidence for whether one is an allophone of the other. First, there are no true minimal pairs between *flat* and *open* because the spreading of fingers has not been found to be contrastive in KSL (§4.2.5).[96] Also, neither shape is a motivated letter or number,[97] so that cannot be a determinant for phonemic status. This leaves the following types of evidence, which will be considered in this sub-section: predictable environments, variation, and substitutability of one shape for the other. In addition, clues were sought in semantic motivation and in the findings from other sign languages.

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[96] Some near-minimal pairs include: MY/MINE and HEALTH-1 (Fig. 75b), MONDAY and HAT, DEPUTY-HEADMASTER-1 and EVERYTHING, CHAPATI-1 and POSHO-MILL-1. These also differ by movement features in addition to finger spreading.

[97] The number five is typically produced with a *fist* handshape in many places in Kenya, including at the site of data collection (see Creider 1977 and Zaslavsky 1999).

a. b. c. d.

Figure 75. Examples of *open* handshape: a. drawing of *open*, b. PINEAPPLE-1, c. HEALTH-1, d. KANGA (name of town)

The first type of evidence considered is whether predictable environments could be found to account for the appearance of one handshape instead of another. Three factors were found that consistently predict an *open* handshape. The first is that when handshapes with all fingers extended have interlaced fingers, such as GATE (Fig. 76), NET, or AMERICA-1, then the fingers are required to be spread to properly execute the sign. The second condition is when the fingers are wiggling/fluttering, such as in DOG (Fig. 77a), RANK (Fig. 77b), and HOUSEFLY. In this case, it is not absolutely necessary to spread the fingers as it is with interlaced fingers, but the sign is more easily articulated if they are spread.[98]

Figure 76. *Open* handshapes with interlaced fingers: GATE

[98] This is probably especially true when all four fingers are selected. Wiggling with unspread fingers that graze each other during finger movement is attested in Saudi Arabian Sign Language (Kozak & Tomita 2012). It also occurs in two signs with *H* handshapes in KSL: SNAKE and EAT-2.

a.  b. 

Figure 77. *Open* handshapes with wiggling fingers: a. DOG, b. RANK

A third factor finds that *flat* or *open* shapes are associated with certain kinds of handpart contact on the body. *Open* handshapes but not *flat* handshapes have thumb tip contact (e.g., LIE, PEOPLE, RANK [Fig. 77b]) while *flat* but not *open* have full ulnar (pinky-side) contact (e.g., TRUE, KNIFE, BOAT, HONEST-4). Ulnar contact with a *flat* handshape is found in 34 signs (10% of signs with *flat* handshapes), suggesting that there could be a constraint such that [+full ulnar] contact is consistently associated with [-spread].[99]

While finger interlacing, wiggling trilled movement, and handpart contact can explain some of the signs with the *open* handshape, this would still only account for a minority of signs. There are 100 *open* handshapes on the dominant hand, including those dynamic handshapes with wiggling fingers (78 are static), but these conditions only account for around 34 signs. And ulnar handpart contact only explains 38 out of 332 *flat* handshapes on the dominant hand.

Several other possible phonetic factors were identified, but these could not explain all instances of *open* vs. *flat* either. Instead, they illustrate trends within signs having these shapes, with most conditions applying to the *open* handshape. For instance, although both *flat* and *open* were equally likely to be one- or two-handed, signs with *open* handshapes were more likely to be

[99] Sometimes the sign FALSE, which usually has a *flat* hand and ulnar contact can appear with an *open* hand and ulnar contact. It's likely but not confirmed that this originates from a compound, LIE^FALSE, where LIE has an open hand with wiggling fingers and spreads its feature, [+spread] to the second sign.

balanced[100] than in signs with *flat* handshapes: 54% of all two-handed signs with *open* handshapes were balanced compared with 34% of two-handed signs with *flat* handshapes. This also reflects the tendency of the *flat* dominant hand to act on the non-dominant hand more than *open* hands (i.e., *flat* handshapes occur in Type 2 and Type 3 signs proportionally more often than *open* hands do). Relatedly, *open* hands were more likely to be made in neutral space without contact on the body than were flat hands: 54% of *open* hands have no body contact (including on non-dominant hand) vs. 38% of *flat* hands.

Also *open* handshapes were more likely to involve continuous contact than *flat* (23% *open* vs. 15% *flat*); they were more likely to occur in ulnar rotations (7% vs. 2%) but not wrist bends (3% vs. 8%); and when featured in a sign with path movement, the axis of movement for signs with *open* hands was more likely to be horizontal/lateral than along the vertical, midsaggital, or diagonal axes (32% *open* vs. 19% *flat* have horizontal movement). For all other featural characteristics, there were only slight differences in the signs involving the two shapes.

Altogether, conditioning environments can account for a subset of signs with these handshapes, which could indicate that they are allophones; and if that is the case, it is most likely that the *open* handshape is an allophone of a *flat* handshape instead of the reverse because (i) it is the one more often found in specific conditioning environments, and (ii) it is much less frequent overall in the lexicon than the *flat* handshape. Yet these conditions still do not account for the majority of *open* handshape in the lexicon. What about other evidence, such as variation?

It was found that some signs could be produced with either handshape and still carry the same meaning. At least a dozen signs in the KSL lexical database showed variation between the two handshape for different signers. Some examples include LEAF (Fig. 78), ROAST (Fig. 79),

[100] That is, a two-handed sign with both hands having the same handshape and moving symmetrically (either simultaneously or alternatingly).

ALWAYS, TO-SIGN, MOTHER-1, PIG-1, WHERE, CONDUCTOR/TOUT, FALL-OVER, WITHOUT, and BASI (THAT'S-ALL/ENOUGH). No common formational or semantic properties are shared by these signs.

Figure 78. Variation between *flat* ▢ and *open* ⩂ in LEAF: a. Signer B2, b. Signer K1

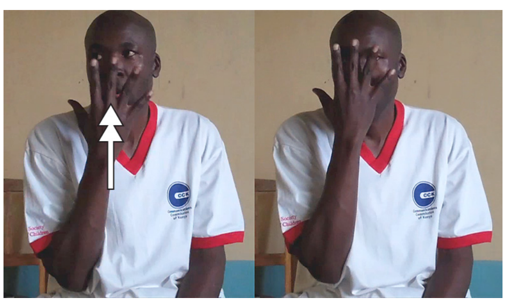
Figure 79. Variation between *flat* ▢ and *open* ⩂ in ROAST: a. Signer X1, b. Signer O1

Also, like the *A~S* allophones, some two-handed signs surface in tokens with different amount of finger spreading on each hand; e.g., BODY in Figure 80 in which the dominant hand has closed fingers and the non-dominant hand has open fingers.[101]

[101] Otherwise, signers are somewhat more likely to produce BODY with *open* hands.

Figure 80. Variation between *flat* ▢ and *open* ⋓ on each hand in two-handed signs: BODY

This further supports the idea that these two shapes are allophones. However, there is opposing evidence when it comes to the substitutability of these handshapes. That is, there are signs that cannot be signed with the other handshape because it would be ambiguous or untranslatable. Some examples of signs with *open* hands that couldn't be signed with *flat* handshapes include NETWORK, SHY (Fig. 81a), POSHO-MILL-1 (Fig. 81b), 'HANDS'[102] (Fig. 81c, d), FLOUR-2, and ROOSTER-4.

a.  b. 

c.  d. 

Figure 81. Signs with *open* hands that wouldn't make sense with a *flat* hand: a. SHY, b. POSHO-MILL-1, c. 'HANDS' (Signer B1), d. 'HANDS' (Signer K1)

[102] 'HANDS' can be translated to mean several things, including (1) vernacular, (2) signing that was directly observed, or (3) the consensus opinion of the deaf community as shared through conversation.

Likewise, many signs with *flat* handshapes could not be replaced with *open* hands, such as IMPORTANT (Fig. 82a), FOCUS-1 (Fig. 82b), STORY (Fig. 82c), PERSON, COMPARE, PLAN, STOP, FUNERAL-1 (Fig. 73), THEIRS, SERVICE, SHORT(LENGTH), and more.

a.  b. c.

Figure 82. Signs with *flat* hands that would be signed incorrectly with an *open* hand: a. IMPORTANT, b. FOCUS-1, b. STORY

Intriguingly, there may be a difference in the direction of substitution—i.e., replacing *open* with *flat* versus *flat* with *open*. This needs to be verified in further elicitation with KSL signers, but it seems that replacing a *flat* hand, like the signs in Figure 82 (above), with an open hand would result in a non-standard articulation—probably displeasing to signers, but parsable—whereas replacing an *open* handshape (e.g., those in Fig. 81) with a *flat* handshape would result in confusion and ambiguity about the meaning of the sign. Even without taking the possible directionality into account, the lack of substitutability in many signs indicates that these handshapes may be independent phonemic units in KSL.

To recap, some of the evidence suggests that *flat* and *open* are allophones: (i) *flat* and *open* do not occur in minimal pairs; (ii) there are conditioning environments that favor one over the other; (iii) several signs can be produced with either shape. At the same time, there is also counterevidence: (i) the conditioning environments only account for 32 out of 100 *open* handshapes and 38 out of 329 *flat* handshapes, (ii) one handshape is not freely substitutable for the other in many signs, and (iii) one near-minimal pair for spreading shows that it probably does carry some contrastive potential.

This leads me to take into consideration two other lines of possible evidence. First, even though this thesis has not used 'semantic implantation rules' (van der Kooij 2002; see also §3.5.3) to account for forms in the KSL lexicon, could there be semantic factors that dictate the form of one handshape over the other because of iconic mappings? I grouped all but 10 of the 68 signs with *open* handshapes into six morpho-semantic clusters, based on the type of form-meaning mappings for the handshape, as shown in Table 12 (10 were unclear). For example, the hand(s) with an *open* shape in BIRD map to bird wings; in HOT-PEPPER-2, they map to flames; in TIRE they map to the actions of a person rolling a tire; and in NETWORK-1, they map to wires or information interconnecting with each other. However, none of these can be formulated into obvious 'semantic implementation rules', as van der Kooij has done. If anything, the array of form-meaning mappings possible with the *open* handshape—considered alongside *open* hands that appear to be unmotivated (e.g., HEALTH-1 [Fig. 75], TO-SIGN, NO-1, SLOW-2, NEVER-1)—indicate that *open* handshapes are generalizable units of form in KSL that are used in multiple ways in the lexicon, either with iconic mappings or without.

Another line of inquiry is to compare the findings here with those in other sign languages. Surprisingly, there was no evidence found in the literature that "true" minimal pairs exist for *flat/B* and *open/5* in either ASL or NGT (the sign languages with the most thoroughly-described phonology), although analyses of both sign languages list them as phonemic.

Table 12. *Possible iconic motivations for signs with an open handshape*

Object shape	Embodiment	Size	Clothes	Indeterminacy	Interconnection
TREE-1, -2	CELEBRATE	BIG	SWEATER	WHAT	NETWORK-1
LEAF/GREEN-1	HOLIDAY	CROWD-1	SOCKS	APPROXIMATE	NETWORK-2
FOREST-1, -2	SHY	CROWD-5	BLOUSE	THINGS	SCHEDULE
PINEAPPLE	FLEE	MANY	UNDER-PANTS	PLACE-2	
MONGOOSE	ENCOURAGE	FULL		OUTSIDE	
ROOSTER	PRAISE	FAT			
BIRD	TOUT				
CURTAINS	VISITOR				
REFUGEE	SHY				
ADULT	'HANDS'				
CHARITY-NGILU[103]	CHARITY-NGILU				
HOT-PEPPER-2	TIRE				
RAKWARO	WITHOUT				

For ASL, Brentari (1990: 66) lists the pairs FOURTH and BLUE to represent a contrast for +/- spread with all four fingers selected. However, this pair has 2-3 featural differences: (i) it is consistently signed with different directions of wrist rotation (BLUE is pronated/twisted outward and FOURTH is supinated/twisted inward; (i) FOURTH is monosyllabic once and BLUE is disyllabic (repeated twice or trilled). And third, signers tend to articulate FOURTH with the lower arm parallel to the ground (fingers pointing contralaterally), and BLUE with an upright forearm (fingers pointing upward), making this an even more distant pair.

For NGT, van der Kooij (2002: 83) finds that the spreading of fingers ([wide] in her model)—is contrastive, and she provides one pair, TO-CALL and TO-BE-PRESENT, that differ only by finger spreading (abduction). However, they also contrast via an obligatory mouth gesture ("shhh" mouthing with TO-BE-PRESENT). Because this kind of lexical mouthing may be contrastive in NGT (2002: 276-277), these would not be considered "true" minimal pairs using the criteria in this thesis. In addition, an online repository of NGT signs that shows both signs by

[103] Charity Ngilu is a Kenyan politician and her namesign derives either from her characteristic open-handed wave (embodiment) during campaign events or her campaign symbol of a rainbow (object shape)—or a semantic blend of both.

the same signer reveals another possible lexical distinction: TO-BE-PRESENT is signed once and TO-CALL is repeated; if this is a true lexical difference, then that would be an additional degree of difference.[104]

The lack of contrast for these handshapes—and spreading in general—is also reported in Adamorobe Sign Language from Ghana. Nyst writes that "(t)he distinctivity in spreading can be questioned, as handshapes with spread and adducted fingers vary between realisations of signs. In fact, variation is even attested within two-handed balanced signs, which usually have the same handshapes" (2007: 76). This is the same phenomenon as the token of BODY shown in Figure 80 above.

However, for Hausa Sign Language in Nigeria, Schmaling (2000) reports one minimal pair for finger spreading: "one-thousand" (DUBU 1) with a *flat-thumb* handshape () and "thus" (HAKA [NE]) with an *open* handshape (). Schmaling provides the phonetic details of the signs using the Hamburg Notation System. It isn't clear if they come from the same signer, which was a criterion for counting minimal pairs in this current project.

Thus, the relationships between the handshapes *flat/B* and *open/5* in ASL, NGT, and Adamorobe Sign Language, at least, may be similar to KSL by not being strictly contrastive. What, then does this evidence taken altogether indicate about the status of *flat* and *open* handshapes in the phonological system of KSL?

I offer an account that fits this data, though it is not very elegant. From a formal standpoint, I propose that these handshapes can be *both* phonemes and allophones of each other, depending on (i) the specific phonetic environments described above and (ii) the lexical specifications of individual signs (whether motivated by semantics or not).

[104] See the difference between "aanwezig" (to be present) and "roepen" (to call) at this site: https://www.lerengebaren.nl/gebarenwoordenboek/gelderland.

There may also be a phonetically-grounded explanation for this lack of either clear contrast or clear allophony; it may derive from pressures against signs that can be confused with each other and therefore result avoidance of formational structures that are too perceptually similar; i.e., those that differ only by whether or not the fingers are spread. Consider the 'whole handshape' minimal pair BUNGOMA and ROOSTER-4 in Figure 83. The two handshapes *B* and *open* vary by two features, spreading and thumb position, making it a near-minimal pair for +/- spreading. Thus, even though finger spreading does not (or cannot?) carry the full contrastive load between these signs, it likely does carry some degree of contrastiveness.

a. b.

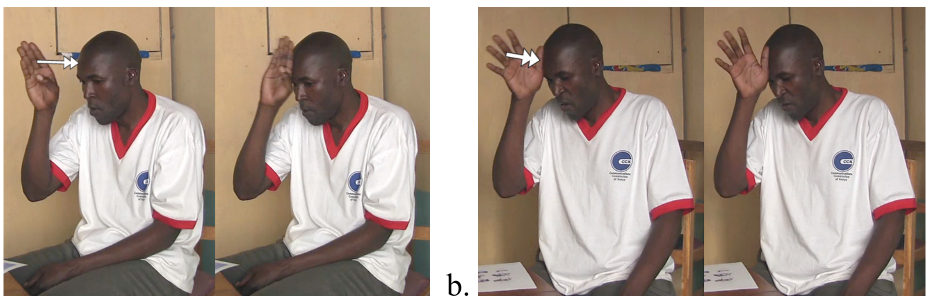


Figure 83. Signs that vary both by thumb position and finger spreading: a. BUNGOMA, b. ROOSTER-4

These accounts lead to some testable hypotheses. First, signs that do allow variation between the two handshapes (e.g., LEAF, ROAST) may be in relatively sparse phonological neighborhoods, in which there is less of a risk of confusability. Second, if there is an avoidance based on *perceptual* confusability, then handshapes with a one-feature difference should be harder to perceive than handshapes with two-feature differences. Also, performance in a carefully designed recall task with one- and two-feature difference handshapes may be able to indicate whether signers are sensitive to these features as categories, or only gestalts.

For the purpose of the current grammar of KSL (and other sign languages, for that matter), handshapes that only differ based on spreading remain somewhat ambiguous as to their phonemic status. Yet, the combined evidence regarding *flat* and *open* presented here suggests that they are distinct in enough environments to be listed separately in the inventory of KSL handshapes.

4.6.2 *Flat* and *bent*

The second pair in the *flat* handshape cluster to consider is *flat* vs. *bent*. The *bent* handshape (Fig. 84) is the fifth most frequent phonetic handshape in the KSL lexical database, appearing in 54 signs (3.5% of database). *Bent* only differs from *flat* by flexion in the metacarpophalangeal or “base” joints. Unlike *flat* and *open*, the distinctiveness of *flat* (also called the *B* handshape) and *bent* (also called *B-bent*) has been addressed more in the literature, on the basis of the same criteria mentioned above: minimal pair contrast, predictable phonetic environments, variability, substitutability, and semantic motivation.[105] I will first present the data for KSL, then discuss how my analysis corresponds to the evidence and analyses about the relationship of these handshapes in two other languages, Sign Language of the Netherlands (NGT) and Israeli Sign Language (ISL).

Figure 84. Examples of *bent* ○̄ handshape (a): b. YOUNG, c. FOLLOW, d. EXAM-4

First, there are no minimal pairs for these two handshapes that would indicate they are contrastive in KSL. As was shown in §4.2.4, there are in fact no signs that differ only by the bending of the base joints. Thus, they are potential allophones.

[105] Symbolic motivation is not relevant in this case because neither handshape is a letter or numeric symbol in KSL.

If *flat* and *bent* are allophones, then we might expect to see variation in handshape for the same signs, and this is indeed the case for many signs, including DECREASE-2 (Fig. 85), FLAT-1, HEADTEACHER-1 (Fig. 86), PAPAYA-1, MORNING (Fig. 87), MANGO-1, UNIVERSITY, etc.

a.  b. 

Figure 85. Variation between *flat* ▢ and *bent* ▢̄ in DECREASE-2: a. Signer K1 (*flat*), b. Signer B1 (*bent*)

a.  b. 

Figure 86. Variation between *flat* ▢ and *bent* ▢̄ in HEADTEACHER-1: a. Signer K1 (*bent*, *flat*), b. Signer B1 (*bent*)

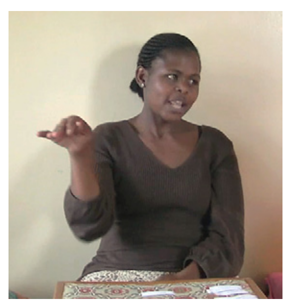
a.  b. 

Figure 87. Variation between *flat* ▢ and *bent* ▢̄ in MORNING: a. Signer B1 (*flat*), b. Signer K1 (*bent*)

In addition, some signs with path movement show a change from *flat* to *bent* or *bent* to *flat* from the start of the path to the end. These are not interpreted as signs with dynamic handshape changes (see §6.4.3), but rather as non-distinctive joint flexion required for the hand to comfortably move along a path, from one position to another. Examples with a change from *bent* to *flat* or the reverse include UNDERPANTS (Fig. 88a), STRESS-1 (Fig. 88b), and FOLLOW.

a. 

b. 

Figure 88. Change from *flat* ▢ and *bent* ▢̄ during sign: a. UNDERPANTS-1,[106] b. STRESS-1

There are also signs like UGALI-2 and MONEY-3, in Figure 89, in which a *flat* hand bends at the base finger joints as the hand returns across the surface of a body part. In all of the cases in Figures 88 and 89, the bending of the fingers is a consequence of maintaining handpart contact with the body and is not an underlying specification. In the tokens with *bent* handshapes for DECREASE-2 and MORNING above, the hand does not make contact with the body, but flexion appears to occur at the base joints in order to maintain the orientation of the fingers which is easier to articulate. In all of these cases, environmental conditions dictate the flexion of the base joints.

[106] from Mjitoleaji 2004; signs collected in Nyanza province showed this handshape change, too, but not quite as clearly because signers were sitting.

Figure 89. Allophonic change from *flat* ▢ to *bent* ▢̄ during sign: a. UGALI-2, b. MONEY-3

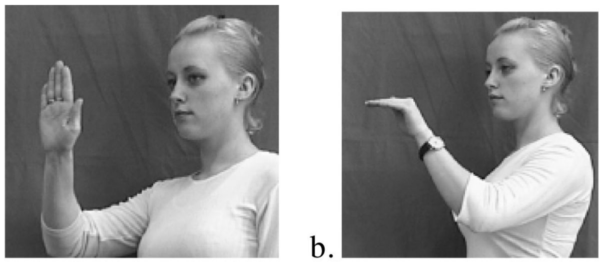
Thus far, it seems likely that *bent* is an allophone of *flat*. What about substitutability? Can one handshape be replaced with another and maintain the same meaning? In the previous section regarding *flat* and *open*, a small portion of signs could not be produced with either handshape and still be considered an interpretable instantiation of the sign. For *flat* and *bent*, the proportion of substitutable signs is much larger. Nearly all the 54 signs with a *bent* shape would be reasonably acceptable (though sometimes odd-looking) if articulated with a *flat* hand. This includes the variants shown in Figures 85-89, and others: BLOOD-1, EARLY, MENSTRUATION-2, SHEEP-2, UNIVERSITY, etc. For most of these, it appears that a bend in joints prevents the awkward outward extension of the elbow(s) while still achieving the target orientation of the hands or contact on the body.

However, there are 11 signs that are exceptions; e.g., TO-ASK (Fig. 90a), JEMBE-2 (Fig. 90b), (Fig. 90c), (Fig. 90d,e), EXAM-4 (Fig. 92), TO-WAIT LAZY-3 COBRA, CAMEL-1. All of these have an upright forearm with a bend at either the wrist or base joints. It would be completely incorrect to produce any of these signs with no bend in either the wrist or base joints.

Figure 90. Signs that require a bend in either base joints or wrist: a. TO-ASK, b. JEMBE-2, c. LAZY-3, d. TO-WAIT in citation form, e. reduced form of TO-WAIT in fluent signing

It is possible to trace the etymology of seven of these signs back to an initial iconic form-meaning mapping. Three of these—JEMBE-2, COBRA, and CAMEL-1—reference the physical shape of an object or animal, while the other four reference a body position that indexes a behavior—of sitting in a relaxed position for WAIT and LAZY-3, and of tapping someone on the shoulder for ASK and EXAM-4. However, the last four are greatly abstracted from that base, thus resisting a straightforward "semantic implementation rule" that might account for the predictability of the *bent* handshape.

One proposal in the literature that accounts for some signs with a *bent* handshape is that they are specified for the relative orientation feature [fingertips] (Crasborn & van der Kooij 1997). Relative orientation refers to the handpart that is the leading side of the hand in a path movement, or which faces a body location. Thus, the signs TO-STOP and TO-CALL in NGT, shown in Figure 91, are not minimal pairs for handshape, but are minimal pairs for relative orientation; TO-STOP is specified for [palm] and TO-CALL is specified for [fingertips], and the bending of the base joints in TO-CALL is only for ease of articulation (van der Kooij 2002: 121).



a. b.

Figure 91. Signs in NGT with different relative orientations: a. TO-STOP with a [palm] orientation, b. TO-CALL with a [fingertips] orientation (reprinted from van der Kooij 2002)

However, unlike in NGT, the *bent* handshape in KSL is not always predictable on the basis of relative orientation (or related phonetic pressures). The sign EXAM-4, shown in Figure 92, has similar inherent properties as TO-CALL in NGT (i.e., handshape, location), but different dynamic properties: the hand moves from side-to-side in front of the body (lateral/horizontal axis), palm out, with an [ulnar-radial] relative orientation. There are no articulatory reasons for EXAM-4 to maintain the *bent* shape. Rather, its shape derives from its morphological relationship to TO-ASK (Fig. 90a). It can be argued that because this handshape is used in this (small) morphological paradigm, its phonetic form has become frozen and it has a non-reducible phonological identity.

Figure 92. Sign with ulnar-radial relative orientation: EXAM-4

In another morphological cluster, CHILD, CHILDREN, TWINS and YOUNG (Fig. 84b), the *bent* handshapes are also invariant—i.e., can't be substituted for *flat*. In this case, it is a matter of conventionalization rather than the encoding of an iconic form. These signs, all with *bent* handshapes that are signed low in neutral space with palms (and fingers) pointing upward, are likely derived from a gesture in the hearing community using a fully flat hand, fingers up, positioned low to indicate the height of a small human, as described by Creider (1977), and consistent with to my observations as a participant-observer in the community.[107] Because of this origin, if CHILD, CHILDREN, or YOUNG were signed with a *flat* hand, it would most likely be interpreted by KSL signers as code switching into a gestural mode rather than using real KSL. However, the sign TWINS is obligatorily signed with *bent* hands; it would be un-interpretable with a *flat* handshape. In this case, TWINS is similar to EXAM-4 in that it derived from other signs and became frozen as a handshape in the KSL lexicon. Altogether, these examples suggest that *bent* should be considered a distinct handshape in KSL.

Another class of signs with *bent* handshapes is less certain: those indicating the concept of "delimitation"—a form-meaning mapping that was first observed in Italian Sign Language by Pizzuto et al. (1995). In KSL this concept is present in at least nine signs, including: LIMIT-2, LEVEL, EQUAL-1, EQUAL-2, SEPARATE, and AFTER-2, nearly all of which appear to be borrowed from ASL (possibly via Signed-English). Only two signs are seemingly of KSL origin: CASH-ADVANCE and ALL-1. This could indicate the productive use of a form-meaning mapping with the *bent* handshape. However, all of these signs also conform to the phonetic conditions already described in which a *bent* hand is the optimal shape in certain environments to prevent awkward or effortful articulations. Also, some signs can be produced with a *flat* hand, as in DECREASE-2 in

[107] In contrast, the height of small non-human animals are described in western Kenya with a palm-down *flat* hand, as reported by both Signer B1 and in Creider (1977).

Figure 85a above. Therefore, there is no firm evidence that *bent* in these signs is anything other than an allophone of *flat*.

To summarize, in the 54 signs with a phonetic *bent* handshape in KSL, 11 of these appear to be distinctive or categorical, while the others can be considered underlyingly *flat* handshapes whose base joint flexion is predictable based on circumstances of contact and/or location. Thus, like the *open* handshape, it is sometimes phonetic and sometimes phonemic.

The degree to which *flat/B* ○ and *bent/bent-B* ○̄ are phonologically distinct has been investigated in two other languages, Sign Language of the Netherlands or NGT (Crasborn 2001; Crasborn & van der Kooij 2003; van der Kooij 2002) and Israeli Sign Language (ISL) (Fuks & Tobin 2008). I will briefly review their findings and comment on where the handshapes in KSL fit in relation to these languages.[108]

Both sign languages describe very similar factors for *bent* handshapes. Using Fuks & Tobins' terms, these are (i) the "human-phonetic" factor and (ii) the "iconic-semiotic" factor. Looking beyond the divergent theoretical positions of the two groups of researchers, the trends in data is quite similar in both NGT and ISL—and in KSL. All three languages contain *bent/B-bent* handshapes whose flexion of the base joints is predictable based on articulatory constraints in some signs (ATTIC in NGT; WHAT-A-PITY in ISL; EARLY in KSL) and motivated by semantics in others. In those signs with semantic motivations, all three languages have those in which *bent/B-bent* represents the visual appearance of a referent (TRAFFIC-JAM in NGT; CAMEL in ISL;

[108] I will also use the handshape names used by Fuks & Tobin and van der Kooij: *B* for *flat* and *B-bent* for *bent*.

HOE/JEMBE in KSL) as well as the abstract concept of delimitation (AFTER in NTG; MAKE-EQUAL in ISL; LIMIT in KSL).[109]

However, there are some language-specific differences with regard to *bent/B-bent*. For ISL, Fuks and Tobin report on one minimal pair: WIDE with *B* and EXPANSION with *B-bent*.[110] By contrast, neither NGT nor KSL has minimal pairs for these handshapes. In addition, they report that 50% of all signs found with the *bent/B-bent* handshape are semantically related to delimitation of "time, space or quantity" (2008: 395). Thus, the morpho-phonemic cluster signifying delimitation in ISL is larger and more consistent than in KSL (in which only 16% of *bent/B-bent* signs relate to delimitation). Yet at the same time, Fuks & Tobin report that ISL also has *bent/B-bent* handshapes that appear to be allophones of *flat.* Thus, there is more reason to consider these two handshapes distinct in ISL, but the same phonetic regularities also occur.

In NGT, Crasborn & van der Kooij find no minimal pairs that suggest the two handshapes are distinctive. Further, they report that the flexion of the base joint alone is never distinctive—even in other handshapes such as *1* and *bent-1*—and can be explained largely by ease of articulation factors (Crasborn 2001: 142-159, van der Kooij 2002: 116-123). Van der Kooij also finds that the *bent* handshape is predictable in signs with that depict the outline of an object: "the base joints are flexed if the shape or surface of the outlined/depicted object requires it" (2002: 127).

In KSL, I have shown that another factor can influence the phonemic status of a handshape: whether it participates in a morphological cluster. Derivational morphology can

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109 It is not yet known whether the concept of delimitation with a *bent/B-bent* handshape is a characteristic of European sign languages or will prove to be a recurrent form-meaning mapping in multiple unrelated sign languages.

110 Screenshots of both signs are shown in Fuks & Tobin (2008), but different signers produce each sign. It is therefore unclear whether the contrast exists in any single ISL idiolect. The importance of considering idiolects, at least in KSL, is addressed in Chapter 3.

change the status of a handshape that was purely allophonic into a categorical unit that is invariable; i.e., (i) ASK > EXAM-4; (ii) short-human (gesture) > CHILD > TWINS).

Considering all the data in these three languages together, a hypothesis emerges regarding the *bent* handshape. This handshape may originate in a lexicon as an allophone of *flat* in response to ease of articulation pressures, but its regular reoccurrence—especially in specific lexical semantic domains (e.g., 'delimitation')—may cause it to become recruited as a contrastive phonological unit (e.g. WIDE vs. EXPANSION in ISL), or to become frozen in a morphological paradigm (e.g., EXAM-4 and TWINS in KSL). However, these phonemicizing processes do not necessarily spread to other instantiations of *bent* in a lexicon, so that it may remain an allophone of *flat* in some proportion signs. In NGT, it seems that neither of these lexical processes have occurred, and *bent* remains fully allophonic with *flat.*

As with *flat* vs. *open*, the distinction between *flat* and *bent* is surprisingly nuanced and dependent on multiple factors in the lexicon. While the dearth of minimal pairs for single handshape features still requires some explanation and is presumably rooted in phonetics, the case of the *bent* handshape demonstrates the importance of widening the frame of reference to other linguistic factors and to cross-linguistic comparisons in order to understand the full picture of the phonological status of individual handshapes.

4.7 Summary and future directions

To summarize, the main goal of this chapter has been to discover the phonological units of handshape in KSL. This entailed two projects: first, determining the smallest distinctive unit of handshape—features or the whole handshape; and second, establishing an inventory of phonemic handshapes. Both tasks were frustrated by a dearth of minimal pairs, yet an unexpected pattern was found in the missing pairs. Out of five types of handshape features, *selected fingers* features were contrastive in several pairs, but the other four features were almost entirely absent from minimal pairs: *joint position/finger configuration*, *finger spreading*, *thumb aperture*, and *thumb position*. Only one minimal pair was found for *joint position*. This led to the conclusion that the smallest discernable unit of handshape in the KSL grammar is the whole handshape rather than individual features.

The analysis thus proceeded on the basis of whole handshapes, beginning from the 71 phonetic handshapes coded in the KSL Lexical Database. Five diagnostics for phonemic status were applied in the phonological analysis. This yielded 38 handshapes found in minimal pairs, a set of handshapes that are allophones of a common handshape on the basis of predictable environments, and several handshapes that are symbols for manual numbers or fingerspelled letters. Altogether, an inventory of 44 KSL handshapes was provided in §4.5 and is further detailed in Appendix 3.

Yet the diagnostics were not sufficient to determine the phonemic status of many handshapes that are potential allophones, differing by only a single feature. To understand whether other factors could determine the phonemic status of such potential allophones, a more detailed analysis was pursued for two pairs of handshapes in the dense phonetic cluster around the *flat* handshape. This analysis yielded the following insights. First, it was found that the same two handshapes may be allophones in some signs and contrastive in others. Second, it was found that very similar phonetic pressures may exist in different sign languages, but that language-specific lexical paradigms may transform otherwise allophonic handshapes into phonemic units.

Follow-up work with Kenyan Sign Language using carefully planned substitutability tests is called for to better determine when handshapes are distinctive and when they are allophones. Are there patterns based on predictable phonetic environments? Are some handshapes lexically specified in some signs? Do morphological paradigms and/or lexical semantics not yet identified play a role?

Also, the gaps in minimal pair contrasts for most handshape features presents an intriguing hypothesis: contrast is avoided in sign language lexicons on the basis of single handshape features (apart from selected fingers). Since there is some indication that minimal pairs on the basis of finger spreading are avoided in sign languages other than KSL, this may reflect general tendencies in the modality, and experimental methods can be developed to test such a hypothesis in controlled data. Finally, another hypothesis to test, via quantitative computational measurements of the lexicon, is whether neighborhood density plays a role in variation, such that sparser neighborhoods may permit more allophonic variation.

At the beginning of this chapter, I offered a quote from Crasborn et al. regarding handshape features: "the possibility that this fine structure only exists in the mind of the phonologist who proposes it, remains a real one" (2002: 11). Given the data presented in in this chapter, this sentiment is understandable. A lack of minimal pairs for the most formationally similar handshapes hampers the phonemic analysis; and when data about potential allophones is investigated in greater detail (e.g., §4.6), the evidence is complex and somewhat contradictory. However, the systematicity of the gaps for handshape minimal pairs is notable and may end up pointing the way toward a more comprehensive explanation for the sub-lexical organization of handshape.

Chapter 5:
Location

5.1 Introduction

Location or Place of Articulation (POA) is one of the major phonological categories and is a relatively transparent aspect of the sign. It is the *'where'* component—the physical place where a sign is articulated. As in other sign languages, Location is a core component of the phonology of KSL, as demonstrated by dozens of minimal pairs that differ only by the place on or off the body where the hands produce movement. For example, the signs COMPLAIN-1 and FEAR have the same features for handshape and movement and only differ by their location—on the *neck* and *trunk-upper*, respectively (Fig. 93).

a. b.

Figure 93. Minimal pairs for location, at *neck* and *trunk upper*: a. COMPLAIN, b. FEAR

The main goal of this chapter is the same as the other two main parameters of Handshape and Movement—that is, to locate the distinctive phonological units that are specific to this dialect of Kenyan Sign Language. Yet because there are relatively few descriptive analyses of Location in the literature, this chapter takes on an additional goal: to establish a set of diagnostic criteria for determining whether a location is distinctive, and to use these criteria systematically in the description of each phonological location.

The chapter begins with a background on the Location parameter in the next section (§5.2) and a description of how location features have been represented in models of sign phonology. I then explain the approach taken in the current analysis and provide a list of of location features for KSL. In §5.3, I offer a quantitative overview of the 37 phonological locations in KSL and how they compare with other sign languages, as well as a synopsis of minimal pairs for location.

In §5.4, I outline the diagnostic criteria used to determine whether a location is distinctive. With this methodological foundation, I then provide a summary description of locations in each major region of the body and neutral space: head (§5.5), neck (§5.6), trunk (§5.7), leg (§5.8), non-dominant limb (§5.9), and neutral space (§5.10). The discussion of neutral space also addresses two theoretical questions: (i) can orthogonal planes in neutral space be considered phonological locations, and is neutral space itself a phonological location? Crucially, these summaries by major area rest upon a detailed analysis of the evidence for each of the 37 locations, which is provided in an annotated registry in Appendix 9, *Inventory of KSL Locations*.

Lastly, in addition to the basic phonological categories, additional features are required to account for the correct surface realization of locations on one or both sides of the body (across the centerline), and with regard to the combinatoric possibilities of the two hands interacting with body locations on either side of the body. These "lateral symmetry" features combine with phonological locations and are described at the end of the chapter, in §5.12.

This analysis of Location in KSL yields both typological findings and some theoretical contributions. These are noted throughout the text and summarized in the conclusion, but overall, locations in KSL are distributed in a roughly similar way to other sign languages in terms of the major partitions of the body. However, locations appear to be more likely to occur outside the constrained signing space that has been proposed for ASL and other European sign languages. These include locations on the hip/butt, thigh, areas behind the body, on the upper arm, and proportionally more signs on the top of the head. Contributions to theories of sign phonology are provided in the discussion about signs in neutral space (§5.10) and in a description of locations that are complex and/or indeterminate, which is provided at the end of Appendix 9. In particular, a discussion of signs with two locations—both two simultaneous locations and two sequential locations—demonstrates the need to be able to account for such signs in models of sign phonology.

5.2 The Location parameter in the literature and phonological theory

Compared to the other parameters, location is often viewed as a more solid, tangible part of the phonology, possibly because it can be easily observed and its manifestation is reinforced through prioperception of body contact. Psycholinguistic studies support a view of Location as easily graspable and durable. Marentette & Mayberry (2000) find that location is the earliest and most accurately-acquired phonological parameter for children learning sign language. Corina (2000) observes that it is one of the most resistant parameters to substitution or change under conditions of language impairment, such as aphasia. Poizner & Lane (1978) report that "sign experience does not substantially alter the perception of locations used in signing" (in Hildebrandt & Corina 2002: 106). And Emmorey et al. (2003) find no effect of categorical perception on location for either signers or non-signers, suggesting that it may be resistant to visual manipulation.[111]

Phonological evidence for location as one of the primary categories in sign phonology is demonstrated by the abundant cross-linguistic existence of minimal pairs for location, as well as

[111] I discovered a two anecdotal instances of misperception based on different categories across languages: (i) the KSL sign FINISH at the mouth often appears to ASL signers to be homophonous with the ASL sign FAKE at the nose, as the contact point of the index finger is perceived differently; (ii) in observing rapid KSL, ASL-fluent signers can fail to spot the sign GIRL/FEMALE that makes a fleeting contact on the ipsilateral breast. This anecdotal evidence hints that perception studies across languages might be informative about language-internal phonological categories.

evidence in 'slips of the hand' signing errors (Newkirk et al. 1980) and the existence of at least some errors in language impairment (Corina 2000). There is also a sense of the durability of Location at the phonological level. For example, in compounds that reduce to blends in ASL, the place of articulation in both signs in the compound are likely to be maintained (though possibly blended), while the handshape in one sign (usually the first sign) is typically lost (Liddell & Johnson 1986, Sandler 1989).[112]

Yet when it comes to the representation of Location in the three main phonological theories addressed in this thesis, this parameter exhibits the most divergence between models, compared to Handshape and Movement. Briefly, before explaining them more fully, the Hand Tier Model represents Location as separate segment type; the Prosodic Model represents locations exclusively as invariant inherent features; and the Dependency Model represents location as a class node with two dependent branches—one for invariant features and one for dynamic features (the latter licensing movement features). In the remainder of this section, I describe these models in more detail, using two ASL signs, IDEA and DEAF, to compare their features, and I provide a summary of these features in Table 13. I then explain the choices made in the current analysis of KSL phonology, and provide a list of features specific to KSL.

In Sandler's Hand Tier model (1989) location plays a structural role as one of the two sequential segment types, L segments, that make up sign syllables—the other being an M or Movement segment. Positing an L segment was Sandler's improvement upon several issues with Hold segments in Liddell & Johnson's model (these are detailed in §3.2 in the previous chapter). That is, Locations unlike Holds, do not readily delete, so rules for deletion and epenthesis are not required; and—once deleted—the surface structure does not contain several identical adjacent

[112] This is my own generalization based on the ASL lexicalized compound data presented by Liddell & Johnson (1989) and Sandler (1989), though neither makes this specific point.

segment types; e.g., the hypothetical sequence of signs that would result from an 'H-deletion rule' applying to all adjacent segments: 'HM M M M M MH.' Also, Ls and Ms diverge more in their feature bundles than Hs and Ms, which contain nearly identical features. Finally, Sandler states that no evidence has been presented that alternations of Holds yield minimal pairs, while there are minimal pairs on the basis of L segment alternations (1989: 22).

In her model, Sandler also makes a structural distinction between *Place*, a larger area on the body, and *Setting*, a sub-location within a Place. This is based on the generalization (Battison 1978; Mandel 1981) that monomorphemic signs stay within the same overall area, Place, but can move between specified sub-locations, Settings. Values for each category are shown in Table 13. Importantly, Setting features in Sandler's model are largely phonetic, an approach inspired by the original feature geometry proposals in spoken languages by Clements (1985) and Sagey (1986), in which a Place feature node dominates such sub-features as coronal, dorsal, and labial. For Sandler, taking articulatory facts into account makes for a more "revealing" phonology (1989: 47). Thus, binary Setting features are combined together to provide more precise sub-locations within one of the six Places.[113] For example, the ASL sign IDEA (Fig. 94a) has the staring Location near the temple ([head], [+ipsi], [+hi], [+contact]) and ends at a point above the head ([head], [+ipsi], [+hi], [+proximal]) (5a). And the sign DEAF (Fig. 94b) has two sub-locations in the Place [head], specified by the Setting features shown in 5b. Thus a cheek location is specified by a combination of [-hi] and [-lo], halfway down the head. van der Hulst & van der Kooij calculate that the Hand Tier Model thus yields a total 78 possible locations for ASL (2006: 277; van der Kooij 2002:169).

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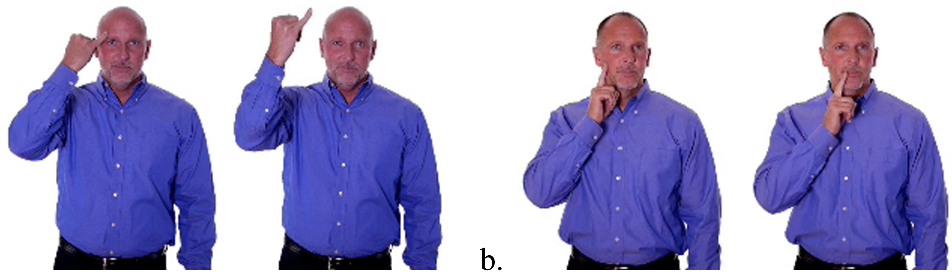
[113] Setting features in Sandler (1989) have been modified in Sandler & Lillo-Martin (2006), such that they are unary, not binary, and occur in dependency relations. However, specific locations are still obtained through combinations of Setting features, which is fundamentally different than the two other models presented here.



a. b.

Figure 94. ASL signs with different location specifications: a. IDEA, b. DEAF
(Images courtesy of SigningSavvy.com)

(5) *Features associated to L segments in IDEA & DEAF in Hand Tier Model (Sandler 1989)*

a. IDEA

L1	L2
Place: [head]	*Place*: [head]
Settings: [+ipsi], [+hi] [+contact]	*Settings*: [+ipsi], [+hi] [+proximal]

b. DEAF

L1	L2
Place: [head]	*Place*: [head]
Settings: [+ipsi], [+contact] [-hi], [-lo]	*Settings*: [+ipsi], [+contact] [+lo]

In Brentari's Prosodic Model (1998), the representation of location has three characteristics. First, this model makes a fundamental distinction between Inherent and Prosodic Features (IF, PF), and each set of features has its own branch in the underlying representation. Because monomorphemic signs stay within the same location, she treats this as a stable, unchanging—i.e., Inherent—aspect of each sign.[114] Second, Brentari follows Uyechi (1996) in proposing that all locations—both on the body and in neutral space—are specified for a *plane*. I.e, all POAs (Places of Articulation) are specified for one of three planes in three-dimensional space, where the body itself lies upon the frontal plane (see §5.10 for illustrations and further discussion of plane). In addition to the three planes, Brentari partitions the body into four "major

[114] Within the IF branch, Brentari uses the division of branching sisters Articulator (handshape) and POA from van der Hulst (1993) and van der Hulst & Mills (1996); i.e., hand is the active articulator and place of articulation is the passive articulator.

body regions" (head, arm, body, H_2)[115] that each have eight sub-divisions, or 32 body locations. Lastly, sub-locations in 'double contact' signs, like DEAF in (6b) are assigned Setting features, which have similar labels as Settings in the Hand Tier model, but which are limited to double contact signs. In addition, Brentari employs a [contact] feature at the top of the POA branch, and two lateral symmetry features, [ipsi] and [contra]. Altogether for ASL, the Prosodic Model posits 35 phonological locations on the body and neutral space, six setting features, and three additional location-related features.

(6) *Location features for* IDEA *&* DEAF *in Prosodic Model (Brentari 1998)*[116]

a. IDEA

POA: [forehead], [ipsi], [contact]

b. DEAF

POA: [cheek], [ipsi], [contact]
Settings: [ipsi], [contra]

The Dutch model (van der Hulst 1993, 1996; van der Kooij 1994, 1996; Crasborn & van der Kooij 1997) and its most recent incarnation, the Dependency Model (van der Kooij 2002), is characterized by three branching nodes in the underlying representation that are connected together in a single hierarchical branching structure; these represent the following class nodes: *hand configuration*, *location*, and *orientation*. Each of these three nodes contains two types of features in a head-dependency relation: (i) invariant features unique to each sign are in the head, and (ii) dynamic features are located in a dependent node with terminal branches containing two "split coordinate values" specific to each domain. This is described in more detail in Chapter 6, *Movement*, but with regard to location, the invariant features in the Passive Articulator

[115] These major body regions are not distinctive in the Prosodic Model, but Brentari points out that they can be referred to in a broad transcription of location; and she finds the symmetry of having eight distinctive locations per region to be a notable part of the phonology.

[116] Based on Brentari's description of planes, signs on the body are specified in the underlying representation for the *frontal plane*; however, only end node features associate to the skeletal tier; i.e., the features shown in (6)—with the exception of [contact], which is not an end node feature, but nonetheless associates to the skeletal tier.

(Location) node contain all the phonological locations that have been found to be phonemic in Sign Language of the Netherlands (NGT), shown in Table 13. In this model, the dynamic location features are Setting features and come in the following coordinate pairs: [ipsi], [contra]; [near], [far]; [high], [low]; [proximal], [distal]; and [ulnar], [radial]. Importantly, these Setting features are fundamentally different than those in either Sandler (1989) or Brentari (1998); i.e., they mark the relative beginning and end point in path movements and are therefore considered Movement, not Location features. The location features for IDEA and DEAF in this model are given in (7).

(7) *Location features for IDEA & DEAF in Dependency Model (van der Kooij 2002); (*dynamic location or movement features)*

a. IDEA
Location: [head:high], [ipsi]
*Setting**: [near]>[far]

b. DEAF
Location: [head:mid], [ipsi]
*Setting**: [ipsi]>[contra]

In terms of the number of locations in NGT using the Dependency Model, Van der Kooij uses relatively strict criteria for determining phonemic status, including the use of phonetic and semantic prespecification rules, which yields a much smaller number of phonemic locations than other models—only 11 in all. Van der Kooij also determines that the feature [contact] is not required in the phonology for the following reasons: (i) contact is predictable if the location is on the body; (ii) path features in the Dependency Model entail locations (via Settings), so contact is predicted even in "compound reduction"; (iii) contact features in sequential segmental models (i.e., Hand Tier) greatly overgenerate the distribution of [contact]; and (iv) contact has no predictive role in determining which signs can undergo Weak Drop in NGT (2002: 250-254, 274). With regard to the lateral symmetry features that dictate the ipsilateral, contralateral or centered position of a sign, van der Kooij posits only one necessary phonological feature, [cross], for signs in which the dominant hand crosses the body to take a position on the contralateral side. By contrast, /ipsi/ is the predictable, unmarked specification for lateral symmetry.[117]

Table 13. *Location features in three phonological models*

	FEATURE TYPE	PHONOLOGICAL MODEL **Sandler 1989**	 **Brentari 1998**	 **van der Hulst 1993, van der Kooij 2002**
1	Major area	head, neck, shoulder, arm, trunk	(neutral space, head, trunk, arm, weak hand)	- -
2	Specific locations	- -	top of head; forehead; eye; cheek/nose; upper lip; mouth; chin; under chin; neck; shoulder; clavicle; torso-top; torso-mid; torso-bottom; waist; hips; upper arm; elbow front; elbow back; forearm back; forearm front; forearm ulnar; wrist back; wrist front; palm; finger fronts; back of palm; back of fingers; radial side fingers; ulnar side fingers; tip fingers/thumb; heel of hand	plane, head:mid, head:high, head:mid=>high, head:high=>midneck, trunk, arm, hand:palm, hand:back, hand:side
3	Settings	+/-ipsi, +/-contra, +/-hi, +/-lo, +/-proximal, +/-distal	ipsi, contra, top, bottom, proximal, distal	(ipsi, contra; high, low; near, far, proximal, distal; ulnar, radial)*
4	Lateral symmetry	ipsi, contra	ipsi, contra	ipsi, crossed
5	Other	contact, restrained[118]	contact	- -

* dynamic features for location, discussed as path movement features in Chapter 6

Table 13 above presents the inventory of features in each phonological model. As mentioned in the previous paragraphs, the number of phonological locations varies widely between models, even between the first two that are both based on ASL. The Hand Tier model

[117] Note that van der Kooij also uses the same manner feature, [cross], for path movements that trace a cross or 'X' in space.

[118] Sandler writes, "A [restrained] location is characterized phonetically by the slight recoil from the place contacted that is found underlyingly in some signs (BITCH, CALL, i.e., 'to get someone's attention'), and in derived nouns such as CHAIR" (1989: 136). This feature is included here because it extends off of the L segment in the Hand Tier Model, though its properties appear to be more movement-like than location-like.

can designate up to 78 specific locations, the Prosodic Model encodes 35, while the Dependency Model specifies only 11 locations.

5.2.1 Theoretical approach to Location in this thesis

Signs in the KSL Lexical Database were coded for phonetic features that could in principle be compatible with any of these theories, but as explained in Chapter 3 and next in Chapter 6, this thesis adopts many of the assumptions about the internal structure of the sign that are shared between the Prosodic and the Dependency Models. In order to maintain consistency with other aspects in the phonology—especially Movement features, as explained in the next chapter—I follow the Dependency Model's definition of setting features as 'split coordinate values that represent path movement (i.e., from one setting within a location to another). I also use essentially the same lateral symmetry features as the Dependency Model ([ipsi], [crossed]; see §5.12) and agree with van der Kooij that contact does not need to be specified as a separate phonological feature.

However, the analysis here diverges from the Dependency Model in a couple of ways. First, instead of using minimal, ordered hierarchical locations (e.g., "head:mid=>high"), I have identified specific individual locations that are more akin to those in the Prosodic Model; e.g., [nose], [hand-ulnar], [hips], etc. This decision was made for two reasons. First, the KSL data contains more contrastive locations than would be permitted with the DM's limited set of features. And second, using individual specific locations with the labels of major landmarks better satisfies one of the overarching goals of this project: to allow for easier and more transparent cross-linguistics comparisons. At the same time, I do not find evidence in KSL for the same eight subdivisions within each major area that Brentari lists for ASL in the Prosodic

Model. As will be shown in subsequent sections in this chapter, the number of locations varies within each major area, on the basis of the criteria outlined in §5.4.

Also, this analysis diverges from both the Prosodic Model and Dependency Model with regard to signs in neutral space. First, I find that neutral space itself can be specified as a phonological location rather than a null location. And second, while 'orthogonal planes' in neutral space are useful in encoding circular path signs, I describe in §5.10.1 how 'plane' in NS is otherwise too ambiguous as a phonological construct for the majority of signs in neutral space—i.e., those with straight and arc paths. For these signs, I find that axis features (e.g., using the Dependency Model's settings features) are sufficient. This analysis is presented in §5.10.

The inventory of location features for KSL is presented in Table 14 below for comparison with features in the other models. Altogether, I propose 37 specific locations for KSL, which compares with 35 for ASL in the Prosodic Model, 78 potential locations for ASL in the Hand Tier Model, and 11 locations for NGT in the Dependency Model.

Table 14. *Location features proposed for Kenyan Sign Language*

	FEATURE TYPE	**Kenyan Sign Language** *(current analysis)*
1	Major area	- -
2	Specific locations	neutral space; face; side of face; top of head; forehead; eye; nose; upper lip; mouth; teeth; tongue; cheek; ear; chin; under chin; neck; trunk whole; trunk upper; trunk lower; shoulder; armpit; thigh; hip; arm whole; upper arm; forearm dorsal; forearm ventral; elbow; h2 whole; h2 palm; h2 back; h2 ulnar; h2 radial; h2 fingertips; h2 between fingers; over shoulder
3	Settings	(ipsi, contra; high, low; proximal, distal; ulnar, radial)*
4	Lateral symmetry	ipsi, cross
5	Other	- -

* dynamic location features for path movements

Throughout the chapter, terms for aspects of the Location parameter are used; these have specifically-defined meanings in this thesis, described in below in 8.

(8) *Terms involving location used in this thesis*

a. **Location:** (capitalized) the overall phonological parameter that involves all features related to place of articulation

b. **phonological location:** a location that is distinctive in KSL, based on various types of evidence

c. **phonemic location:** a phonological location that is contrastive with another phonological location on the basis of minimal pairs

d. **major area:** the partitioning of body and neutral space into a few overall zones—*head*, *neck*, *trunk*, *leg/thigh*, *non-dominant limb*, and *neutral space*

e. **position:** the place within a phonological location that is dictated by lateral symmetry features; i.e., ipsilateral, contralateral, and center

f. **sub-location:** in dispersed signs (§6.5.7), the two places within a phonological location where syllables are articulated

g. **setting:** the split coordinate values in path movements that pick out the relative beginning and ending points of a path axis (high<>low; ipsi<>contra; proximal<>distal), following the Dependency Model

h. **place, region, area, site,** and **point:** neutral terms to describe aspects of location

In this section, I have discussed how Location has been represented in theoretical models and compared types of location features between models, and then provided an inventory of the phonological features proposed for locations in KSL. In the next section, I provide a quantitative overview of phonological locations in the KSL data, prior to describing the characteristics of locations by major areas in the rest of the chapter—e.g., head, trunk, etc.

5.3 Overview of locations in KSL

The phonetic coding of the KSL Lexical Database yielded a total of 65 phonetic locations, which are listed with their quantities in Appendix 7. As described in the methodology for this project (Chapter 2), phonetic categories were refined during the coding process as more signs were progressively added and could be compared with each other. Thus, the phonetic locations already reflect some degree of categorization. From these 65 descriptive categories, a further analysis finds a total of 37 phonological locations. These determinations were made on the basis of the specific diagnostic criteria that are described in the next section, but here I present an overview of the quantitative findings.

In Figure 95 below, the 37 phonemic locations are shown from most-to least frequent. This chart includes all 1,880 monomorphemic signs in the phonological analysis. Three categories (totaling 137 signs) are marked with asterisks and require further explanation: unsure, two-location, and variable. These three categories include: (i) 37 signs that have two clear location designations, either locations that are ordered sequentially or that occur simultaneously and are described at the end of Appendix 9; (ii) 100 "unsure" signs with various issues that are grouped into nine categories that are also described at the end of Appendix 9; and (iii) two signs, BITE-1 and STING listed as "variable" because the location can be changed to reference different parts of the body.[119]

In Figure 95, a striking difference can be seen in the number of signs in *neutral space* compared to locations on the body. Several aspects of neutral space (NS) in KSL are addressed at the end of this chapter in §5.10, including the status of NS as a phonological location and the possible division of NS into orthogonal planes or other partitions, i.e., vertical and lateral subdivisions. In brief, it is found that NS is a single phonological location, and is not divisible into individual phonemic locations like the head and non-dominant limb, for example. Even when all phonological locations are grouped together into major areas, as shown below in Figure 96, neutral space is still much more frequent, with 41.7% of the signs in the lexicon. This

[119] It is likely that there are a few of these variable location signs in most sign languages. Van der Kooij cites a few in NGT, including TATTOO and PAIN-ON-THE-ARM (2002: 195). And ASL has SURGERY, HURT, CUT and others (Marla Hatrak, p.c.)

compares to 25.5% of signs on the head, 22.3% on the non-dominant limb, 7.2% on the trunk, 1.4% on the neck, and ≥1% on 'over shoulder', leg, and 'other' (the two 'variable' signs).[120]

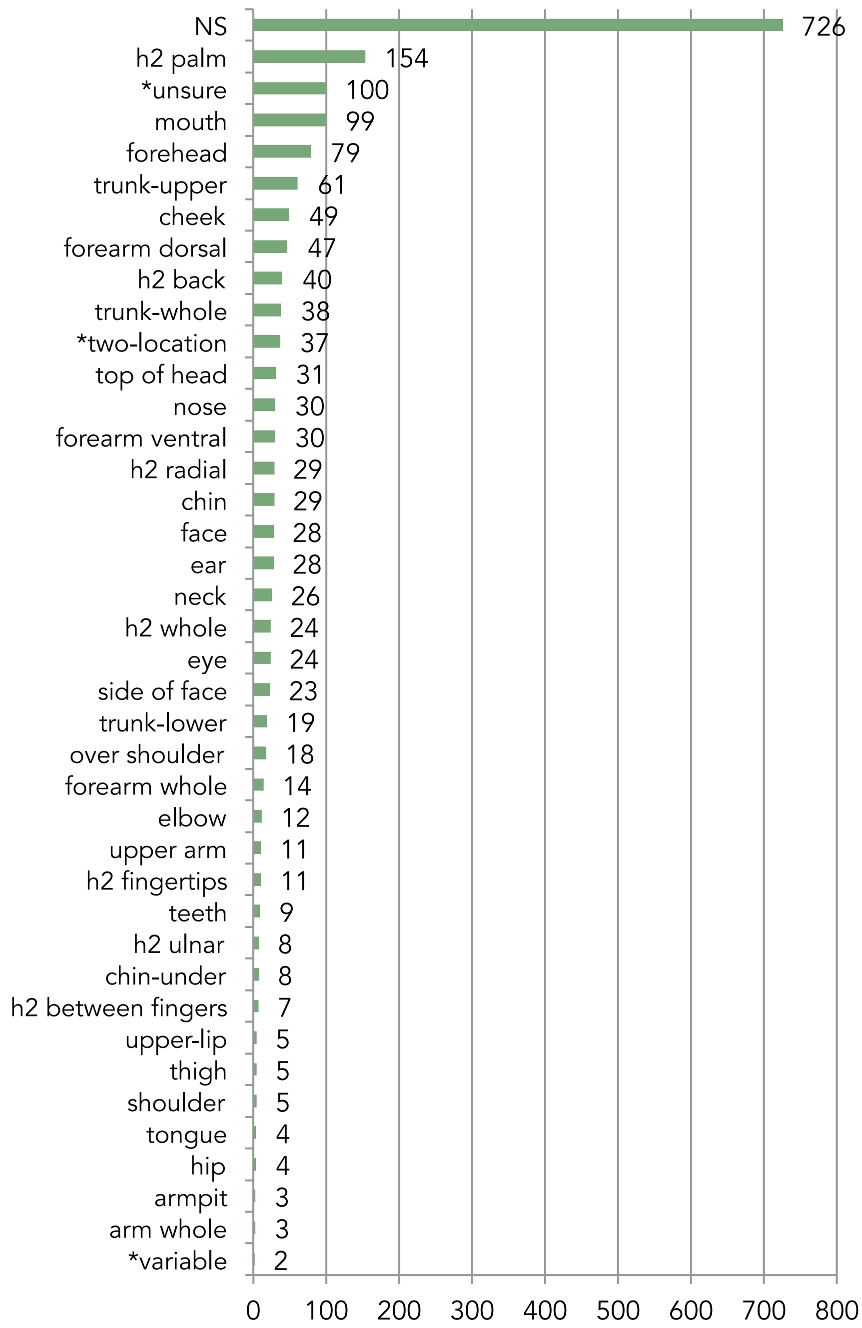


Figure 95. Number of signs in 37 phonological locations in KSL, plus three additional categories(*) (1,880 signs)

[120] *Neck* and *over-shoulder* are listed separately because there is mixed evidence for grouping them with other locations; see *neck* in §5.6 and *over-shoulder* in Appendix 9, #22.

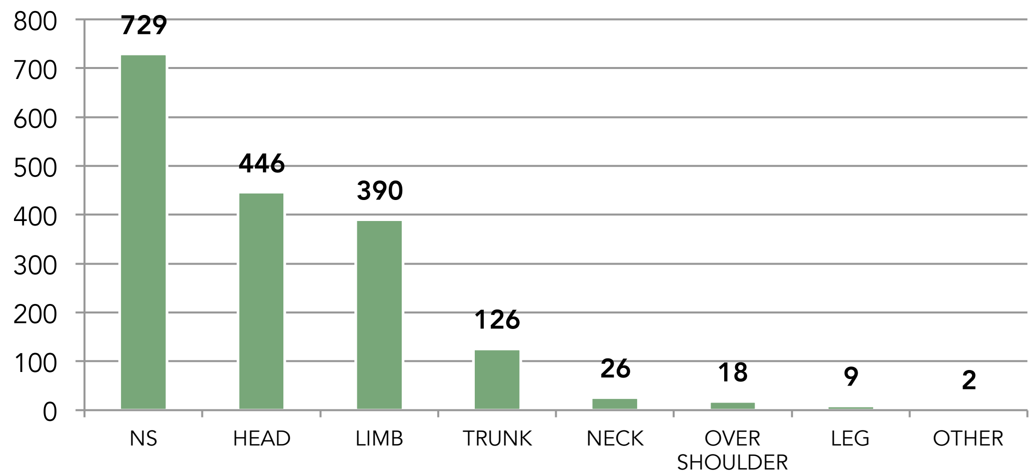


Figure 96. Major areas in KSL (1,746 signs, with 'unsure' not included)

These groupings of KSL locations into major areas are comparable to those in other sign languages. Figure 97 shows the proportion of signs in six sign languages by major area. Some caution is warranted because in the first four languages (ASL, Korean SL, NZSL, and Finnish SL), Rozelle (2000) seems to have counted some two-handed signs in neutral space as having a hand/h2 location, whereas the Sign Language of the Netherlands (NGT; van der Kooij 2002) and KSL have classified the same signs as being in neutral space. Despite that, there is a notable consistency cross-linguistically: most signs are produced in neutral space, followed by the non-dominant hand and head (in different orders), with trunk, arm, and neck occupying a consistently smaller proportion of the lexicon. However, KSL stands out for the higher proportion of signs on the arm. This is discussed further in §5.9, but suggests a propensity for more 'proximal' (closer to the body) signs on the non-dominant limb.

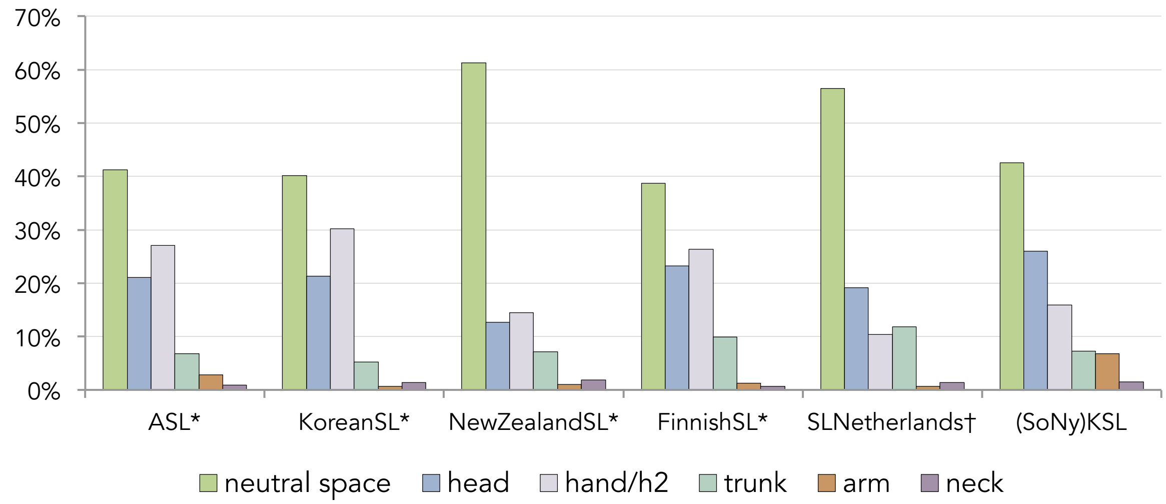


Figure 97. Proportion of signs in different major areas in six sign languages (*Rozelle 2000; †Kooij 2002)

What about lexical contrast between these phonological locations? When the 37 locations are compared for their relative contrastiveness, a clear difference between the major areas is apparent. Figure 98 shows the total number of minimal pairs for each phonological location—out of a total of 177 pairs, shown from most-to-least frequent. When contrasts in head locations are considered separately, they account for a striking 52.0% of all contrasts, followed by 24.6% of all minimal pairs being on the non-dominant limb locations, 11.0% on the trunk, 6.5% in neutral space, 3.1% on *neck*, and only 0.6% each for the leg and *over-shoulder*. Appendix 8 provides a chart of all location contrasts found in the dataset.

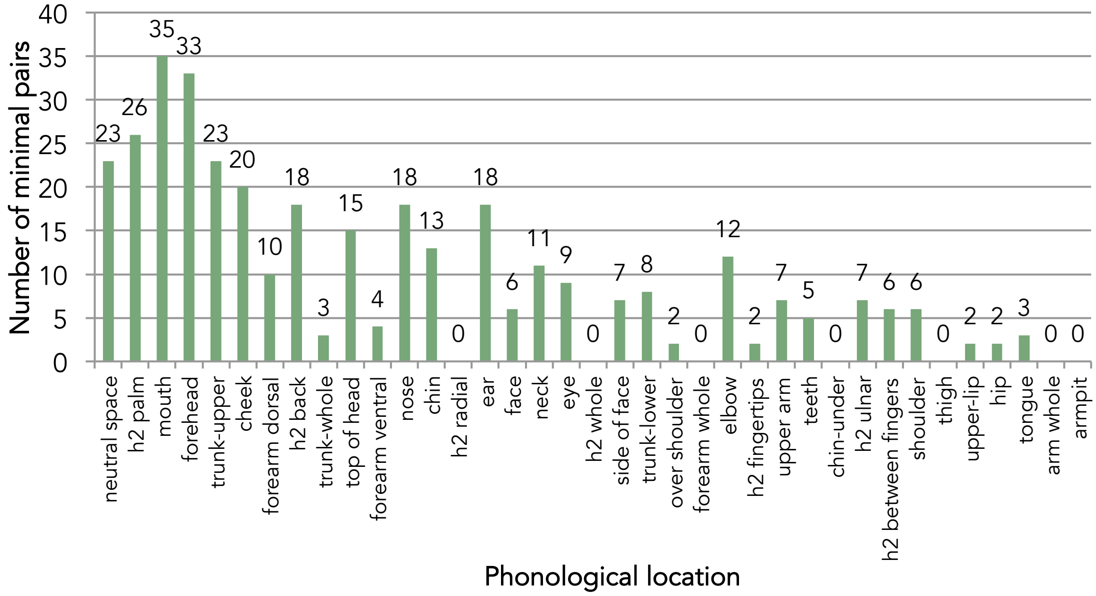


Figure 98. Number of minimal pairs for all 37 phonological locations (177 total minimal pairs; sorted by most-to-least frequent location in database)

This distribution of contrasts also seems to show a frequency effect between minimal pairs and occurrence in the lexicon, such that a location is more likely to be found in a minimal pair the more often it occurs in the lexicon. The graph of this relationship first discussed in Chapter 3 is repeated here in Figure 99.

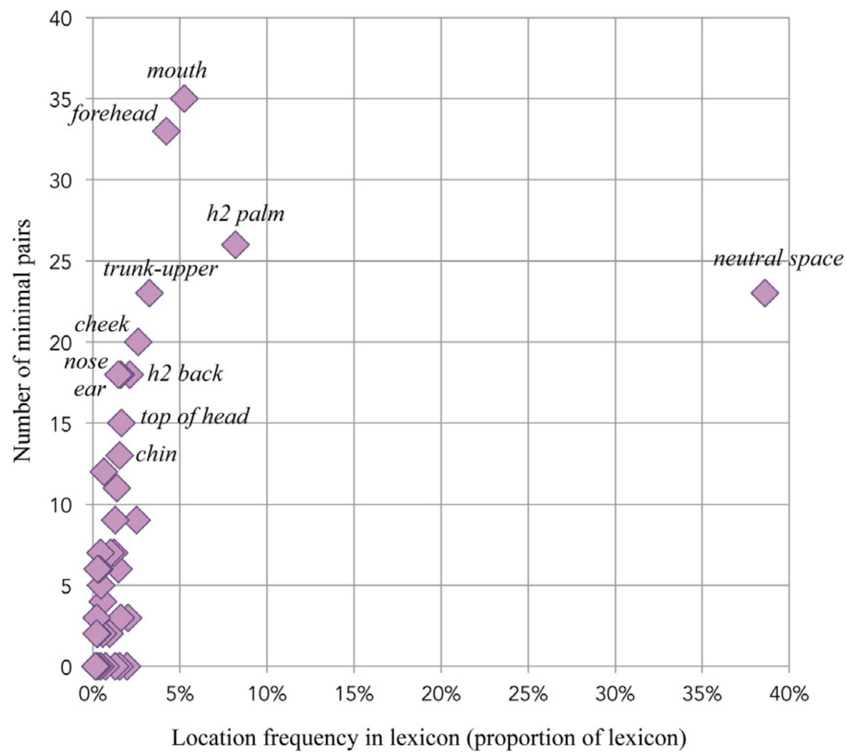


Figure 99. Relationship of the number of minimal pairs by location with frequency in distribution of location prime minimal pairs

Altogether, this data shows that KSL is relatively similar to other sign languages in its overall proportion of locations by major areas. When it comes to lexical contrast, there is no equivalent data for other sign languages, but we can observe an interesting trend: minimal pairs are more likely to be found on the head in KSL than other areas. A portion of this trend may be explained by a frequency effect on minimal pairs, but there are other likely explanations as well, which are explored below in the section *Head*, in §5.5.

Having provided a quantitative overview of phonological locations in this southwestern dialect of KSL, I will turn to the descriptive analysis of the locations themselves. Yet this first requires an explanation of how the 37 phonological locations were determined.

5.4 Criteria for determining phonological locations

A key aspect of the analysis of location in KSL has been the identification and systematic use of several diagnostic criteria for determining the boundaries of a phonological location.

These nine criteria are listed in (9), and all but 'substitutability' were applied to the data, where it was relevant. Some of these diagnostics are standard across modalities (e.g., minimal pairs, substitutability, phonetic tokens), while others are specific not only to the sign language modality, but to the Location parameter in particular (e.g., continuous contact signs, dispersed signs, and arc path signs).

(9) *Types of evidence for determining a phonological location:*

1. **Minimal pairs**: two signs that differ only by location, while all other aspects (handshape, orientation, movement) of the sign are the same
2. **Continuous contact or Parallel path signs**: a path movement parallel to the surface of the location that moves either in a straight line from one point to another or in a circle that encompasses the external boundary (or sometimes center; e.g., *trunk-upper*, *forearm-dorsal*) of the location
3. **Dispersed signs**: the same syllable repeated at two sub-locations that are evenly distributed within the boundaries of a phonological location; e.g., 'double contact' signs
4. **Arc path**: path with an arc shape that starts and ends on the location (i.e., not including arc paths with other contact patterns)
5. **Delineation**: spread of hand(s) throughout the extent of the location by spreading/extending the fingers to match the area, or by placement of both hands throughout the location; includes the modification of finger aperture to match the size of a location
6. **Center point**: contact by a handpart with a very small surface area, such as the fingertip; can be diagnostic for the center of an area or for degrees of variation, especially in high frequency signs
7. **Citation form default**: intentionally precise articulation in which the hand makes contact at an idealized point
8. **Phonetic tokens**: individual instances of the same sign that is articulated or makes contact at slightly different sites within an area; elucidates the allowable boundaries of a phonological location
9. **Substitutability**: the sign would be incorrect if not signed in a specific region; i.e., how far is too far away?

Importantly, these nine types of evidence are mutually reinforcing, meaning that one type of evidence can predict another and can provide additional means of confirmation for the boundaries of a location. For example, as shown in Figure 100, one can predict that the contact point in an end-contact sign (Fig. 97d) will land between sub-locations in a dispersed sign (100c), and that the beginning and end point in a continuous contact sign (100b) will at least extend as far as the sub-locations in a dispersed sign.[121]

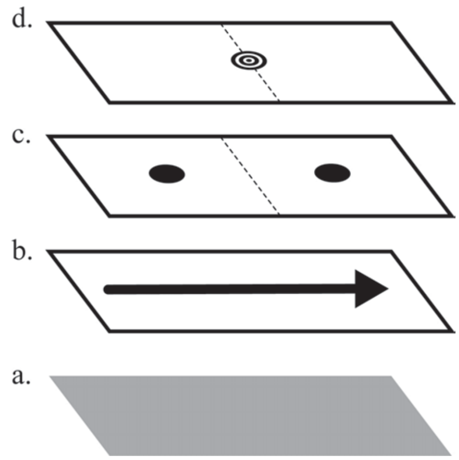


Figure 100. Schematic depiction of how sign types relate to location: a. boundary of phonological location, b. continuous contact sign, c. sub-locations in dispersed sign, d. center point[122]

Minimal pairs, as explained in Chapter 3, are the primary type of evidence for determining a phonemic location. For location primes, unlike handshape primes and movement features, the data from the sign types listed in (9) provide supporting evidence for categorical boundaries where minimal pairs are lacking. This was important for two situations in the analysis of location: (i) adjacent locations without minimal pairs (e.g., *mouth* and *chin*) and (ii) locations without any minimal pairs (e.g., *h2 radial*, *chin-under*). In both cases, regularities in the other types of evidence (e.g., delineation, center point, continuous contact, etc.) can be used to demonstrate that these are categorical units in the phonology. At the same time, the lack of lexical contrast in these situations may be informative about phonetic or other pressures on the phonology in ways that present an opportunity for further investigation.

[121] Other factors can cause a continuous contact path to shrink (e.g., being bidirectional), or to lengthen (e.g., for prosodic reasons, such as in emphatic forms).
[122] The form of this schematic was inspired by Uyechi (1992).

It should also be noted that not all criteria can be used in all locations. For example, *arc* signs of the type useful for determining location (i.e., with a path that starts and ends on the body, but is above the location during the rest of the path) do not occur in most locations; e.g., *mouth*, *h2-palm*, *ear*, etc. Also, certain criteria were more helpful in some locations than others. For example, phonetic tokens were very useful in determining the boundaries of *forehead* and its [+ipsi] realization, the temple, while they were not determinative in a large location like *trunk-upper* with less density of signs per area. And finally, substitutability could not be systematically employed for this project due to lack of regular access to signers, although elicitation sessions did sporadically employ questions about licit productions and confirmation checks.[123]

Previous phonological descriptions of Location in different sign languages have relied upon some of this evidence (e.g., Friedman 1976, van der Kooij 2002),[124] but not often in a fully transparent and systematic way; and phonological descriptions of Location also often lack quantification or sufficient visual representation of the data (e.g., photographs, drawings, or notation system like Stokoe Notation or the Hamburg Notation System). Thus, while the diagnostics provided here are not new in the literature, this is the first analysis of Location that explicitly brings all the evidence together as an internally consistent set of criteria, and systematically applies it in a transparent way. This thesis therefore represents a new approach to linking evidence in the lexicon to phonemic location categories.

The evaluation of each location takes into account all of the criteria listed in (9), which is presented in detail in Appendix 9 for each of the 37 phonological locations. In the sections that

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[123] Many KSL signers, especially the ones who participated in this project the most, exhibit confident and internally consistent phonotactic judgments.

[124] Friedman (1976) in particular is notable for drawing upon several types of location evidence: minimal pairs, double contact signs, continuous contact signs, end contact, phonetic variants, frequency, and exact location of fingertip contact.

follow, I provide a summary of these results, organized by six regions: head (§5.5), neck (§5.6), trunk (§5.7), leg (§5.8), non-dominant limb (§5.9), and neutral space (§5.10). Each section will describe patterns unique to each area, highlight signs in this southwestern dialect of KSL that appear to be typologically noteworthy, and compare the KSL data with other sign languages, where possible. Finally, a discussion of lateral symmetry features is presented in §5.11, and the conclusion in §5.12.

5.5 Head

The area of the head contains fourteen phonological locations, shown in Figure 101. This overall area is notable for several reasons. First, the biggest proportion of signs on the body are found on the head, in 41% of body location signs (or 24% of all locations, when neutral space signs included). Signs on the head also have the greatest number and density of phonological locations—14 in relatively small area, compared to 13 locations on the bigger non-dominant limb, five locations on the trunk, and one location each for *neutral space*, *neck*, and *over-shoulder*. Finally, as explained in §5.3 above, signs in this area participate in just over half (52%) of all the location minimal pairs. In this section, I first present the quantitative results of head locations, then suggest some phonetic and semantic reasons for the unique properties of the head. I also provide a summary of the evidence for locations on the head, and briefly address how the locations in KSL compare to other sign languages.

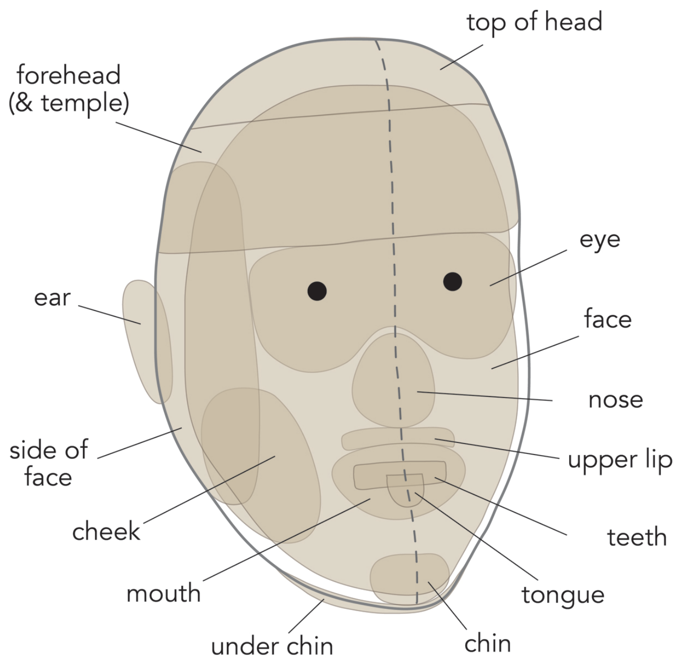


Figure 101. Phonological locations on the head

The number of signs in each of the fourteen head locations are shown in Figure 102 below. One location, *mouth*, stands out as the most frequent, followed by *forehead* and *cheek*, and then seven locations that all have 25-30 signs each, and finally four with a small number signs (all in the vicinity of the mouth).

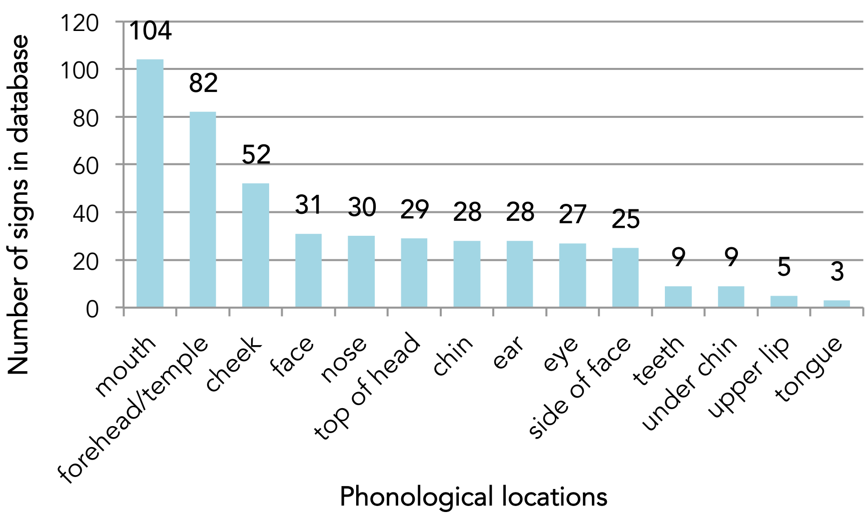


Figure 102. Number of signs in 14 phonemic locations on the head (462 total signs)

As noted, the head has the highest number of location contrasts per area, and this includes several minimal pairs solely within the head, as shown in the chart in Figure 103, and sign pair example, MANGO-1 and BEER in Figure 104. *Forehead* (including the ipsilateral forehead, or temple) has the most contrasts, followed by *mouth* and then *ear*, and so on.[125] Note that within this smaller dataset we see the same frequency effect mentioned above, with more minimal pairs found in locations that are more frequent in the lexicon overall; this is illustrated in Figure 103 by the greater density of contrasts in the top left corner of the chart.

	mouth	forehead	cheek	nose	chin	face	ear	top of head	eye	side of face	teeth	upper lip	tongue
mouth	17												
forehead	5	23											
cheek	2	2	11										
nose	2	5	1	11									
chin		3	2		7								
face	1					3							
ear	4	3	2	1	1	1	14						
top of head	2	2	1	1		1		8					
eye	1	1		1			1	1	5				
side of face					1					2			
teeth		1					1				3		
upper lip		1								1		2	
tongue			1								1		2

Figure 103. Minimal pair contrasts solely on the head (54 pairs; in left-to-right order of most to least frequent location in the lexical database)

Figure 104. Minimal pair that contrasts within the head: a. MANGO-1 (*mouth*), b. BEER (*forehead*)

[125] Note that locations that take lateral symmetry features (i.e., in all major areas except the non-dominant limb) must be matched by these features to be minimal pairs. See §5.12 for a description of lateral symmetry features.

The abundance of phonological locations on the head is probably driven by multiple factors, originating in different phonetic conditions as well as the iconic affordance of locations on the head. With regard to the perception of linguistic signals, this part of the body is highly accessible during communication because interlocutors tend to watch a signer's face while signing. Emmorey et al. (2009) found that both native and beginning ASL interlocutors fixated on the face of a signer approximately 87% of the time while a story is being told. The point of fixation is important because visual acuity is sharpest at the center of the eyes' focus and drops off as distance from the focal point increases (Siple 1978).[126] In practical terms, this means it is much easier for a signer to notice the difference between a contact point at the *forehead* versus the *chin*, for example, than it would be to notice a difference of the same absolute distance but far away from the focal point; e.g., at the *clavicle* versus the *sternum* (which both fall within the same phonological location, *trunk upper*, in KSL) Thus, this perception-related factor itself may account for the high number of signs on the head in the lexicon as well as multiple instances of lexical contrast.

The head is also a rich semantic resource, as the seat of sensory organs for sight, smell, taste, and hearing and their associated physical landmarks (not to mention evolutionarily-ancient neural connections for each sense): eyes, nose, mouth, tongue, ears. The importance of these senses is apparent by their persistence in the lexical semantics of the world's languages (Majid & Levinson 2011, Winter 2016). From a purely typological point of view, therefore, the use of such landmarks in sign languages as metonymic referents is unsurprising, and indeed many KSL signs use these locations as semantic sources in word formation; e.g., signs with a *temple* location

[126] "Although the human visual field extends about 160 degrees horizontally and 120 degrees vertically, only objects in the center of the visual field can be easily perceived." (Crasborn 2001: 42)

often have lexical semantic meanings related to cognition, signs on the *mouth* can reference different foods or adjectives related to taste senses, and signs on the *ear* can be related to hearing or deafness. Appendix 9 provides further details about the source of semantic motivation for some of the phonological locations in KSL. Thus, the lexical semantic productivity of head locations may also play a role in its relatively high frequency.

The evidence for locations on the head was determined by a combination of all the criteria listed in §5.4 above and which is detailed by individual location in Appendix 9. Using a combination evidence was especially helpful for less frequent locations.

With regard to the minimal pairs evidence, the 32 lexical contrasts within the head are depicted graphically in Figure 105. Note that minimal pairs for adjacent locations are attested in a number of cases, such as the *top of the head* and *forehead*, *forehead* and *eye*, *eye* and *nose*, *cheek* and *ear*, *cheek* and *mouth*, etc. Yet not all adjacent locations have contrast, which might suggest that they are allophones of another location category. For instance, there are several adjacent locations on the lower face without contrasts, such as *mouth* and *chin*, *nose* and *upper lip*, and *mouth* and *upper lip*. However, for these cases, other sign types supplementary evidence that supports their categorical independence. For example, continuous contact signs demonstrate the boundaries of a phonological area. Figure 106 shows a schematic of these path movements (with straight vertical, straight horizontal, and circular paths) on different head locations, showing that while there may not be minimal pairs between some locations, path movements are constrained to these specific locations. In addition, the sub-locations of dispersed signs also pick out the boundaries of phonological locations, by two points that are distributed evenly throughout a phonological location. A schematic of all sub-locations in dispersed signs on the head is shown in Figure 107.

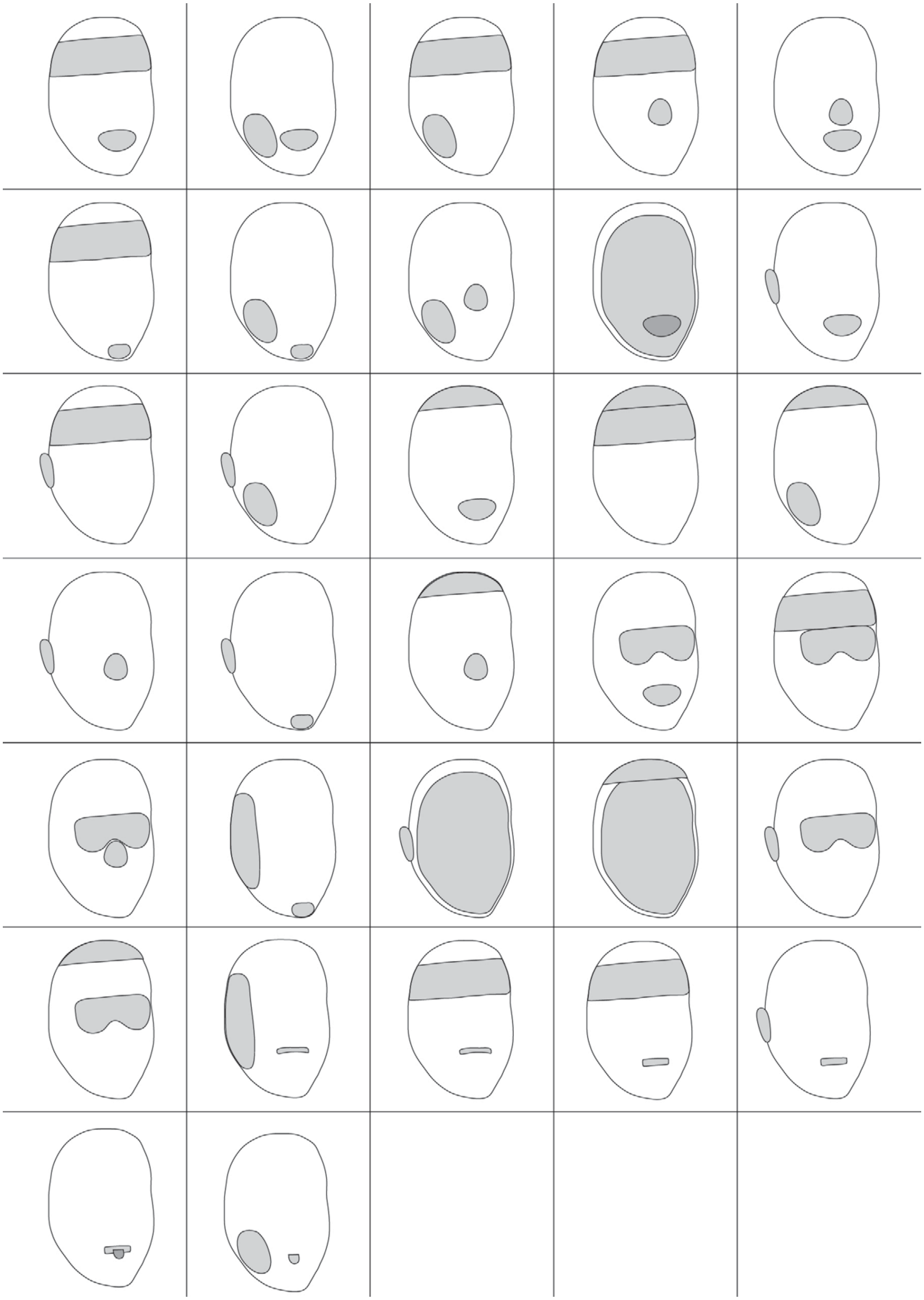


Figure 105. Thirty-two minimal pair contrasts on the head found in KSL

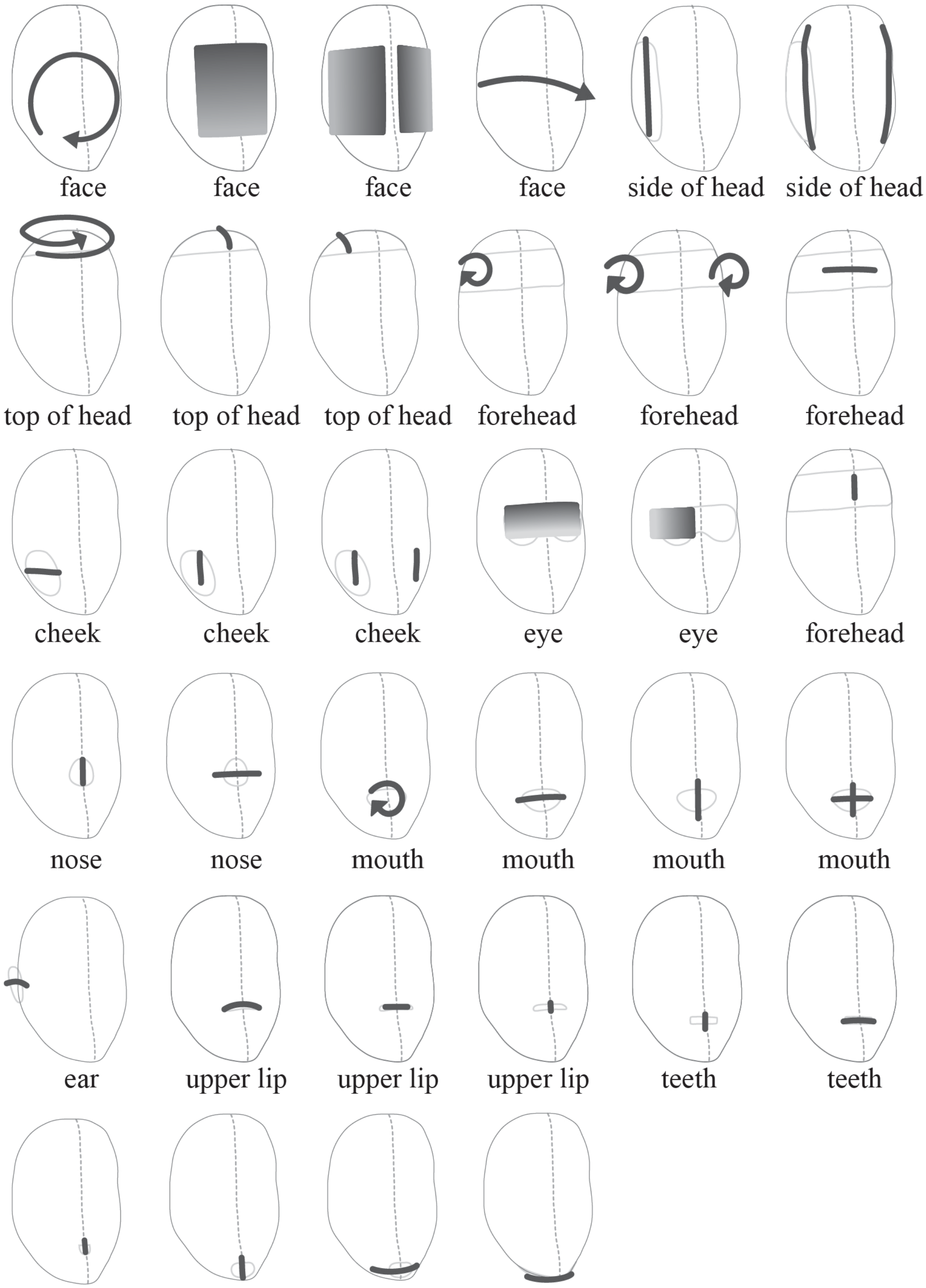


Figure 106. Types of parallel path/continuous contact signs on the head

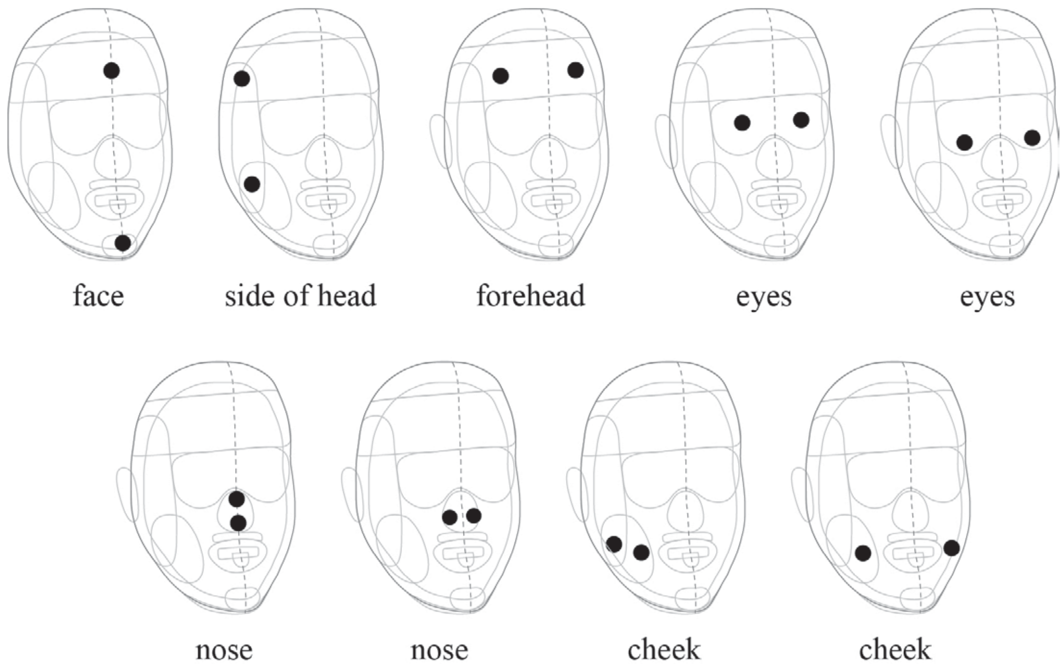


Figure 107. Sub-locations of dispersed signs on the head

Lastly, most locations have examples of delineation, in which the extent of the hand spreads across the entire phonological area, or demarcates it with a handshape aperture, such as a *claw* handshape. Where relevant, these are illustrated for each location in Appendix 9, as are relevant data regarding the center point of locations, citation defaults, and variable phonetic tokens.

However, for adjacent locations without minimal pairs, the possibility that one location is an allophone of another must also be considered. The results have shown that for the most part, there are no conditioning environments that could account for different realizations of one or the other adjacent location, with one exception. The ipsilateral forehead (temple) has two slightly different allophonic realizations, which are correlated with semantic motivation and number of hands. That is, one-handed signs related to cognition appear closer to the eye, while two-handed signs related to animal ears, horns, or antennae occur higher and in a more lateral position on the head. These are illustrated in Appendix 9, #4.

How do these results compare with other sign languages? First, the degree of contrast within the head runs counter to an observation about NGT that there "appear to be very few signs within these major areas that differ in their location only" (2002: 160). This suggests a potentially important difference between these two languages of a sort that has not been described before—i.e., solely on the basis of lexical contrasts. At the same time, there may be methodological factors that account for this difference. That is, van der Kooij does not encode location specifications for signs that are completely motivated by semantics (e.g., iconic references to headgear or horns as "things you put or have on your head" [2002: 201]). This may have removed signs from the NGT analysis that are associated with the senses on the head, but this needs to be confirmed. Van der Kooij proposes only four phonological locations on the head.

In ASL, there have been many different proposals for phonological head locations (e.g., Stokoe 1960; Sandler 1989; Brentari 1998; Liddell & Johnson 1989), and all of them create slightly different divisions within the head; *forehead* is the only consistent location between these inventories. This makes it difficult to compare specific locations in KSL with ASL.

However, for both NGT and ASL, *tongue* and *teeth* are not listed as phonological locations in the previous literature. In contrast, both locations are listed in Hausa Sign Language (in Nigeria), as possible locations, with a minimal pair between them; i.e., signs for 'kola nut' and 'rice' (Schmaling 2000: 90). This resembles a minimal pair in KSL, BEANS-1 (*tongue*) and RICE-1 (*teeth*). In addition, Kata Kolok in Bali, Indonesia also lists the tongue and teeth as locations; e.g., UYAH 'salt' (*tongue*) and PUTIH 'white' (*teeth*) (Marsaja 2008:143).

It bears mentioning that a phenomenon seen in head locations in ASL involving a shift to a lower location on the head is not found in KSL. Specifically, in ASL at least two highly frequent signs on the temple, namely KNOW and THINK, can be signed on the cheek rather than the temple, and signs whose etymology originally made iconic reference to the mouth—e.g., RED and EAT—are now usually articulated on the chin. These types of shifts are not found in KSL, and might be interpreted as poorly formed signs or even different signs by KSL signers. I offer a speculative proposal here that this lack of location shifting in KSL, combined with high degree of lexical contrasts on the head may signal a greater categorical rigidity in head locations in KSL compared with ASL, and also suggest a more complex phonology of location on the head in ASL (and possibly NGT)—something that may have developed over the longer lifetime of ASL compared to KSL.

To summarize this section, locations on the head are particularly numerous and dense, with a much higher proportion of lexical contrast than in other areas of the body and neutral space. Several reasons for these patterns were suggested, from those involving perception to physiology to semantics, or a combination of all three. The locations *teeth* and *tongue* were addressed as potentially typologically infrequent, and it was observed that KSL does not exhibit the same kind of location lowering on the head that occurs in frequent ASL signs.

5.6 Neck

There are 26 signs in the KSL Lexical Database on the phonological location, *neck* (1.3% of the database), and it occurs in 11 lexical contrasts with all of the major body regions. Examples of signs in this location are shown in Figure 108, illustrating that signs on *neck* can appear on the center/midline of the body (e.g., LIKE), the ipsilateral side (e.g., BLOOD-1, SWEET), and the contralateral side (e.g., ROBBER-2). More details about the *neck* location are provided in Appendix 9, #17.

Figure 108. Signs on *neck* with different lateral positions: a. LIKE (center), b. BLOOD-1 (ipsilateral), c. SWEET (ipsilateral), d. ROBBER-2 (contralateral)

Previous analyses of the neck location in ASL and NGT have been split about how to classify this region. Should it be considered part of the head, the trunk, or its own major area? Sandler (1989) classifies *neck* in ASL as essentially its own major area by attaching it as a branch off of the Place node,[127] while Brentari (1998) groups it with the major area trunk/torso. In her analysis of NGT, van der Kooij (2002) treats *neck* as its own phonological location and not categorically tied to a major area; however, she points out that in the NGT sign DIRTY, "the extended thumb touches the contralateral side of the neck. This implies that we may link up the neck into one category with the chest rather than with the head" (2002: 189). This is because signs that only contact the contralateral side of the body are not found on the head in NGT.

In KSL, it was found that *neck* patterns with both the head and the trunk regions, though in different ways. First, *neck* behaves like a location on the head in its distribution of one- and two-handed signs. While handedness is relatively evenly split on the trunk with 54% one-handed

[127] A 2006 update to Sandler's model shows it has been removed from the Place node, but it's not clear how the update now specifies this location (Sandler & Lillo-Martin 2006: 176).

signs and 45% two-handed, handedness is very uneven on the head, with 78% one-handed signs and only 21% two-handed. On the neck, fully 90% of the signs are one-handed, so it strongly resembles the head in this dimension.

Yet with regard to lateral position, the neck patterns with the trunk, similar to NGT. In KSL, there are up to a dozen signs on the trunk that are contralateral-only (e.g, PATIENCE, CANADA, etc.), while the head has no contralateral-only signs, despite the fact there are many more signs on the head than the neck or the trunk. By comparison, there are two or three contralateral positions on the neck in KSL: ROBBER-2 (Fig. 108d), CRY-FOR-HELP (Appendix 9; #17), and possibly TO-COMPLAIN-1. Thus, *neck* in KSL can be treated as its own region (and distinct phonological location) that is both physically and phonologically in between two major areas with their own characteristics.

5.7 Trunk

There are 126 signs in the lexical database (7.2%) with locations on the *trunk* or *torso*. I have identified five phonological locations for KSL in this region: *trunk whole*, *trunk upper*, *trunk lower*, *shoulder*, and *armpit*, illustrated in Figure 109. In comparison to locations on the head, the absolute size of the trunk is much larger, yet there are many fewer signs located in this area, as well as fewer contrastive locations. This presumably relates to the area of visual acuity discussed above (Siple 1978), because if an interlocutor is looking at the signers face, small distinctions on the trunk are less likely to be perceived.

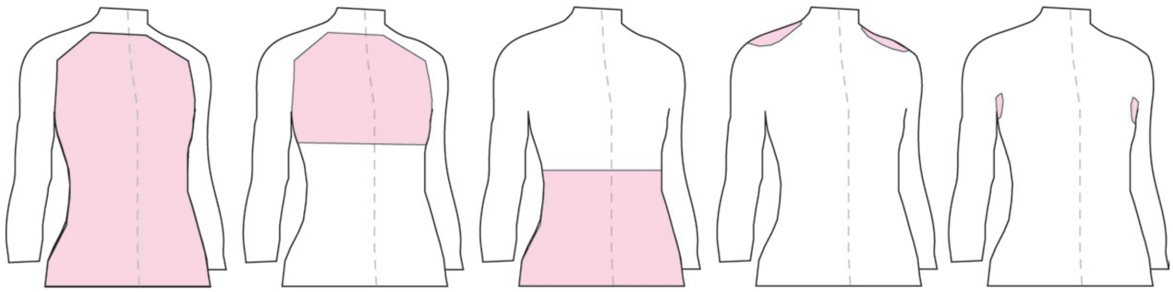


Figure 109. Five phonemic locations on the trunk (left to right): *trunk-whole*, *trunk-upper*, *trunk-lower*, *shoulder*, *armpit*

Locations on the trunk contrast with 17 phonemic locations on other parts of the body in 28 minimal pairs, as shown in Table 15. *Trunk-upper* is found in many more contrasts than the other trunk locations, while signs produced at the *armpit* occur in no true minimal pairs.

Table 15. *Number of minimal pairs between locations on the trunk (columns) and other phonological locations (rows)*

	Location	trunk whole	trunk upper	trunk lower	shoulder	armpit
1	face		1	1		
2	top of head		2			
3	forehead		1			
4	temple		1		1	
5	eye		1			
6	ear		1	1		
7	nose		1		1	
8	cheek		1	1		
9	mouth		1	1		
10	tongue				1	
11	neck		1			
12	forearm ventral		1			
13	forearm dorsal			1		
14	elbow-raised		1			
15	h2 palm		1	1		
16	h2 back		1			
17	neutral space	2	1	1		
	total pairs:	***2***	***16***	***7***	***3***	***0***

In addition to having a relatively low density of phonological locations in this region, there are almost no contrasts made between trunk locations. Only one possible minimal pair, HAVE-1 VS. YOUTH (Fig. 110), could be found, which contrasts *trunk upper* and *trunk lower*. This pair also differs by palm orientation, but this is likely due to non-distinctive phonetic differences.[128] The only other near-minimal pairs that could be found on the trunk are likewise contrastive only between the upper and lower trunk with no other trunk-internal contrasts found; e.g., GIRL vs. PROSTITUTE; MY vs. STOMACH; WEEKEND-2 vs. SKIRT; T-SHIRT-1 vs. HUNGRY-2 (*trunk-upper* listed first in each pair, followed by *trunk-lower*).

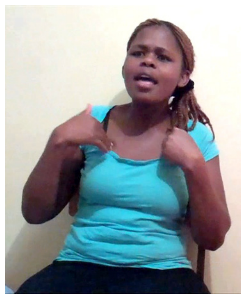
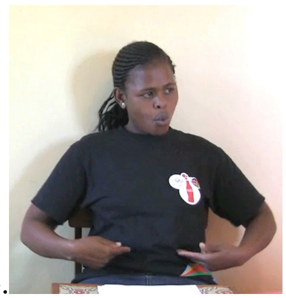
a.  b. 

Figure 110. Minimal pair for *trunk-upper* and *trunk-lower*: a. HAVE-1, b. YOUTH

In searching for minimal pairs between the trunk and other locations, I discovered that one reason why it might be hard to find such pairs is related to the number of hands in signs on the trunk: 48% of signs in this area are two-handed. Because the number of hands in a sign is contrastive in KSL (discussed in Chapter 8), minimal pairs for location must be matched for such handedness features. This lowers the likelihood of finding minimal pairs with head locations, 78% of which are one-handed, and locations on the non-dominant limb, which are one-handed by default. In other words, with around half of the signs on the trunk being two-handed, the possible minimal pairs for location with those two other populous areas, head and limb, are halved. Also, signs on the trunk have characteristics that would not be easy to articulate in other places on the body, such as in a smaller location on the head. For example, a two-handed alternating sign like RWANDA (polysemous with 'gorilla') in which the fists strike the torso alternatingly or the sign PREGNANT on *trunk lower* that has a vertical high>low arc (see

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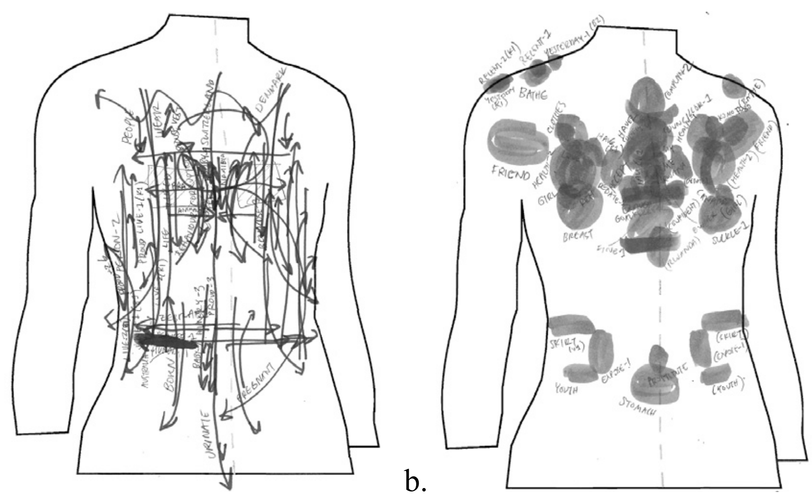
[128] For example, see the variation in orientation in double contact signs on *trunk whole* in Appendix 9, #9. These signs first contact the contralateral side of the upper torso and then the ipsilateral lower torso (e.g., KING, SISTER, NYANGWESO-PRIMARY-SCHOOL, etc.), and exhibit a change in palm orientation simply due to the mechanics of the arm and hand joints.

Appendix 9, #9 and #21). These signs would be very hard to articulate on the *chin* or *ear*, for example.

Another aspect of locations on the trunk is that they are less constrained than locations on the head, with larger paths and contact points. This necessitated a new way to assess the boundaries between phonological locations. Figure 111 shows drawings of the distribution of parallel path signs (mostly two-handed signs shown in this graphic, Fig. 111a) and the delineation of simultaneous contact points (Fig. 111b). These helped to reveal a distinction between upper and lower trunk locations, whose concentration can be observed in these drawings. In addition, there is an overall trunk location, *trunk whole*, in which the hands move between upper and lower trunk or contact both domains in a way that is similar to how *forehead* and *chin* represent the two poles of the overall *face* location. Examples of signs that fit these generalizations are shown in Appendix 9.



a. b.

Figure 111. Hand drawings of signs on trunk: a. parallel path (continuous contact) signs (mostly two-handed), b. the delineation of the hand(s) in all end-contact signs

More evidence for the patterned division of the trunk is found in dispersed signs (Fig. 112) with two dispersed types contacting *trunk whole*, one type on *trunk upper*, and one on *shoulder*. *Trunk lower* and *armpit* do not have any dispersed signs.

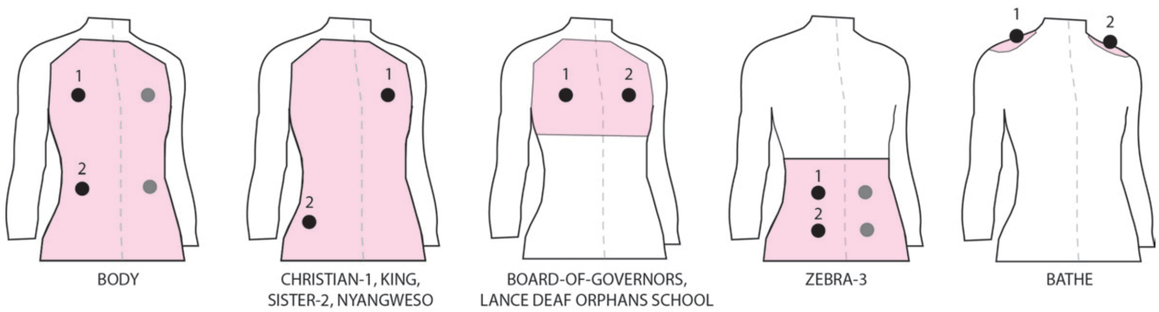


Figure 112. Dispersed signs on trunk locations

Comparisons of trunk locations in KSL versus other sign languages are difficult for the same reasons discussed for the head; that is, location categories within the same language vary by linguist. Within ASL, categories on the trunk range from one (Stokoe 1960) to six (Brentari 1998). For NGT, Crasborn recognizes three phonetic locations, while van der Kooij proposes only one phonological category. However, there is a degree of similarity between all analyses and KSL, with one exception, *armpit*. Uyechi claims there are no ASL signs at the armpit (1996: 83), and it is not mentioned in van der Kooij's description of NGT, nor in descriptions of Hausa Sign Language (Schmaling 2000) or Adamorobe Sign Language (Nyst 2007). The only language I have found so far that lists it as a location is Kata Kolok; e.g., IPAH 'brother-in-law' (Marsaja 2008: 145). Therefore, this appears to be a particularly unusual location cross-linguistically.[129]

To conclude, phonological locations on the trunk are relatively large and the combined evidence for the physical boundaries of these locations shows that these locations are not as tightly bound as locations on the face or non-dominant hand, for example. However, there is sufficient evidence to argue for these five locations as distinct in KSL, as supported by the evidence shown in Appendix 9.

[129] I have observed a Kenyan sign name that uses the armpit, which further suggests its productivity in KSL, even if it is very uncommon.

5.8 Leg

There are nine signs on the body below the level of the trunk that were coded in the database as occurring on the leg. These nine signs can further be distinguished by whether they are produced on the *thigh*, as with TROUSERS-1 (Fig. 113a), TROUSERS-2, and UNDERPANTS-1 (Fig. 113b); or produced at the *hip*, such as DEFECATE-2 (Fig. 113c), SHEEP-1 (Fig. 114a), and MONGOOSE.

Figure 113. Signs on the leg: a. TROUSERS-1 and b. UNDERPANTS-1 at the thigh, c. DEFECATE-2 at the hip

Only one minimal pair is found in either *thigh* or *hip*: SHEEP-1 on *hip* contrasts with MOTHER-1 on *trunk-upper* (both on ipsilateral side).

Figure 114. Minimal pairs for *hip* and *trunk-upper*: a. SHEEP-1, b.MOTHER-1

A location on the leg is worth noting because it is outside of the classic "signing area" that was established for ASL, which doesn't go lower than the bellybutton (Klima & Bellugi 1979: 51, 73). In the phonetic coding of NGT (from a corpus), van der Kooij documents no signs on the body that were below the waist and only 0.4% of signs in neutral space that were below the waist (2002: 183-184). In her phonological analysis of NGT, therefore, only [trunk] is included as a phonemic location, but not leg, hip, or thigh.

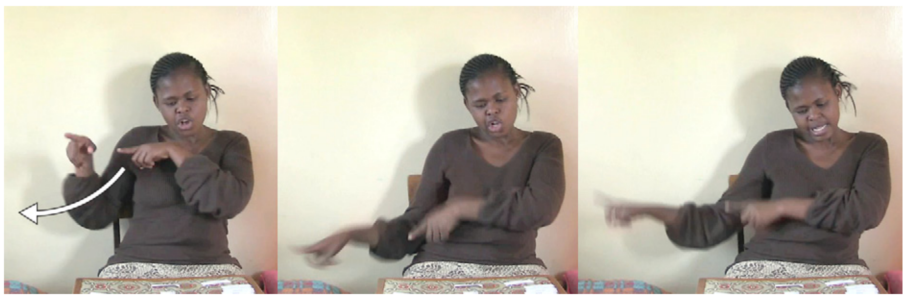
If we take the phonological evidence from §5.4 into account, the patterns of movement on the leg and hip argue for them as separate locations in KSL. This conforms to patterns described in two other African sign languages, including Adamorobe Sign Language (AdaSL; in Ghana) in which nine signs have *leg* as a location (Nyst 2007: 66), and Hausa Sign Language (in Nigeria) with "about a dozen signs" that have *thigh* or *hip* as a location (Schmaling 2000: 90). However, AdaSL is different than KSL in that the leg can be the sole *active* articulator (i.e., FOOTBALL is articulated only with the movement of the leg), while the leg in KSL is usually a passive articulator, or in a very few cases, a co-articulator with the hand. The *thigh* and *hip* locations in KSL appear to be more similar to the passive articulators in Hausa Sign Language. Not that the sign language Kata Kolok in Bali, Indonesia also lists *hip/buttock* as a location (e.g., SUNTIK 'injection'; Marsaja 2008:143).

Although this is still relatively meager evidence, I hypothesize that one common feature of African sign languages, no matter their age, population size, or complexity, may turn out to be this kind of larger signing space in general that includes signs on the legs, on top of or above the head, and behind the signers body.

There are also a few signs whose locations are in the same vicinity, but exact location difficult to conclusively determine (they are not included in the nine mentioned above).

DIARRHEA-1 (Fig. 115a) was coded as connected to the torso, but this particular token may be signed higher because of analogy with a compound that has the first sign on the stomach. This also mimics the pattern of URINATE-1 (Fig. 115b) in which the hand starts on the stomach and arcs downward, almost to the knees. These will need to be followed up on with more signers, but shows how KSL permits very long path movements outside of the usual signing space described for other sign languages.

a.



b.

Figure 115. Signs uncertain for location on trunk: a. DIARRHEA-1, b.URINATE-1

Note that it was considered whether *hip* was actually *thigh +ipsilateral*, but *thigh* already has an ipsilateral side. That is, there are signs in each location that are on the ipsilateral side, but do not overlap; e.g., SHEEP-1 on *hip*, TROUSERS-3 on *thigh*. Therefore, *thigh* and *hip* can be regarded as separate phonological locations, though used much less frequently than other locations.

5.9 Non-dominant limb (arm and h2)

Locations on the non-dominant limb, from *upper-arm* to *fingertips*, are considered altogether here because to their similar characteristics, discussed below. Previous treatments of the non-dominant limb in the literature have tended to separate hand locations from non-hand limb locations (e.g., Battison 1978, Brentari 1998, Schmaling 2000), but using the diagnostics in §5.4, the KSL data indicates that the boundary between the hand, wrist, and forearm is not strongly demarcated. Indeed, the phonetic variability of signs up and down the arm presents a bit of a challenge in determining the phonemic categories on the limb, as will be explained. In this section, I first offer a summary of the findings regarding locations on the non-dominant limb (supplemented by details in Appendix 9), then discuss several noteworthy aspects and generalizations about signs in this major area.

There are 405 signs on the non-dominant limb in the KSL Lexical Database, representing 21% of all locations in the database.[130] The analysis of the non-dominant limb, utilizing all the types of evidence applied for other areas, has yielded a total of thirteen phonological locations in this overall area, depicted in Figure 116.

[130] Not included here are 135 signs coded primarily as occurring in neutral space, but with aspects of h2 involvement. These include: (i) h2 acting as a horizontal base for the h1 forearm (e.g., FOREST-2); (ii) h2 as the beginning or end point in a sequential two-location sign (e.g., GOAL); (iii) connected two-handed signs that move together (e.g., SHOW); (iv) two handed signs with an immobile h2 that is physically distant from the h1 articulator (e.g., TO-BEAT-2, PANGA-2); and (v) some two-handed dispersed signs articulated both on h2 and moving through NS (e.g., TO-DEBATE-2, HAY).

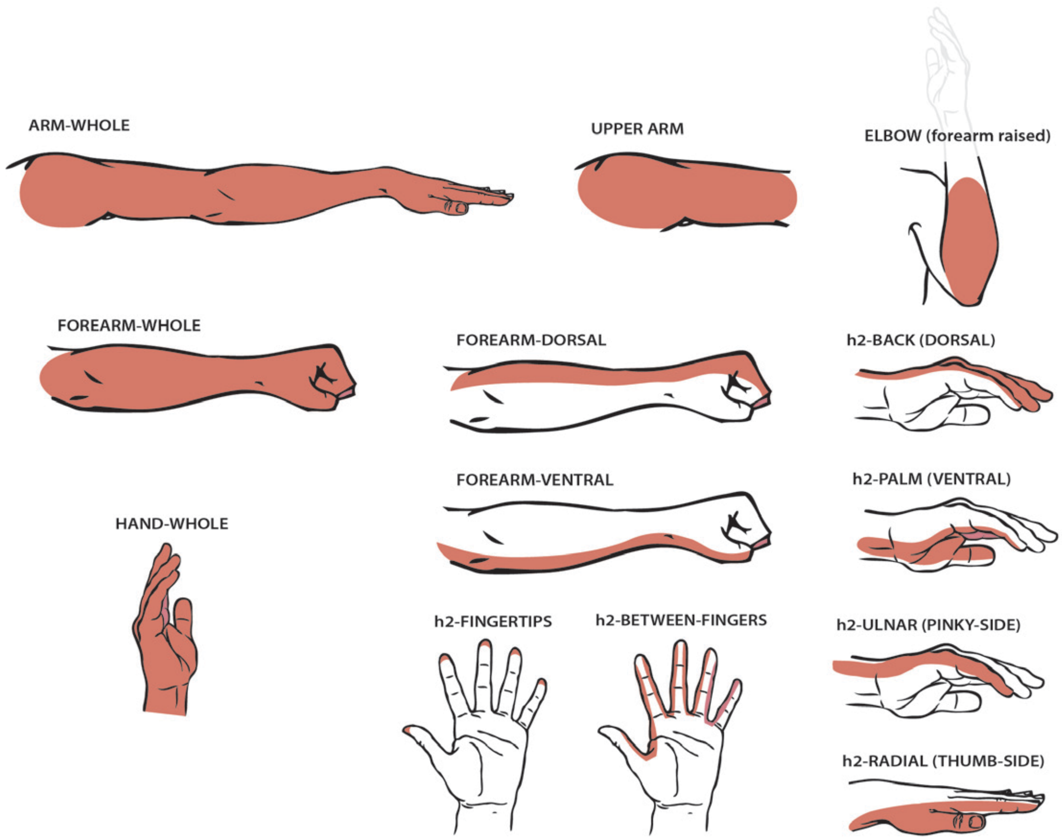


Figure 116. Thirteen phonological locations on non-dominant limb

This evidence is presented in detail in Appendix 9, but is summarized in this section.

First, nine out of the thirteen locations involved a dispersed sign, as shown in Figure 117.

Second, the most salient demarcation on the limb is between the *upper arm* and locations on the forearm (including the hand), with *upper arm* being clearly and consistently distinguished by the phonemic criteria established in this chapter, such as parallel paths (e.g., HOSPITAL-2; Fig. 118a) and dispersed signs (e.g., POLICE-BOSS; Fig. 118b).

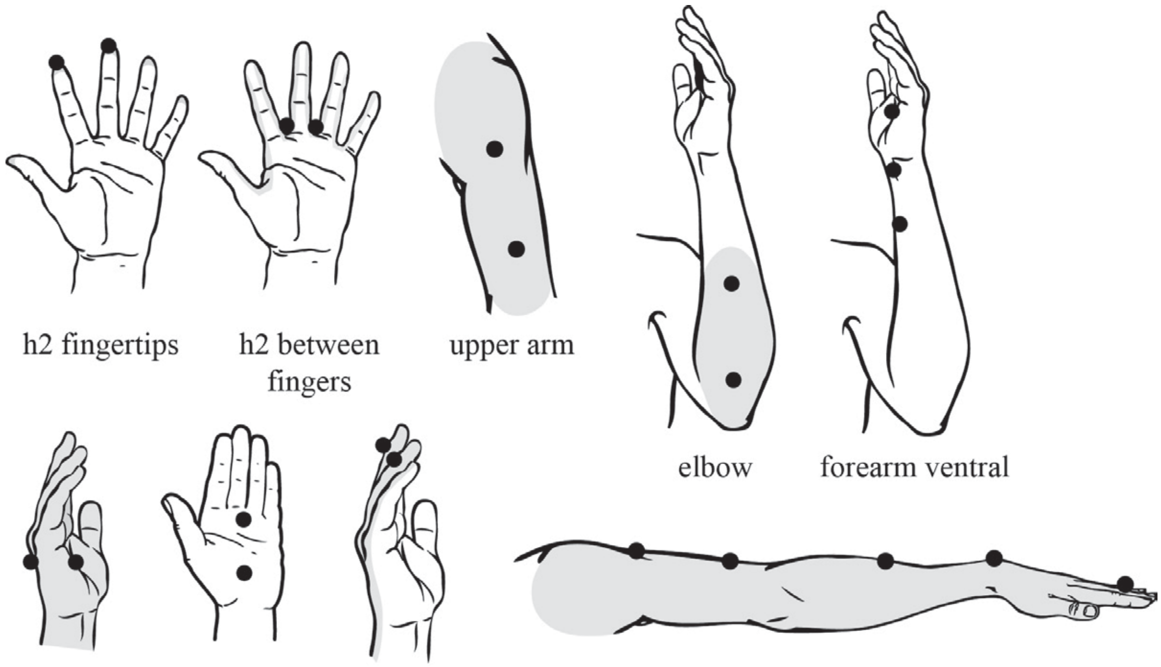


Figure 117. Dispersed signs on non-dominant limb

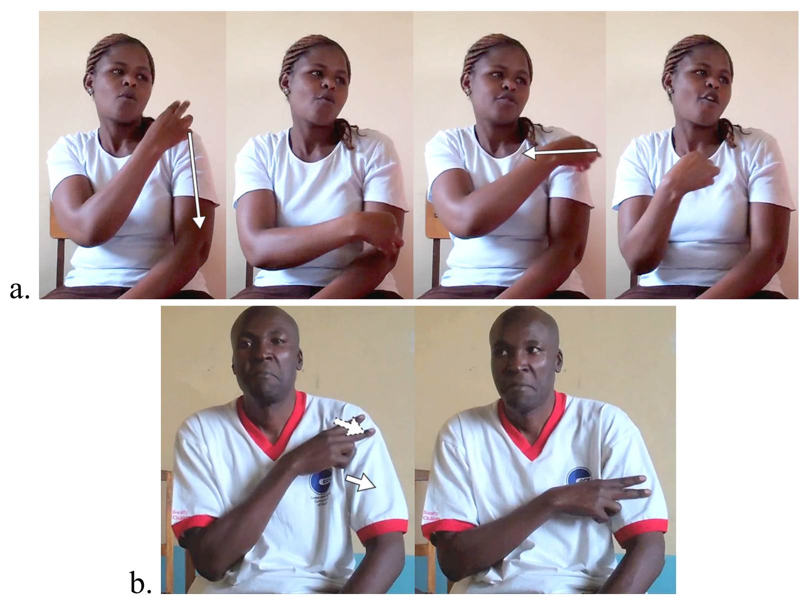


Figure 118. Sign evidence for *upper arm* location: a. HOSPITAL-2 (parallel path) POLICE-BOSS (dispersed sign)

Only three signs move across the elbow boundary from the forearm to the upper-arm and are designated as arm-whole: IMPROVE and WORSEN (Fig. 119) and ARM. This is admittedly scant evidence for phonemic status of this location, and further elicitation is called for to determine if *arm whole* is truly its own category.

a.  b.

Figure 119. Dispersed signs that extend along the entire arm: a. IMPROVE-2, b. WORSEN

Within the forearm, the next most salient demarcation is the side of the forearm; that is, ventral (palm-side), dorsal (back-side), ulnar (pinky-side), and radial (thumb-side). This side-based demarcation is supported by various evidence: (i) the number of lexical contrasts on the basis of side of the forearm/hand (see Fig. 125, below), (ii) signs located on the ulnar side that spread freely down the forearm, and (iii) examples of phonetic variants up and down the arm for the ventral and dorsal sides, but no corresponding signs that vary on the basis of side of the forearm. That is, the lengthwise boundaries are more permeable than the side-based boundaries.

In the other dimension, up and down the forearm, there is a distinction between the forearm and the hand in many signs—i.e., they could not be freely substituted with each other—but, as mentioned, this distinction is more permeable than the side-of-forearm distinction, as shown by signs that move from the back of the hand to the middle of the forearm (e.g., TO-SHAVE, TABAKA-1 in Fig. 120) and some signs with variants that can occur either on the forearm or on the hand (e.g., KIKUYU-1 in Fig. 121, AFRICA-1).

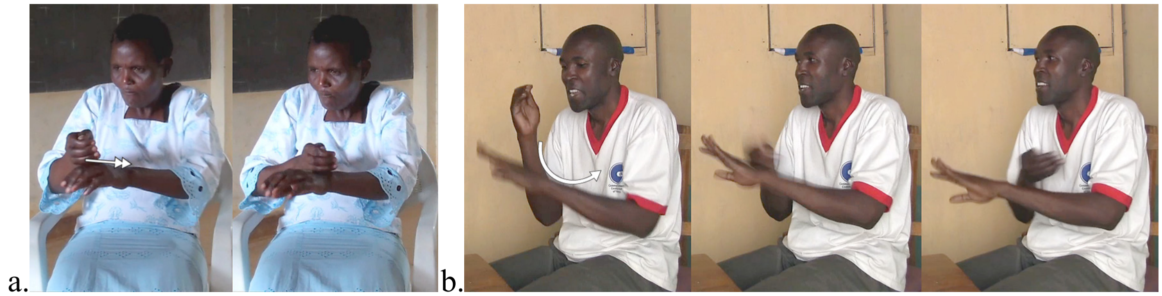


Figure 120. Signs with beginning and end points on either side of the wrist: a. TO-SHAVE, b. TABAKA-1 (a Kenyan town)

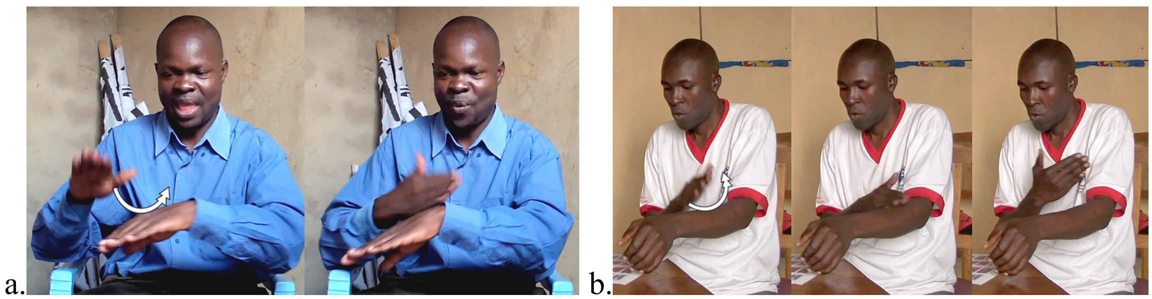
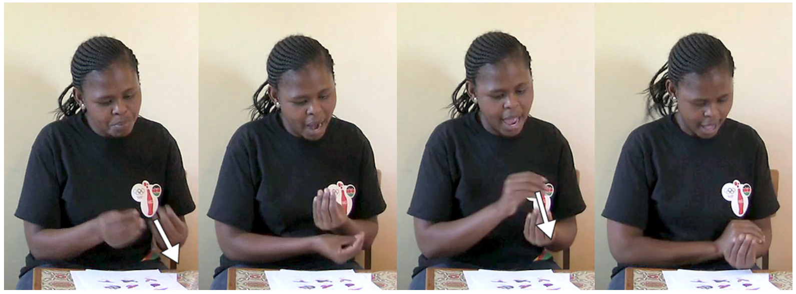


Figure 121. Different locations for the same sign, KIKUYU-1: a. Signer O1 on *h2 back*, b. Signer B1 on *forearm dorsal*

Another factor is that the manifestation of the specific position along this lengthwise dimension seems to be largely driven by factors related to a preference for the hand location (described below) rather than the establishment of lexical distinctions between the two sub-domains (hand and forearm). This does not mean that the designation isn't a real one and encoded in the phonology, but the categories of hand and forearm are not directly in contrast with each other in the lexicon. This may be due in part to the fact that the hand is nested within the forearm, as shown by signs that start at the fingertips and either extend to base of the hand (e.g., BANANA in Fig. 122a) or start at the fingertips and extend down the forearm (e.g., HARVEST in Fig. 122b).

a. 

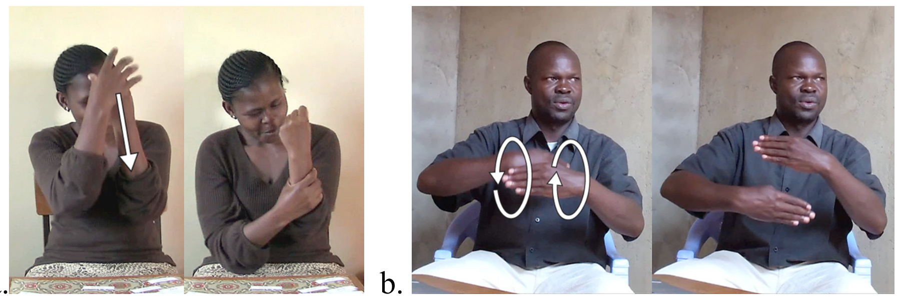
b. 

Figure 122. Parallel path signs showing the extent of the hand versus forearm: a. BANANA (h2), b. HARVEST (forearm)

Note that this 'nesting' relationship is different from another potential type of demarcation on the forearm in which the hand, wrist, and forearm locations would be contiguous and non-overlapping. This latter type of division appears to be what is described for other sign languages. Whether this is a cross-linguistic difference with KSL or is due to differences in the analysis remains to be seen. With regard to the wrist, there is no evidence that it is a distinct location in KSL; there are no continuous contact signs constrained only to the wrist and no lexical contrasts with adjacent areas. At the same time, there is phonetic variability from the back of the hand to the forearm for some frequent signs, like TIME (see Appendix 9, #7).

For the remaining five locations on the non-dominant limb, three of them are phonetically distinct from each other and participate in lexical contrasts: *elbow*, *h2 fingertips* and *h2 between fingers*. Only for *elbow* are there some remaining questions because it is only realized when the forearm is raised upright, presenting the possibility that it could be an allophonic realization of *forearm-dorsal*. The evidence for this is mixed and requires follow-up.

Finally, some signs involve contact and/or parallel paths on both ventral and dorsal sides of the limb, either sequentially (e.g., the dispersed signs BANANA and HARVEST in Fig. 122) or simultaneously with physical contact (e.g., CONDOM-3 in Fig. 123a) or proximity only (e.g., CLOTH/FABRIC in Fig. 123b). Based on the extent of the contact down the forearm, they are designated as having either a *hand-whole* or *forearm-whole* location.



a. b.

Figure 123. Contact patterns of *forearm-whole* locations: a. CONDOM-3, b. CLOTH/FABRIC

Locations on the non-dominant limb have some noteworthy characteristics. First, there is a particularly lopsided distribution in this overall region. As shown in Figure 124, 40% of signs are located on *h2-palm* and the next most frequent location is *forearm dorsal* with 12% of signs on the limb. The remaining eleven locations are all below 10%. In this respect, it is unlike the head (and torso, to a lesser degree), which also has one more frequent location, *mouth*, but the other locations are distributed more evenly on the head.

This pattern reflects a second noteworthy aspect of the non-dominant limb, which is a trend toward *distalization* of locations; that is, signs are located further from the trunk and toward the hands. Only ~3% of signs are on the upper arm, 22% are on the forearm, and 66% are on the hand. Equivalent data from other sign languages shows a similar pattern in which most signs occur on the non-dominant hand (Rozelle 2003). However, other sign languages are even more distalized than KSL. Rozelle's analysis of four historically-unrelated sign languages—ASL, Finnish SL, Korean SL, and New Zealand SL—shows that these languages have only between 0.7%-2.8% of signs with a location more distal than h2 (i.e., wrist, forearm, elbow, upper arm).[131] By comparison, 6% of KSL signs are more proximal than the hand, which is substantially different than other languages and represents a third noteworthy observation about signs on the non-dominant limb in KSL.

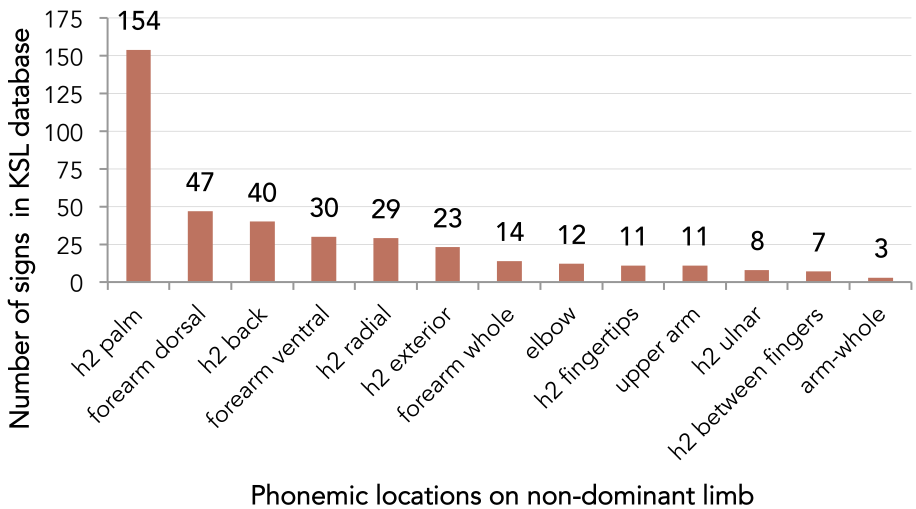


Figure 124. Number of signs in each phonological location on non-dominant limb[132]

Why do so many more signs occur on h2 than other parts of the limb? There are several possible factors that might explain this: (i) pressures toward motoric symmetry (Frishberg 1975), (ii) the greater sensitivity of the hand (neural feedback), (iii) the greater combinatoric possibilities on the hand instead of the forearm because h2 can change its shape and enter into many more complex physical relationships with h1, such as interlocking fingers. Also, relatedly, (iv) there are more phonological locations on the hand overall, and (v) the semantics of h2 make it a productive meaning-bearing object, indicating surfaces (e.g., POST OFFICE, WET), objects (e.g., BANANA, NAIL), symbols (e.g., POSITIVE), etc. (see Lepic et al. 2016).

[131] These figures culled from Rozelle's summary data (2003: 142, 146, 150, 154).

[132] 389 signs shown here. Not included are 16 signs with variable locations within the non-dominant limb, 'two-location' signs, or those whose location is unclear.

A fourth notable aspect of the non-dominant limb is that it contains one of the three phonological locations in KSL that require special articulation to make it visually accessible. That is, the *elbow* location is only realized with the forearm upraised; otherwise, this location is not visible. It is therefore similar to the *tongue* and *teeth*, which require sticking tongue out or pulling back lips to be seen.

A fifth aspect regards the sub-division of phonological locations on the limb. On the head, trunk and in neutral space (to a lesser extent), locations can subdivide on the basis of lateral symmetry; i.e., positions on the ipsilateral side, contralateral side, or in the middle of the body. However, on the non-dominant limb, lateral position is not used. Instead, the non-dominant limb sub-divides primarily by the side of the limb as explained previously: ventral, dorsal, radial, ulnar, as well as the terminus of the limb (fingertips). This shows how phonological categories are connected to the phonetic affordances of the body.

This leads to a sixth noteworthy aspect, which is that contrast is most pronounced between the ventral and dorsal sides as compared to the lengthwise position up and down the limb. The chart of minimal pairs within this overall region in Figure 125 shows that the most frequent contrast within the limb is between *h2-palm* and *h2-back* (4 minimal pairs), and the only minimal pair for *forearm-dorsal* and *forearm ventral* are with each other. As mentioned, there is conflicting evidence regarding the categorical distinction between the forearm and arm, and h2 and the forearm. Otherwise, it can be noted that contrast within the arm is fairly sparse overall. This low number may be for essentially the same reason that the head has such comparative density and a high number of contrasts within it: the non-dominant limb is relatively far from the center of visual acuity because eyegaze is typically directed to the interlocutor’s face during conversation.

	h2 palm	forearm dorsal	h2 back	forearm ventral	h2 radial	h2 whole	forearm-whole	h2 fingertips	elbow	upper arm	h2 ulnar	h2 between fingers	arm-whole
h2 palm	11												
forearm dorsal		1											
h2 back	4		7										
forearm ventral	1	1		2									
h2 radial					0								
h2 whole						0							
forearm-whole							0						
h2 fingertips	1		1					2					
elbow			1						2				
upper arm	2		1							3			
h2 ulnar	2										2		
h2 between fingers	1								1			2	
arm-whole													0

Figure 125. Minimal pair contrasts within the non-dominant limb (ordered by the frequency of the location)

The last observation regards the exact point of contact by the dominant hand (h1) on the non-dominant hand (h2): it appears to be dictated by the handshape on h2, or more specifically, the number of extended fingers. If all fingers are extended, contact defaults to the midpoint of the hand at whichever side is specified (palm, back, ulnar, radial), e.g., TECHNICAL and SWAHILI in Figure 126.[133] If some fingers are extended while others are folded into the palm, contact shifts to the midpoint (usually) of the extended fingers; e.g., OMENA-1 and FULU-FISH-1 in Figure 126. If all fingers are closed into a fist, contact either happens on a specified side or the entire hand is considered the location (i.e., *h2-whole*). Van der Kooij reports the same phenomenon in NGT: "(t)he size of the phonetic space associated to the side of the weak hand seems to depend on the selected fingers specification" (van der Kooij 2002: 198).

[133] As mentioned, previously, contact on the ulnar side in particular can occur lower, i.e., onto the forearm.

Figure 126. Contact on h2 dictated by extended fingers: a. TECHNICAL, b. SWAHILI, c. OMENA-1, d. FULU-FISH-1

To summarize, locations on the non-dominant limb are subject to unique physiological facts involving the shape of the arm and hand, and articulatory constraints on how the dominant hand accesses these locations. This results in several characteristics that are different from other locations on the body. First, there are no lateral symmetry features. Instead, the sides of the limb (ventral, dorsal, ulnar, radial) play a similar role in partitioning the overall area. Second, there is a complex relationship between locations running lengthwise along the limb. They are nested within each other—the hand is nested in the forearm, and forearm nested in the whole arm. There appears to be some permeability between these domains that warrants more exploration in KSL—and in other sign languages, as well, where the partitioning of lengthwise parts of the limb may be language-specific. And third, physical constraints and opportunities affect how phonological locations on the limb manifest. The mobility of the limb allows the (external) elbow to be accessed, but only (in KSL) when the forearm is raised in a vertical position (elbow pointing down, fingers pointing up). In contrast, the underside of the upper arm is not accessed as a location, presumably because it would require even more effort to raise the arm high enough.[134]

5.10 Neutral Space

The largest percentage of signs in the KSL Lexical Database involve articulations that do not contact the body and this number includes all those signs made in the area in front of the signer, or *neutral space*: 726 signs, or 41.7% of the database.[135] Signs in neutral space are the most frequent not just in KSL, but cross-linguistically as well. As shown in Figure 97, above, Rozelle (2003) documents this in four historically unrelated sign languages: 41% of signs in ASL are in neutral space,[136] 38% in Finnish Sign Language, 61% in New Zealand Sign Language, and 40% in Korean Sign Language. Schmaling also reports that "more than half of the signs" in Hausa Sign Language (in Nigeria) are produced in neutral space (2000: 91).

Because of the large number of signs in neutral space and also because of some gaps in the literature in describing their phonological properties, I spend time in this section first reviewing how neutral space has been approached in previous literature. I then look at the concept of planes in neutral space and whether the data in Kenyan Sign Language can be analyzed using planes. Next, I address the issue of whether NS is itself a phonological location or not. And lastly, I evaluate whether NS can be subdivided into smaller locations, or whether it is a single location.

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[134] Indeed, a larger phonetic generalization emerged out of observations that have accumulated over the stretch of this project. Signers appear to be sensitive to the height of the elbow and prefer articulations that keep the elbow down and close to the body, unless the height of the elbow also confers meaning. For example, TO-THROW and FAR-1 differ—phonetically, at least—only by the position/height of the elbow.

[135] 'Imbalanced' or 'h2-Place' signs that are made on an unmoving non-dominant hand are not included here as NS signs.

[136] Klima & Bellugi report that 37% of ASL signs are in neutral space (1979: 53); and Friedman says that it is "the area in which the greatest number of signs are articulated" (1976: 55).

There have been three main approaches to neutral space, or *NS*. The first approach has been to leave NS unmarked so that a sign lacking a specified body location is by default articulated in neutral space. This is the approach followed by Stokoe (1960), Friedman (1976), and others influenced by Stokoe. Klima & Bellugi interpret this as treating NS as "a single location" (1979: 52). However, it seems more likely that Stokoe and Friedman intended NS to be the absence of any specified location (van der Kooij 2002). This approach is also probably closest to the one taken by Sandler, who does not list neutral space as a specified location, and seems to treat movement in neutral space (off the body) as dictated exclusively by setting features (she uses the ASL example TO-GIVE [1989: 154]).

A second approach, pursued by Liddell and Johnson (1989), is to partition neutral space into multiple vectors on the basis of distance from the body and as well as height in the signing space. This phonetic classification results in at least 40 possible points in neutral space—and more to account for directionality of movement in agreement verbs. However, they do not report on whether any of these locations in space are contrastive with each other, or with locations on the body.

A third approach was first described by Klima and Bellugi (K&B), who find that NS can be "usefully viewed as an articulated space with distinguishable loci…partitioned into mutually intersecting orthogonal **planes**, horizontal, vertical (frontal), and sagittal (the plane of bilateral symmetry)" (1979: 52). They provide two minimal pairs in ASL on the basis of such orthogonal planes to illustrate their distinctiveness: (i) JUDGE and EXPLAIN, (ii) SUNDAY and HERE, shown in Figure 127. However, only two planes (horizontal and vertical) are illustrated, and nothing further is said by K&B about phonological distinctions in neutral space, although grammatical modifications and semantic aspects of signs articulated in neutral space are discussed elsewhere in their work (1979: 82, 273-315).

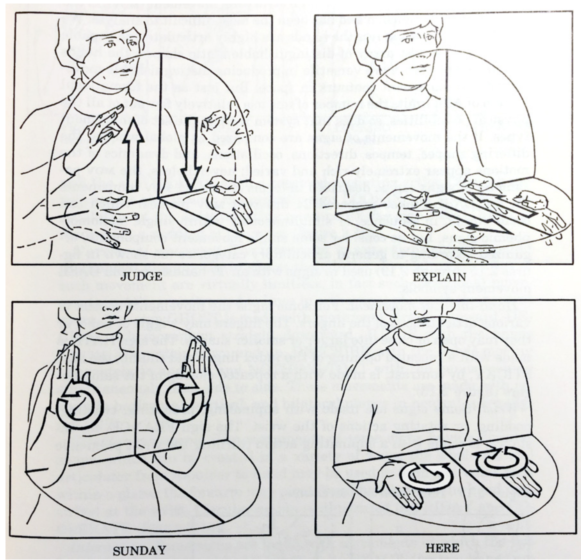

Figure 127. ASL signs in Klima & Bellugi that differ by *plane*: JUDGE and EXPLAIN with straight path; SUNDAY and HERE with circle path
(reprinted from Klima & Bellugi 1979: 53)

The idea that *planes* are phonemic sub-locations in neutral space has been maintained by most sign phonologists since K&B, including Uyechi (1996), Brentari (1998), and the Dutch researchers. Uyechi's 'Visual Phonology' model of sign phonology is fundamentally based on three-dimensional planar geometry, which would seem to be ideal for capturing these sub-locations in neutral space. Uyechi refers to signs in NS as being articulated in a "floating local signing space" (1996: 89), and she works out an implementation for verbs that move through space to agree with arguments. However "other properties of neutral signing space are left for future work" (1996: 84), which includes the majority of basic, non-inflecting lexical signs in NS.

Brentari integrates Uyechi's conception of three-dimensional geometry, stating that any "place of articulation is specified for the plane in which it is located," including signs on the body, which are on a plane that is "abstracted from an ideal…to accommodate the contours of the body" (1998: 120-121). Brentari labels these as the **frontal** or ventral plane, **horizontal** or transverse plane, and **midsagittal** plane, which are illustrated in Figure 128.[137]

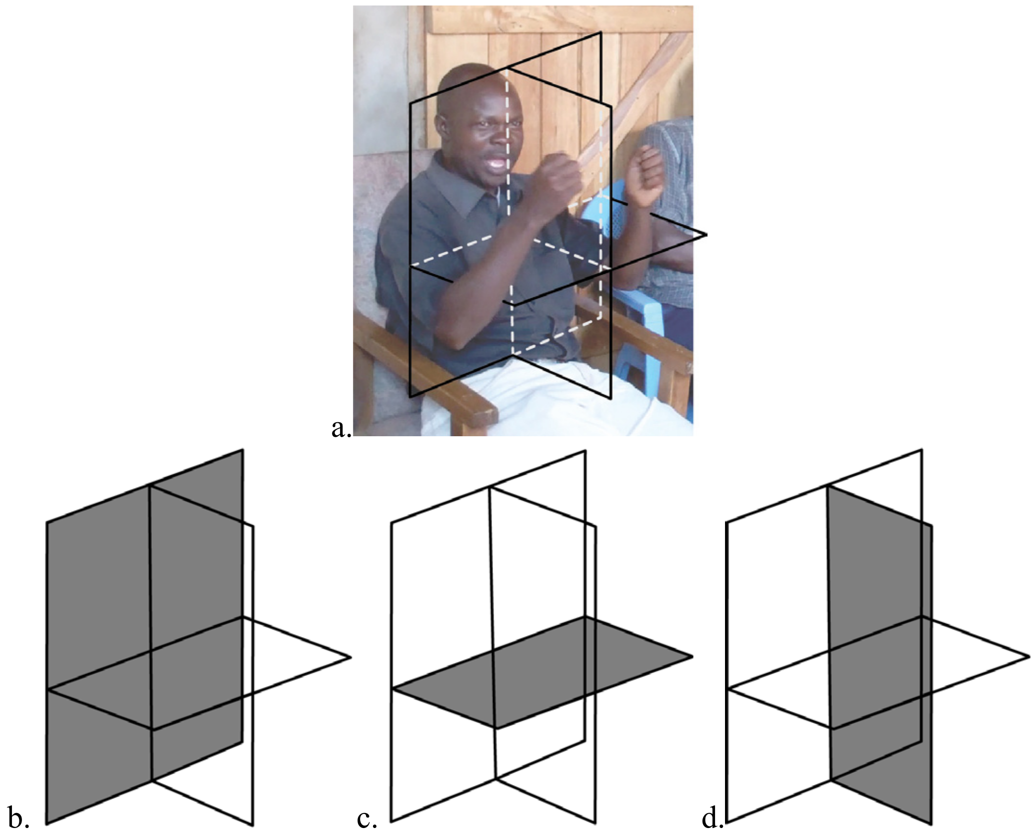

Figure 128. Planes in neutral space: a. relation of planes to body, b. *frontal* or vertical plane (parallel to surface of body), c. *horizontal* or transverse plane (surface of ground, table), d. *midsagittal* or median plane (toward or away from the body)

Planes are, in fact, fundamental to Brentari's Prosodic Model. They are implicated in her classification of two different movement types, *tracing* and *direction*, (see §6.7 in Chapter 6, *Core Articulatory Movements*), are involved in the orientation of the hand, and distinguish core lexemes from classifiers because "(o)nly one plane of articulation is allowed in core lexemes," but morphological classifiers may specify two planes (1998: 123).

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[137] Brentari also uses the labels *x-plane* for the frontal plane, *y-plane* for the horizontal plane, and *z-plane* for the midsagittal plane. However, this can be confusing since it is different than the standard conception of points on an x-axis that are distributed horizontally and points on an y-axis that are distributed vertically.

Brentari elaborates on the specification of planes in neutral space in ASL, beyond Uyechi. Signs like MIRROR, JAIL, and SUNDAY (Fig. 127) are produced on the *frontal plane*; the *horizontal plane* is the one "most commonly used for one-handed signs in neutral space" (no examples provided); and the *midsagittal plane* is "most commonly used for two-handed symmetrical signs," like BICYCLE (1998: 120-122).[138] However, no further descriptive details about the large number of signs in NS is provided, such as the number or specific proportions of NS signs that are articulated in these planes.

The Dutch researchers also state that planes in neutral space are part of the phonology of Sign Language of the Netherlands (NGT). However, they determine that not all signs in neutral space have a phonologically-specified location. That is, some signs are not specified for any location at all, but are articulated in neutral space by default, which was Stokoe's approach to all neutral space signs. Crasborn lists five phonetic neutral space locations in NGT with examples: (i) *none/neutral space* (ALTIJD, 'always'); (ii) *NS: horizontal plane* (KAMER, 'room'); (iii) *NS: frontal plane* (HALTE, 'stop'); (iv) *NS: midsagittal plane* (GEBAREN, 'sign'); (v) *NS: high horizontal plane* (HEMEL, 'sky') (2001: 84).[139] These locations are based on phonetic and semantic regularities, though not a comprehensive study of NGT phonology. It was van der Kooij who undertook such an analysis of NGT, using a relatively austere theoretical framework that does not encode in the phonology anything that can be predicted by semantics (i.e., forms that are motivated by iconicity or pragmatics). Using this approach, she finds that a "specified location can thus be either a body location or the horizontal plane" and "(a)ll other spatial locations are filled in by morphosyntax and pragmatics" (2002: 179). That is, only the horizontal

[138] BICYCLE in KSL, ASL, and many other sign languages is produced with two fists (palms facing downward) moving in alternating circles in front of the body.
[139] Videos for most of these NGT signs can be found at this website: https://www.lerengebaren.nl

plane is specified in the phonology and all other locations in NS are not specified for a location. In this way, her approach has similarities with both Stokoe (1960) and with the planar approach of K&B, Uyechi, and Brentari.[140]

To summarize, previous theories have treated neutral space as a 'zero location' without a phonological specification (i.e., Stokoe, Friedman, Sandler), or as a place of articulation that is (exhaustively, one presumes) subdivided into virtual orthogonal planes in space (i.e., Klima & Bellugi, Uyechi, Brentari), or that some signs have a lexical specification for plane while others are simply unmarked for location (e.g., Crasborn, van der Kooij).

In the process of coding and analyzing signs in the KSL lexicon, I encountered several issues with assigning a plane of articulation to signs in neutral space. Since none of these issues appears to have been addressed yet in the literature, I describe in some depth the issues with using planes in neutral space.

5.10.1 Are *planes* phonological locations in neutral space?

The idea that virtual planes are used phonologically in neutral space is intuitively appealing because so many iconic mappings, spatial metaphors, and even poetic expressions in sign language involve the use of imagined objects and scenes in front of the body that are inherently three-dimensional. Also, as shown in the ASL examples in Figure 127, there are lexical signs that do appear to be minimal pairs only on the basis of a virtual plane. In addition, as Brentari discusses for ASL and van der Kooij illustrates in NGT, all the types of contact that occur on the body can be interpreted as occurring on virtual planes in neutral space, such as "brushing, touching, and continuous contact" (van der Kooij 2002: 178).

[140] She also provides three arguments for the underspecification of neutral space involving assimilation in compounding, spatial modifications in predicates only in neutral space, and the unmarked status of NS on the basis of relatively high frequency (2002: 164-165).

However, while coding KSL signs, I discovered that it was very often not possible to determine the plane of articulation with confidence. There are several ambiguities with regard to plane—both objectively geometric ambiguities and subjectively iconic ambiguities—that prevent a conclusive specification for plane in the phonology. I will first describe these ambiguities and then present arguments in favor of ***axis*** over *plane* for all signs with path movements except those with circular paths, which is explained at the end of this section.

First, a plane in neutral space can be ambiguous because any straight line in space lies upon two planes simultaneously. For example, in HIGH-2 in Figure 129a, the line created by the hand moving straight upward in space simultaneously lies upon both the *frontal plane* and the *midsagittal plane*. Brentari herself observes this when noting that "each type of plane has two possible sets of setting features" (1998: 151-152).[141] And the situation is not necessarily less ambiguous for two-handed signs. For example, in a sign like WHEELBARROW (Fig. 129b), the fact that the movement of the two hands creates two parallel lines that lie flush on the *horizontal plane* might seem to conclusively demonstrate that the plane in this sign is horizontal. However, WHEELBARROW could also be interpreted as two lines lying on two parallel *midsagittal planes*, both equidistant from the centerline of the body. Recall that for Brentari, the midsagittal plane is "most commonly used for two-handed symmetrical signs" like BICYCLE; and WHEELBARROW appears to be just such a sign.

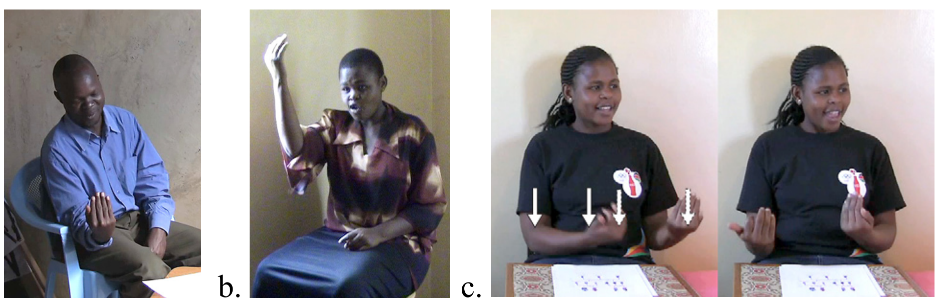
[141] However, in Brentari's Prosodic Model, *setting* features are not used for signs like HIGH-2, but only for 'double contact' signs (i.e., dispersed signs).

a. b.

Figure 129. Ambiguous plane in path movements that create virtual lines through space: a. HIGH-2, b. WHEELBARROW

The second ambiguity is illustrated by analogy to signs articulated on the body. A sign can move either parallel to the surface plane of the body (e.g., FULU-FISH-1 in Fig. 126a) or perpendicular to it (e.g., TECHNICAL in Fig. 126b), and both are prolifically attested in all sign languages. This means that HIGH-2—which was already ambiguous when interpreted as a line that lies parallel to either the *frontal* or *midsagittal* plane—could also be interpreted as moving perpendicular to the *horizontal* plane. This even applies to circular movements which otherwise don't share the geometric ambiguity of a line moving through space (discussed below). This ambiguity is evident in two separate phonological analyses that come to different conclusions about the plane specified in BICYCLE in ASL. While Brentari assesses BICYCLE as specified for the *midsagittal plane*, Uyechi, says about this sign that, "(t)he hands alternate along circular paths that are perpendicular to the signer's body as though pumping the pedals of a bicycle" (1996: 110). I.e., Uyechi views BICYCLE as specified for the *frontal plane*. Therefore, even careful sign phonologists can interpret plane differently for the same transparently iconic sign in the same language.

This brings up the third ambiguity, as well as a deeper issue with regard to iconicity and phonology in sign languages. Brentari states that "core lexemes are specified with respect to one plane" (citing Wallin [1994]), while "classifier predicates may involve a second plane," (1998: 136); however, I find that many core lexemes appear to implicate two planes; BICYCLE is such an example. Another example from KSL is a cluster of morphologically-related signs: CHILD, CHILDREN, YOUNG, and ADOLESCENT/YOUNG-ADULT. These signs all likely derive from a gesture used in East Africa (Creider 1977) to depict the height of a human by a flat hand, fingertips upward, with palm facing the signer[142] and positioned vertically to index height. Figures 130a and 127b show signers producing modified adjectival signs (in conversation) to indicate the age/height of a referent, while 127c is a non-modifiable noun, CHILDREN. In this cluster, the hand and/or forearm facing inward appear to be meaningfully parallel to the *frontal plane*, while the height of the hand corresponds to the *horizontal plane* (to connote height/age). If only one plane is specified, what are the determining factors for doing so? I can find no formational (phonetic or phonological) criteria to arrive at the single, correct plane for these signs. To me, this is another indication—in addition to the ambiguities—that *plane* is not a phonological construct.



a. b. c.

Figure 130. Signs that implicate two planes: a. YOUNG/CHILD, b. ADOLESCENT/YOUNG-ADULT, c. CHILDREN

I propose that the optimal solution to these problems is to use an axis specification rather than a plane. **Axis** refers to a line connecting any two points in space (or on the body), with the following three values: (i) **vertical axis** moves upwards/downwards; (ii) **horizontal axis** moves from side-to-side; and (iii) **midsagittal axis** moves towards and/or away from the body. Thus, HIGH-2 moves unambiguously along the vertical axis, WHEELBARROW moves along the

[142] Brentari states that "the plane of articulation is the plane toward which a designated handpart faces" (1998: 123).

midsagittal axis, and CHILDREN is a dispersed sign (see §7.9) that moves vertically, in two locations. A key advantage of this approach is that while plane must be inferred, axis is always visible.

In this way, no matter what the iconic motivation, signs in neutral space can be identified by their visible articulatory characteristics, which do not require an appeal to iconicity in order to interpret the phonology. For example, the signs HILL and CHARITY-NGILU (a Kenyan politician) in Figure 131 both feature an arc path whose end points are along a horizontal axis in front of the signer. However, their iconic motivations are distinctly different and also complex: HILL traces the three-dimensional shape of hill as it sits upon the horizontal surface of the earth while CHARITY-NGILU is an embodied sign that mimics this politician's characteristic wave to the crowd when she ran for president in 2013. Ngilu's wave gesture itself was also meant to evoke her campaign symbol, a rainbow, which adds to the semantic complexity of this sign and illustrates how rich iconicity can be—not to mention the peril of trying to use iconic motivation to determine phonological properties. The point is that despite their complex iconicity, both signs visibly move along a horizontal axis in front of the body.[143] If phonology operates upon the visible, formational characteristics of signs, then axis should be preferred to plane.

[143] Note that these are not minimal pairs; they differ by three featural dimensions: spread of the fingers, single vs. bidirectional movement, and absolute orientation of the palm (or finger orientation).

Figure 131. Signs that illustrate difficulty of identifying *plane*: a. HILL, b. CHARITY-NGILU

Even stronger evidence for the usefulness of *axis* over *plane* is seen in minimal pairs for HILL and TOWN, in Figure 132. The signer distinguishes between these meanings only on the basis of axis: HILL moves from left to right (or [contralateral>ipsilateral]) along the *horizontal axis* and TOWN moves from near to far (or [proximal>distal]) along the *midsagittal axis*. Plane cannot be used to distinguish between these signs because the same three-dimensional facts are present in both signs: the hand "contacts" the "horizontal plane" representing the ground/earth at the beginning and end of each sign, and the vertical slope of the entity (hill or town) is depicted by the flat, curved handshape that follows the three-dimensional surface of this imagined entity. That is, the plane for both signs appears to be the horizontal plane, but the signer uses axis to produce a minimally different formational contrast.[144]

[144] Incidentally, HILL and TOWN in Fig. 129 are also good example of how phonological features obtain regardless of iconicity; i.e., both phonology and iconicity are present at the same time.

Figure 132. Minimal pairs by *axis*: a. HILL, b. TOWN

Crucially, directional axis can also account for the ASL minimal pairs referred to above, JUDGE and EXPLAIN, that were attributed to different planes by K&B. That is, the hands in JUDGE move along the *vertical axis* while in EXPLAIN they move along the *horizontal axis*.

However, there is one movement type that is not straightforwardly captured by a single axis alone: **circle path movements** such as (in ASL) SUNDAY and HERE (Fig. 127), HEARING, and BICYCLE. Unlike arc movements, which have a beginning and end point that form a virtual axis line, there is no beginning and end point in a circle. For example, the axis in BICYCLE could be interpreted as moving upwards and downwards (vertical axis) and also moving away from and back toward the body (midsagittal axis). Plane, therefore, appears to be a necessary construct for signs with circular path movement. Yet instead of requiring an appeal to iconicity to determine *plane* in these signs, I use the same logic described above: encode the visible plane that the hands actually move along. For example, HEARING and BICYCLE move in the *midsagittal plane*; SUNDAY is in the *vertical plane*; and HERE is in the *horizontal plane*. This avoids the ambiguity of whether the circle path is parallel or perpendicular to a plane and, again, presumably encodes the actual, visible forms that phonology acts upon.

It should be noted that one consequence of encoding path movements as moving along axes rather than planes is that signs like CHILDREN (Fig. 130c), which have been treated as *double contact* signs in the past are treated here as a distinct class of signs called *dispersed* signs and require a different analysis than one that assumes planes. As explained further in §7.9.3, these signs are analyzed as containing two different axes—one operating at the level of the syllable and one at the level of the morpheme or word. Thus, in CHILDREN-2, the path movement at the syllable level is on the vertical axis ([high>low]), while at the sign or morpheme level, there is a path movement on the horizontal axis ([contra>ipsi]).

To summarize, the KSL data shows that plane of articulation, as it has been conceived in the literature, is problematic for phonology. There is a purely geometric ambiguity in determining plane in paths through space: (i) a straight path lies upon two planes at the same time and (ii) any path shape can be articulated either parallel or perpendicular to a plane. Therefore, in order to disambiguate plane, it is necessary to rely on iconicity. Yet iconicity also contains much ambiguity: (i) paths may iconically implicate more than two planes at the same time (e.g., CHILD, YOUNG), (ii) iconicity can involve layers of complex symbolism that are not straightforward to disambiguate (e.g., HILL and CHARITY-NGILU), and (iii) even signs that use the same underlying iconicity can differ formationally (e.g., HILL and TOWN). I propose that *axis* is the more transparent, reliable, and minimally contrastive construct for the majority path movements (straight and arc). However, plane of articulation is still necessary for circular movements, although it is encoded using the visible plane the hands move in rather than an iconically inferred plane.

The next section addresses whether there are other locations distinctions in neutral space in Kenyan Sign Language, and addresses whether neutral space itself should be considered a phonological location.

5.10.2 Can neutral space be subdivided in KSL?

Having established that orthogonal planes are not adequate subdivisions within neutral space, we are left with the following questions: (i) are there any other subdivisions of location in neutral space in KSL, and (ii) is neutral space itself a location or is it the absence of any specified location? I address these questions below and find—in short—that there are no contrastive phonological locations *within* NS. A distinction in **height** is explored in this section, but finds that there's no conclusive evidence for lexical contrast on this basis. A distinction in **laterality** is also explored, and does find minimal contrast, which can be handled by lateral symmetry features [+/-ipsi] and [+/-cross] that also apply to locations on the body. This leads to the conclusion in §5.10.3 that NS *should be* considered its own phonological location, since (i) NS can take symmetrical features, and (ii) a distinction in directionality in 'dispersed' signs on the body versus in neutral space.

Regarding distinctions by height, if there are any phonological subdivisions in neutral space, one of the most likely divisions would be vertical, by analogy to another large region, the trunk, where vertical position is one of the major distinctions (e.g., *trunk upper*, *trunk lower*, as well as the many vertical positions on the head. To determine contrastiveness, all 111 signs that were coded in the KSL Lexical Database with a phonetic distinction at one of the two extremes, 'NS: high' (91 signs) and 'NS: low' (10 signs),[145] were evaluated for whether there was another

[145] By far, most signs in neutral space, 570 signs (80% of NS signs), are those that are articulated roughly in the middle of NS at the midsagittal centerline of the body (e.g., MAYBE, PLATE), or those that move across the signing space through modification with an argument (e.g., YOURSELF, TO-BRING, TO-PRESENT-GIFT) or by tracing a shape (e.g., TABLE, JUG).

sign in the database that contrasted with that sign only by height. I found 11 near-minimal pairs, but in each case at least one other phonological difference separated the two signs. The closest pair is DECEIVE versus DONE-FOR/DONE-IN[146], shown in Figure 133. However, these two signs were not produced by the same signer so it is not clear if they would occur exactly in the same form in the same in the same idiolect. Also, DECEIVE has spread fingers, an additional mouth feature (tongue protrusion) and is modified toward a recipient.

a. b.

Figure 133. Possible pairs by height in neutral space: a. DECEIVE, b. DONE-FOR/DONE-IN

Based on the available data, I hypothesize that the majority of signs that are phonetically high or low would probably either be interpretable as the same sign if produced in the opposite height position or they would be awkward to produce for articulatory reasons. However, this needs to be confirmed with signers in a more systematic way. The conclusion thus far is that height is not a contrastive feature in KSL phonology, and signs that are consistently produced with higher or lower position in NS are due to reasons other than lexical contrast; i.e., articulatory ease, semantics (e.g., quantifier domain; see Davidson & Gagne 2014), discourse constraints, and other possible pragmatic reasons.

Another way that locations are partitioned is via lateral symmetry features, which are discussed further in §5.12. Neutral space signs are produced in the center of the body by default,

[146] The glossing for this sign is difficult without more research. It literally means 'to sweep away' and its use borders on a past perfective meaning in constructions like 'JOB SWEEP' for 'to be fired/sacked' and 'DIE SWEEP' for 'to have died'.

in the most comfortable position of the hands, but this default location can be modified toward either side of the centerline for many reasons (i*psilateral* is on the dominant hand side of body, and *contralateral* is on non-dominant hand side of body). There are supra-linguistic reasons for a sign to be off-center: i.e., to accommodate an interlocutor positioned next to the signer or to conceal one's signing. Also, there are grammatical reasons for off-center signing, such modifying a sign in the direction of an argument (TO-PRESENT, Fig 134a), or using space in a topographic way[147] to distribute virtual linguistic objects in front of the body. Third, there are phonetic reasons, such as the fact that most one-handed signs in neutral space (e.g., 'BADO' ["not yet"] in Fig. 134b) are produced at the ipsilateral side of the body for ease-of-articulation.

a.  b.

Figure 134. Signs offset from the midline of the body, but not phonologically-specified for ipsi/contra features: a. TO-PRESENT, b. BADO ('not yet')

However, at least some signs are lexically-specified to be produced on one side of the midline or the other. At least 15 signs in the lexical database appear to require phonological specification as [+/-ipsi] or [+/-cross] because they would be ill-formed or likely misunderstood if signed at the midline (or in some cases if signed on the opposite side of the body). Fourteen of these are [+ipsilateral]: PLOUGH-1, HYENA, BUTERE (Kenyan town), OBAMA-2, CAMEROON, MORNING (Fig. 135a), SUNRISE, EARLY, LATE, TO-GRAZE, DIARRHEA-2, and 'RIGHT-ONE'. In contrast, only three of these are [+contralateral]: EVENING (Fig. 135b), CLITORIS, 'LEFT-ONE'.

[147] KSL signers appear to rarely use bird's-eye or 'topographic space', preferring viewer-perspective use of space, but more research is needed to test this observation.

Among these is the phonological and morphological minimal pair, MORNING and EVENING (Fig. 135), which shows that *ipsi* and *contra* can be contrastive in neutral space.[148] Note that these are minimal pairs for lateral symmetry, not a separate phonological location; see §5.12 below for more information on symmetry features. There is also a second potential minimal pair, but signs from the same signer were not collected: BORDER, produced in the center neutral space, and NEIGHBOR (or the homophonous signs RELATIVE and BUSIA-3) produced on either the ipsi or contra side. These signs have implications for neutral space as its own phonological location, addressed in the next sub-section.

a. 

b. 

Figure 135. Minimal pairs for laterality/symmetry in neutral space: a. MORNING on ipsilateral side, b. EVENING on contralateral side

Thus far, I have shown that neutral space is not made up of smaller locations, as are other major areas; i.e., neither orthogonal planes nor differences in height are phonemic distinctions that are supported by the data. However, lateral symmetry features do appear to apply to neutral

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[148] The *absolute* palm orientation is the same in both signs; and even though the absolute position of the fingertips is facing a different direction, both signs also have the same *relative* orientation, [tips], because the leading handpart in both signs is the fingertips.

space in general. This leads to the conclusions about the phonological status of neutral space presented in the next section.

5.10.3 Neutral space as a phonological location

In this thesis, I take the position that neutral space should be specified as its own phonological location, and not a 'null' or absent location. This is based on three pieces of evidence. First, the fact that we can assign the symmetry features [+/-ipsi] and [+/-cross] to neutral space (e.g., MORNING, EVENING) suggests that it has to be a designated location to receive such features. That is, something that has an ipsilateral and contralateral subdivision must occupy some definable domain.

Second, as the section on dispersed signs discusses (§7.9 in Chapter 7), there are consistent patterns in KSL in which signs that repeat the same syllable along a horizontal axis *on the body* are ordered [ipsi]>[contra] (e.g., BOARD-OF-GOVERNORS, DIRTY-1, NAIROBI-2, NYERI-2, etc.), while dispersed signs on the horizontal axis *in neutral space* are consistently [contra]>[ipsi] (e.g. COMMUNITY-2, MOUNTAIN, INDIVIDUALS, MILLION, etc.).[149] This means that there are rules for the ordering of sub-locations in neutral space that—like [+/-ipsi] and [+/-cross]—must apply to *something* rather than nothing—i.e., neutral space as its own phonological location.

And finally, there are ~25 minimal pairs for location between neutral space and body locations; e.g., TO-LOOK-FOR vs. INVIGILATE (*forearm-dorsal*) (Fig. 136a,b); CARD vs. GLASSES (*eyes*); ACCOUNT vs. DECIDE (*forehead*); BANK-1 vs. DUCK-1 (*mouth*); TO-WARN vs. PENIS (*trunk-lower*); FRESH vs. FRUIT (*mouth*; Fig. 136c,d), etc. It is unclear how these would be accounted for in theories in which neutral space has a null value. As discussed previously, other theories propose that NS is made up of orthogonal planes (i.e., *horizontal*, *vertical*, and *midsagittal*

[149] Curiously, there is just one dispersed sign in NS, TO-SUFFER, which contradicts this pattern; it is signed in all six tokens (by 5 signers) as [ipsi]>[contra].

planes). In addition to the other issues with planes, some of the *neutral space* minimal pairs pose a problem for these theories because the signs lack path movements or other semantic reference to a plane. For example, the movement in the minimal pairs FRESH in *neutral space* vs. FRUIT on *mouth* (Fig. 136c,d) is a trilled ulnar rotation in both signs, and cannot be straightforwardly assigned a plane of articulation.

Figure 136. Minimal pairs for neutral space vs. body location: a. TO-LOOK-FOR, modified for question 'look for whom?' (*NS*), b. TO-INVIGILATE (*forearm-dorsal*) c. FRESH (*NS*) d. FRUIT (*mouth*)

I conclude that in the purely abstract system of phonological contrast, *neutral space* should be equal to any other location. However, while maintaining that it has a phonological status, it must also be acknowledged that this location is both quantitatively and qualitatively different than signs on the body. Quantitatively, there are more signs in neutral space than in any body-anchored location (748 signs compared to the next highest, *h2-palm* at 150 signs). Also, *neutral space* is the physically largest location; the next largest is *trunk-whole*.

Qualitatively, much contrastive potential is opened up by the freedom of the two hands to move in relation to each other. On the body, not only are the hands are constrained to the boundaries of the physical location, but the relationship of the two hands is relatively limited on the body.[150] In contrast, the two hands in neutral space participate in many different types of formational relationships. Some examples are: tracing a shape in space (e.g., CAR-1 in Fig. 137a); interlocking the fingers (e.g., PASSIONFRUIT-1 in Fig. 137b); two connected hands moving together through space (INTERNATIONAL-CRIMINAL-COURT-3 in Fig. 137c); and the hands moving in opposite directions, with vertical position reversed in the second syllable (e.g., EVERYTHING in Fig. 137d).[151]

Figure 137. Two-handed signs in *neutral space* with notable relationship between hands: a. CAR-1, b. PASSIONFRUIT-1, c. INTERNATIONAL-CRIMINAL-COURT-3, d. EVERYTHING

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[150] Exceptions to this are the few 'two-location' signs profiled at the end of Appendix 9, but it is their comparative rarity and complexity that makes them stand out.

[151] Note, too, this discussion does not include 'h2-place' or 'unbalanced' signs in which the non-dominant hand is itself a location (see §5.9 above and the end of Appendix 9). Those signs also exhibit many types of interaction between the two hands.

One reason for the impression that neutral space is a zero or null location may indeed arise out of the greater formational 'informativity' of the relationship between the hands as well as other featural degrees of freedom afforded by articulations in space. I propose that *neutral space* may be less 'informative' as location—in the sense of information theoretic approaches to language—than locations on the body, but that does not necessarily make it irrelevant as an abstract phonological category.

To conclude, neutral space is where the greatest proportion of signs are produced in KSL (and other languages as well), but it also has the least phonological locations—that is, only one.

5.11 Lateral symmetry features (ipsi, contra, center positions)

Signs can vary by whether they are produced on the midsagittal centerline of the body (HAVE-2 in Fig. 138a), on the *ipsilateral* or dominant-hand side (RICH in Fig. 138b), and *contralateral* or non-dominant-hand side (PATIENCE in Fig. 138c) of the body. In this section, I explain which "lateral symmetry" features are needed in KSL, and how these features manifest in different types of signs.

a. b. c.

Figure 138. Locations differing by symmetry: a. HAVE-2 (on centerline), b. RICH (ispilateral), c. PATIENCE (contralateral)

Evidence from a few minimal pairs shows that these lateral positions alone can be contrastive. There are three minimal pairs that contrast between an ipsilateral and a center position: UNCLE vs. POLICE (*forehead*; Fig. 139); TEA-1 vs. FRUIT (*mouth*); THINK-HARD vs. INDIA (*forehead*). There is one pair that contrasts ipsilateral and contralateral positions: MORNING vs.

EVENING (Fig. 140). And there is one pair that appears to contrast a two-handed symmetrical sign that has the hands positioned on either side of the body with a sign in which the two hands are centered on the midline: HEALTH-2 vs. CONFIDENT (Fig. 141). However, there are no minimal pairs that contrast a center and a contralateral position.

a. b.

Figure 139. Minimal pairs that contrast by an ipsilateral vs. center position: a. UNCLE, b. POLICE

a.

b.

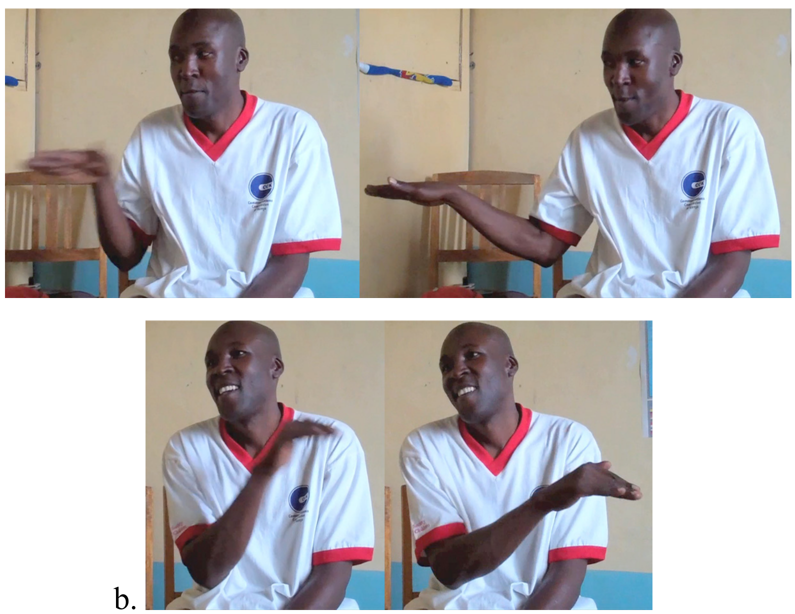


Figure 140. Signs in neutral space that differ by an ipsilateral vs. contralateral position: a. MORNING, b. EVENING

a. b.

Figure 141. Two-handed minimal (or near-minimal) pairs that contrast by non-center vs. center: a. HEALTH-2, b. CONFIDENT

The phonetic distribution in the KSL Lexical Database in Table 16 also shows that signs occur in all three lateral positions: ipsi, center, and contra. For signs on the body, these positions are mostly invariant. That is, they can't be shifted to another position and be well-formed and/or retain the same meaning. By contrast, there is much more flexibility in lateral position in neutral space, and the fact that the only pair with contrast in NS (MORNING, EVENING; Fig. 140) occurs at phonetic extremes in distance from each other may not be accidental. That is, it may be necessary to be far apart to encode a distinctly different position in neutral space.

The distributions in lateral position are not evenly balanced in the lexicon. Table 16 shows that contralateral positions are much less frequent overall and never occur on the face/head; the contralateral sign closest to the head is ROBBER on the contralateral side of the neck (Appendix 9, #17). Also, out of the three positions, most signs on the body occur in the center, on the midline. Note that the data for center position here includes path movements that cross the midline, such as HOT-1 on *forehead* (Appendix 9, #4), US-2 on *trunk upper* (Appendix 9, #5), and some dispersed signs, discussed below. In other words, 'center' location here is one that encompasses the entire location across the midline.

Table 16. *Phonetic distribution of lateral symmetry in three overall regions*[152]

	ipsi	**center**	**contra**	**2-handed symmetrical**
head	146	242	0	69
trunk	21	80	11	48
neutral space	159	235	3	342

Which features are required to account for all of the attested positions? Lateral symmetry is interconnected with other aspects of signs and cannot be viewed solely in isolation. As van der Kooij writes, "lexical specifications of signs should contain information on the number of hands and the type of two-handed signs, because these factors influence the precise setting of the hand(s)" (2002: 189). With this in mind—and after considering several different configurations of featural specifications—I follow the logic of van der Kooij's basic specifications for lateral symmetry features and propose that [+/-ipsi] and [+/-cross] are the main lateral symmetry features, as well as the principle she adopts that these specifications only apply to the dominant hand because the position of the non-dominant hand is predictable. However, while van der Kooij treats /ipsi/ as the unmarked phonetic case, here it is a full phonological feature with binary values.

The operation of these features is defined in (10). In one-handed signs, when the dominant hand (h1) is on the *center* of the body like HAVE-2 and POLICE, the features are [-ipsi], [-cross]; a sign with h1 on the *ipsilateral* side like RICH and UNCLE is [+ipsi], [-cross]; and a sign with h1 on the *contralateral* side like PATIENCE and CANADA is [-ipsi], [+cross]. Note that under this schema, POLICE and UNCLE are minimal pairs, but MORNING and EVENING are not true

[152] Locations on the non-dominant arm and hand are not included here; phonetically, they are always on the contralateral side, and phonologically they do not take lateral symmetry features.

minimal pairs since they differ by two features: MORNING is [+ipsi], [-cross] and EVENING is [-ipsi], [+cross].

(10) *Lateral symmetry features*:
a. **[+ipsi]**: dominant hand positioned on the ipsilateral side of the body
b. **[-ipsi]**: dominant hand not positioned on the ipsilateral side of the body
c. **[+cross]**: dominant hand is positioned on the opposite side of the body
d. **[-cross]**: dominant hand is not positioned on the opposite side

How do lateral symmetry features apply to two-handed signs, since the hands can take different configurations? Most two-handed signs are straightforwardly accounted for by these two features because when a sign is two-handed, the most common arrangement is when the non-dominant hand (h1) act as an "echo-articulator" (Sandler 1989: 97) and each hand stays on its own side of the body, mirroring the other across the midline; e.g., HEALTH-2 (and the 342 two-handed symmetrical signs in neutral space in Table 16). These signs have the features [+ipsi], [-cross]. There are also two-handed signs that stay in the center of the body (e.g., CONFIDENT in Fig. 141b, ENOUGH, VOMIT); these are [-ipsi], [-cross]. Then there are two-handed signs that mirror each other across the midline, but the hands take opposite lateral positions where h1 is on contralateral side and h2 is on ipsilateral side, as in FRIEND and LOVE in Figure 142. In this third case, the lateral symmetry features encode the position of h1, and h2 simply mirrors it on the other side. These signs have the features [-ipsi], [+cross], as well as a feature to mark the two hands, [2H] because the number of hands is contrastive in KSL; see Chapter 8.

a. b.

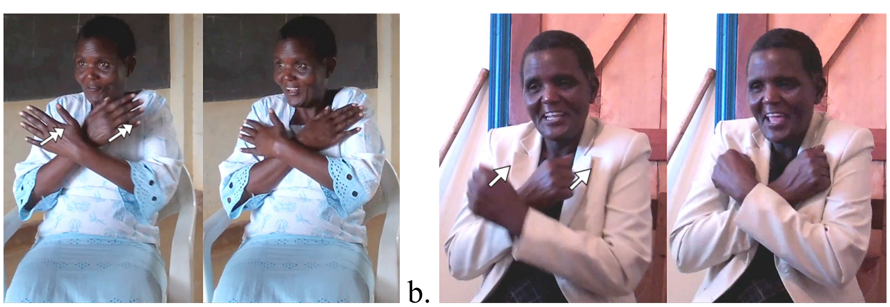


Figure 142. Two-handed echo-articulator signs with hands on opposite side of the body: a. FRIEND, b. LOVE

However, there are two-handed signs in which both hands stay on one side of the body or the other, such as RESPONSIBLE on the ipsilateral shoulder (Fig. 143a) and SWEETHEART-1 on the contralateral upper trunk (Fig. 143b). These take the same features as in one-handed signs, but require some further way of ensuring the correct surface form. I therefore propose an additional feature for two-handed signs, **[+/-connected]**. The specification [+connected] dictates that the hands move together, as if they were one articulator, while [-connected] dictates that the two hands remain separate echo-articulators, mirrored across the centerline of the body.[153] Therefore, when a two-handed sign is [+connected], both hands take the position indicated by the lateral symmetry features—as if it were one-handed. Note that without any additional features, the features in RESPONSIBLE would be ambiguous with a typical echo-articulator sign like HEALTH-2, and SWEETHEART-1 would be ambiguous with a sign with crossed hands on the chest like FRIEND and LOVE.[154]

a. b.

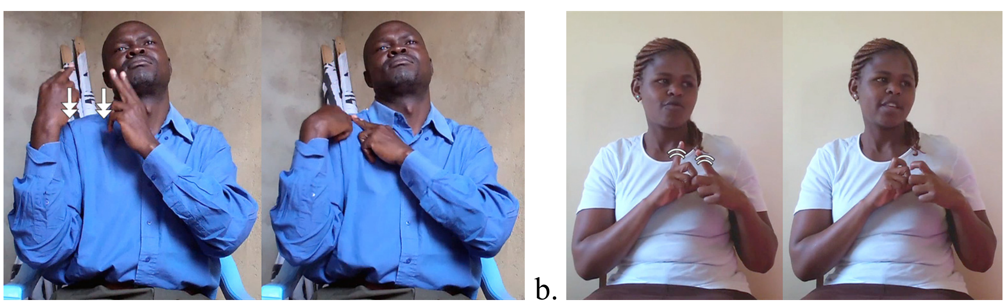


Figure 143. Signs with the two hands connected: a. RESPONSIBLE, b. SWEETHEART-1

(11) *Hand configuration feature [+/-connected]*:

a. **[+connected]**: hands position together as a unit during articulation (may or may not be physically connected)

[153] The converse approach would be to call this [+/-mirror], where the hands either mirror each other across the midline (i.e., [-connected]) or they follow the lateral symmetry specifications of h1 as [-mirror] (i.e., [+connected]). However, "connected" was chosen because the marked situation is simply more salient—it's easier to notice when the hands are *not* mirrored.

[154] [+connected] can also account for the signs like HOW and BECOME, in which the dominant *flat* hand, palm down, turns face up. Because BECOME is [+connected], the palms of the hands stay connected during articulation, while in HOW, they remain on either side of the body.

b. **[-connected]**: hands move independently of each other, though constrained by the Symmetry Conditions (Battison 1978)[155]

Altogether, there are 95 signs in the KSL Lexical Database coded as [+connected] out of 1,052 two-handed signs. Another reason to propose [+/-connected] is a minimal pair in KSL that differs only by these features: MARKET vs. SUFFER, shown in Figure 144.[156] Both signs are two-handed with *open-spray* handshapes, produced in neutral space, have the same type of syllable-level movement (a *vertical* path [high>low]), and the same *horizontal* word-level axis ([contra]>[ipsi]). Both are also 'h2-echo' or 'Type 1' signs, meaning that the non-dominant hand echoes the movement of the dominant hand. But they differ in how the hands are positioned with relation to each other throughout the sign. In MARKET, the hands are symmetrical and mirror each other across the center divide of the body, with each hand staying on its own side. By contrast, in SUFFER, the hands move together as a unit, producing the first downward syllable on the contralateral side and the second syllable on the ipsilateral side. No other existing features in the main sign phonology models would be able to account for this pair.

I will not explore in depth the formal representation for this proposed [+/-connected] feature, but its integration into each the three main models could be relatively straightforward, though incorporated differently based on the differences in internal structure (which are shown in Appendix 2). Briefly, in the Hand Tier model, [+/-connected] would probably be placed somewhere in the Hand Configuration node. In the Prosodic Model, it would presumably be placed in the H_2 node under the Articulator branch of Inherent Features, in the same place as the [alternating] feature. And in the Dependency Model, it would most naturally be included as a

[155] The Symmetry Condition states that if both hands in the sign are moving, then they must be specified for the same location, handshape, and movement—performed simultaneously or alternatingly (Battison 1978: 33).

[156] Note: two clear tokens of this sign for the same signer were not available, so images from two signers are used, but these are both common signs in this dialect of KSL, with few variations.

manner feature, attached to the root node, though it could also be placed on the Hand Configuration node.

a. 

b. 

Figure 144. Different [+/-connected] features in two-handed signs in neutral space: a. MARKET [-connected], b. SUFFER [+connected]

A summary of the types of signs and their features discussed thus far—except for MARKET and SUFFER, addressed momentarily—is shown in Table 17.

Table 17. *Featural designations for different sign types using lateral symmetry features and [+/-connected]*

	ipsi	cross	connected
One-handed sign at center/midline (e.g., HAVE-2, POLICE)	–	–	n/a
Two-handed sign at center/midline (e.g., CONFIDENT, ENOUGH)	–	–	varies
Two-handed sign as an echo articulator (e.g., HEALTH-2, BICYCLE, COW)	+	–	–
Two-handed echo articulator, opposite sides (e.g., FRIEND, LOVE)	–	+	–
One-handed sign on ipsilateral side (e.g., RICH, UNCLE)	+	–	n/a
Two-handed echo articulator on ipsilateral side (e.g., RESPONSIBLE, DEPENDS)	+	–	+
One-handed sign on contralateral side (e.g., PATIENCE, EVENING)	–	+	n/a
Two-handed echo-articulator on contralateral side (e.g., SWEETHEART-1, SWEETHEART-5)	–	+	+

The interaction of these features must also be addressed in relation to dispersed signs, which involve a specific interaction of repetition and sub-locations, and include the examples of MARKET and SUFFER, and as well as signs like PRETEND-1, NAKURU, and NYANG'OMA-PRIMARY, and BATHE shown in Figure 145. However, a description of the lateral symmetry features in these signs is best reserved for the discussion of their properties in §5.12.

Figure 145. Dispersed signs with different lateral symmetry features: a. PRETEND-1, b. NAKURU, c. NYANG'OMA-PRIMARY, d. BATHE

Thus far, this section has established the need for lateral symmetry features in order to account for the variety of positions the hands take within phonological locations. How do these patterns in KSL correspond to what is known about other sign languages? In his analysis of hand configurations in ASL, Battison discovered an implicational relationship between contralateral and ipsilateral positions, stated as a morpheme structure condition: "(i)f a sign is specified for contralateral contact for a place other than the opposite breast or arm, then it is also specified for ipsilateral contact; contralateral contact does not occur on its own" (Battison 1978: 46). Van der Kooij found that this holds in Sign Language of the Netherlands (NGT) as well, with only one counterexample (i.e., DIRTY; 2002: 189); and uses this distribution to generalize that the contralateral position is must less frequent and therefore more marked than the ipsilateral or center positions (2002: 189-190).

The same generalizations are found in KSL, and without any counterexamples. That is, if a phonemic location has signs that are positioned on the ipsilateral side of the body (e.g., MOTHER, GIRL, RICH [Fig. 138a]), then there may be signs in that phonological location on the contralateral side of the body (e.g., PATIENCE, SWEETHEART-1), but never the reverse (a contra, but not ipsi position). Table 18 shows this relationship, as well as an additional implicational relationship that seems to have not been previously documented: if a phonemic location has dispersed signs that cross the midsagittal centerline (e.g., NYANG'OMA-PRIMARY [Fig. 145c], BATHE [Fig. 145d]), that location also has ipsilateral-only signs. However, there is no additional implicational relationship between contralateral-only and dispersed signs—the presence of one without the other goes in both directions.

Table 18. *Distribution of lateral positions in KSL by phonemic location*

phonemic location	**ipsi only**	**contra only**	**dispersed across center**
top of head	+	–	–
forehead	+	–	+
eyes	+	–	+
nose	+	–	+
upper lip	–	–	–
mouth	+	–	–
cheek	+	–	+
chin	–	–	–
under chin	–	–	–
neck	+	+	–
shoulder	+	–	+
trunk-whole[157]	+	+	+
trunk-upper	+	+	+
trunk-lower	+	–	–
neutral space	+	+	+

[157] All the locations in Table 18 are unambiguous except for *trunk-whole*, which is based on signs with somewhat uncertain locations. NAIVASHA is the only sign on the ipsilateral side, but is not unambiguously on *trunk-whole*. Likewise, PURSE is on the contralateral side but may be *trunk-upper*.

This data conforms to Battison's morpheme structure condition, but provides more information about the exact manifestation of contralateral contact. That is, Battison treated contralateral-only signs like PATIENCE and dispersed signs like BOARD-OF-GOVERNORS as equal in designating a contralateral position and did not draw a distinction between them. Yet one consequence of making the distinction between these sign types, is that it reveals a difference in contralateral contact for locations on the head versus those on the neck, trunk, and in neutral space. That is, there are no contralateral-only signs on the head, only dispersed signs with *ipsi* and *contra* sub-locations, which are always ordered in a *ipsi*>*contra* direction (see discussion of default directions in dispersed signs in §7.9.3). It remains to be seen if other sign languages have this additional implicational relationship between ipsilateral-only and dispersed signs across the midline; however, the same basic lateral symmetry distinction between the head and other locations is observed in NGT as well (van der Kooij 2002) and presumably ASL, suggesting that sign languages avoid contralateral-only signs on the head.

To conclude this section, the lateral symmetry features [+/-ipsi], [+/-cross], and a [+/-connected] feature are required in the phonology to account for minimal pairs, to ensure the correct form of a sign, and to avoid ambiguity in the representation. It was also found that KSL conforms to an implicational relationship that holds cross-linguistically, in which contralateral-only positions are only found in locations that also have ipsilateral-only positions. However the KSL data reveals a more specific type of implicational relationship involving dispersed signs across the centerline—i.e., onto the contralateral side of the body.

5.12 Conclusion

This chapter started with a view in the literature that Location is a relatively more transparent and durable part of the phonology than a parameter such as Movement, for example.

And indeed, the set of diagnostic criteria outlined in §5.4 for determining distinctive locations show a level of consistency in the physical manifestation of these locations that contribute to the sense of transparent and stable phonological categories. This evidence is detailed in Appendix 9 and summarized above in the six sections organized around major regions of the body and neutral space—i.e., head, neck, trunk, leg, non-dominant limb, and neutral space. In providing a systematic description of such evidence, this thesis establishes a new methodological benchmark for descriptive analyses of Location in other sign languages. Following this evidence led to finding 177 minimal pairs for location primes and resulted in naming 37 phonological locations out of 65 phonetic locations in the KSL Lexical Database.

At the same time, the analysis has revealed some previously unknown patterns as well as some gaps in knowledge that present opportunities for further research. For example, in following the diagnostic criteria, locations on the head in KSL were found to be particularly dense, and participate in relatively more lexical contrasts than other parts of the body. Do other sign languages exhibit the same patterns, or is this somehow characteristic of KSL as a younger sign language compared to languages like ASL and NGT? If so, what are the factors that would lead to changes in phonological density over time?

Another question is whether some of the typologically unusual locations in KSL—i.e., *tongue*, *teeth*, *hip*, *armpit*—and greater frequency of some locations that are attested in other sign languages but are not as frequent—e.g., *upper arm*, *top of head*—affect the systemic nature of KSL as a whole, or if they remain somewhat peripheral. For example, is the signing space of KSL detectibly larger in natural language production? And are these unusual locations actively recruited in newer signs or neologisms, or do they seem to be frozen in the lexicon? Another question is whether they are they shared in other dialects of KSL, and the neighboring languages of Ugandan Sign Language and Tanzanian Sign Language—i.e., do these signify areal characteristics for the phonology of Location in East Africa?

Other future directions involve three possible modifications to theories of sign phonology on the basis of specific findings in this chapter and in Appendix 9. First, it may not be possible to maintain a role for planes in neutral space in the phonology because of the pervasive ambiguity in determining what is the 'correct' plane. This has consequences especially for a model like the Prosodic Model whose Place of Articulation structure for neutral space is based upon such planes. Second, models of sign phonology must have a way of accounting for signs with two locations—both two simultaneous and two sequential locations, which is discussed at the end of Appendix 9. And third, do other sign languages have minimal pairs like MARKET and SUFFER in KSL (Fig. 144) that require a feature such as [+/-connected]? If there are not similar signs in other sign languages, this could indicate a novel type of feature in KSL—although signs with both hands positioned on one side of the body or another are not typologically unusual. In any case, the KSL data here shows that such a feature should be integrated into models of sign phonology, or otherwise provided for in theoretical representations (i.e., via structural modifications instead of features).

Chapter 6:
Core articulatory movements

6.1 Introduction

The movement of the hands and body during a sign is the *'how'* component in the sign. How do the hands change through time, and in relation to the location? And how are the articulations of specific joints and muscle groups interpreted as phonological elements in the language? While theories of movement vary widely, phonologists tend to agree that there are three basic movement types. The most frequent type are **path movements**, such as WHEELBARROW in Figure 146a, in which the hands move from one place to another within the same phonological location. Path movements are usually straight, but can also be a circle, arc, or other shape. Second, there are **handshape movements**, such as DOG in Figure 146b, in which only the finger joints move. This sign exhibits one of the many types of handshape movements: the fingers wiggle or flutter alternatingly as the hand is held under the chin. And third, there are **palm orientation movements** in which the direction that the palm faces changes. Because of the dynamics of the lower arm, this happens as the result of a wrist nod, such as THURSDAY-1 in Figure 146c, or when the lower arm rotates (ulnar rotation), such as TO-LOCK in Figure 146d. These three types are referred to here as **core articulatory movements**.[158]

[158] I have not been able to find a standard term for these movement types, so I am using this term *core articulatory movement* based on the "articulatory tier" referred to in the literature (Liddell & Johnson 1986, 1989; Wilbur 1993) for that tier containing path, handshape, and orientation movements (Liddell & Johnson posit a single tier; Wilbur and others posit multiple articulatory tiers).

a.  b. 

c.  d. 

Figure 146. Examples of basic movement types: a. WHEELBARROW (path movement), b. DOG (handshape movement), c. THURSDAY-1 (palm orientation movement [via wrist nod]), d. TO-LOCK (palm orientation movement [via ulnar rotation])

A second category of movements modify these basic types, and are called **manner of movement** features. For example, a movement can be articulated only once or can be repeated, a difference that is contrastive in KSL as shown in the minimal pair SHORT (PERSON) with one movement versus RONGO with two movements (Fig. 147).[159]

a.  b. 

Figure 147. Minimal pair by manner of movement features: a. SHORT (PERSON) (single movement), b. RONGO (reduplicated movement)

Another example of manner features is found in modifications to two-handed signs in which both hands have the same core articulatory movement, but it is produced either

[159] Note: this token for SHORT (PERSON) has added emphasis, making the path longer (i.e., begin higher) than usual. It was decided to use this token with the same signer rather than use an image from another signer with a more canonical form.

simultaneously on both hands, as in LORRY in Figure 148a, or alternatingly, as LITEIN (town name). Note that the perpendicular bar on the arrows in LITEIN are used to indicate alternating movement. LORRY and LITEIN are also a minimal pair by manner of movement.

a.
b.


Figure 148. Minimal pair by manner of movement features: a. LORRY (simultaneous movement), b. LITEIN (alternating movement)

Movement is often viewed as the most complex or hard to categorize parameter, presumably because it changes over time and is therefore less perceptually stable than handshape and location, but also because it is subject to variations based on body mechanics. This may be why it is more likely than handshape and location to be minimized or left out of phonological descriptions (e.g., Zeshan 2000, Rozelle 2003, Nyst 2007), given relatively less priority in theoretical models compared to other parameters (e.g., van der Kooij 2002), and to be coded last in lexical databases (e.g., British SignBank, ASL-LEX, LSE-Sign). At the same time, the categorical nature of movement is evident in minimal pairs, such as the ones just shown, as well as experimental data from behavioral and neurolinguistics studies, discussed in §6.4.

The fact that there are comparatively few phonological descriptions for this parameter in the literature means that it is important to make sure all movement types encountered in the KSL

Lexical Database are adequately accounted for. This is one of the goals of the next two chapters. In the current chapter, Chapter 6, I describe the *core articulatory movements* in KSL (i.e., path movement, handshape movement, orientation movement), while Chapter 7 describes *manner of movement* features in KSL (e.g., [repeated], [alternating], [circle], etc).

At the same time, this investigation of Movement in KSL has yielded insights about the relative fit of different theoretical models to the data. Therefore, a second goal in these chapters is to establish a coherent theoretical approach that fits the observable data. An initial insight that emerged from the coding process was that the organization of movement features in the Dependency Model (DPM) provides a particularly clear and coherent classification of movement that is found in KSL signs. However, some types of KSL signs reveal places where the DPM could be refined or clarified. In particular, there are some gaps in the relationship between movement features and prosodic structure that are better addressed by Brentari's implementation of prosodic features in her Prosodic Model (PM). Further, there are places where none of the models adequately fit the KSL data, requiring proposals for (i) a new sign type (i.e., 'hold' signs), (ii) new manner features (i.e., [dispersed], [switch dominance], [circle+straight]), (iii) modifications to the definition of the sign syllable and (iv) a clarification of the relationship between manner features and prosodic structure.

This second goal requires an understanding of how movement is represented in different theoretical models. Therefore, in the next section, §6.2, I provide a background of the different theoretical approaches to Movement, which is followed in §6.3 with a description and justification of the approach to Movement taken in this thesis, based on the structure of the Dependency Model, but with some clarifications and additions.

The chapter then turns to *core articulatory movements* in KSL, beginning with a discussion of the articulatory phonetic basis for phonological movement categories in §6.4, and the analytical methods used for the movement parameter including what does and does not count as a minimal pair for core articulatory movements in §6.5. In the rest of the chapter, four categories of articulatory movements are described: (i) 'hold' signs in §6.6 without any lexically specified movement; (ii) path movements in §6.7; (iii) handshape movements in §6.8, and (iv) palm orientation movements in §6.9. Lastly, §6.10 analyzes syllabic complexity in KSL on the basis of multiple simultaneously core articulatory movements. Evidence from minimal pairs is presented, as well as comparisons with other sign languages, where possible.

6.2 Movement in theoretical models

Movement in sign languages is the phonological parameter with the most fundamentally different theoretical representations across phonological models. In this section, I explain how movement has been depicted in previous theories.

The first approaches to movement were based on Stokoe's inventory of movement primes in American Sign Language, which he referred to as the "signation" aspect of the sign or *sig* (1960). Stokoe used 24 symbols to represent the *sig* primes; e.g., path movements such as *upward*, *downward*, *approach*, *entering*, handshape movements such as *opening*, *closing*, *wiggling*, and orientation movements such as *nodding*, *twisting*. And while the notation symbols for *sig* could be additive (e.g., *downward* + *right*), Stokoe made no further attempt to describe generalizations about the distributions and co-occurrences of *sigs*. As researchers began to investigate the distribution of subparts of signs and the temporal organization of phonological material, divergent views emerged.

One family of theories came out of a framework first proposed by Stack (1988), which was followed by Hayes (1993), Wilbur (1993) and Uyechi (1996). The basis of this theory is that movement does not need to be specified in the underlying phonological structure because it is an epiphenomenon arising out of the transition or interpolation between different articulatory positions/states. That is, the phonological content includes only the beginning and ending positions (static segments), which the hands move between. Some of the ideas and generalizations outlined by Stack were influential on the major phonological theories. However, the key notion that movement is not a phonological primitive was not universally adopted. The more prevalent view has been that movement does have phonological status in sign languages and requires representation in the underlying structure. Yet many different ways of representing the structure of movement have been proposed.

There are two types of framework that diverge most pointedly from this movement-as-transition, movement-less or no-movement model, as it has been variously called. One of these posits that there are two different segment types in signs: Movement segments or M-segments plus another segment type, which is considered to be a Hold (H), Location (L), or Position (P) depending on the theory (i.e., Liddell & Johnson 1986, Sandler 1989, and Perlmutter 1992, respectively). M-segments occur in a sequential string with H/L/P segments, much as consonants and vowels appear in segmental strings in spoken language. Movement features (e.g., [wiggling] in DOG, above) are then contained in (Liddell & Johnson's **Move-Hold Model**) or associate to (Sandler's **Hand-Tier Model**) the M-segment. A reduced version of the Hand Tier Model relevant for movement is shown in Figure 149, and the full Hand Tier model is presented in

Appendix 2.[160] Note that a discussion of theoretical issues with the LML syllable were presented in §3.3.1 and will not be recapitulated here.

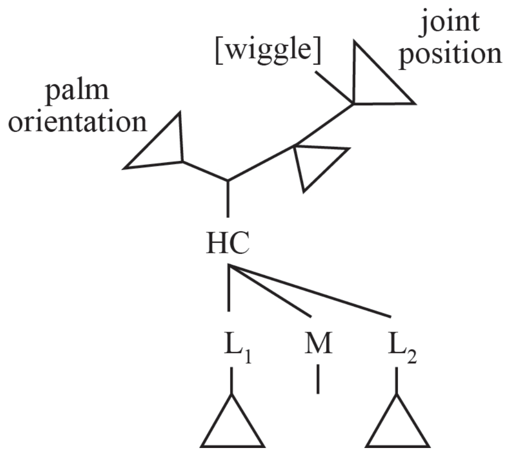


Figure 149. Reduced version of the Hand Tier Model
(HC = Hand Configuration)

The differences in how movement features are represented are demonstrated here using the sign KNOW-THAT in KSL, shown in Figure 150. This sign has only a path movement (not handshape or orientation movements), which approaches and contacts the side of the forehead (temple) twice. In the representations of this sign that follow, features are shown in blue and the segmental tier is shown in red.

Figure 150. KSL sign with a path movement that is repeated: KNOW-THAT

In the Hand Tier Model, the sign KNOW-THAT has the Location features [proximal] and [contact] to represent the position of the hand first close to and then contacting the forehead, and

[160] A graphic representation of the Move-Hold model was shown in Figure 18 in Chapter 3 and discussed in §2.7 and §3.2, but is not discussed further here.

uses the movement feature [restrained] to indicate the repeated movement. The straight path movement itself is not specified with features.

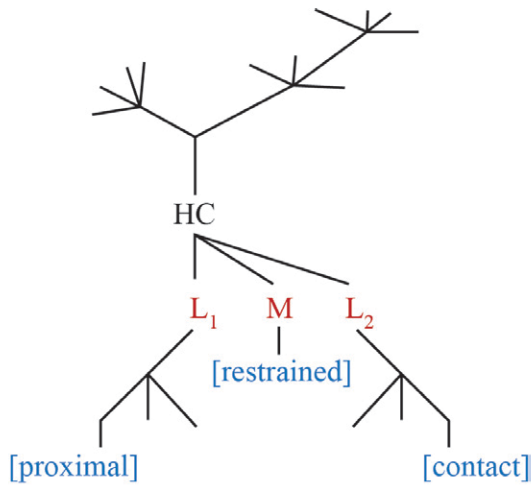


Figure 151. KNOW-THAT in the Hand Tier Model

The other theoretical framework that also opposes *movement as transition/interpolation*, but does not posit two different segment types is the **Prosodic Model** by Brentari (1998). Brentari suggests that certain path features offer counterevidence to the view that movement is not specified in the underlying representation. Specifically, she points out that path shapes like straight, circle, and arc paths can be produced using different sets of joints. For example, a circle can be produced by tracing with just the finger, or with movement only in the wrist, or only in the elbow. This means that path features are not simply interpolations between two specific articulatory positions, but rather abstractions that must be specified in the phonology (Brentari 1998: 131). In the Prosodic Model, movement features are represented in a dedicated branch of structure, the Prosodic Features branch, shown in a reduced version of the model in Figure 152 (full version in Appendix 2). This branch is organized in descending order of prosodic weight or "sonority," so that those movements with the greatest sonority—path movements and setting features—are positioned at the top of the hierarchy and those with the least sonority, aperture (i.e., handshape movements), are at the bottom. Features in the prosodic branch (e.g., [repeat], [straight], [arc], [tracing], etc.) associate to two x-slots on a separate timing tier in a linear association from left (temporally first) to right (temporally second). Crucially, these slots or units do not contain different categorical types of features, unlike the models with M and H/L/P segments. Thus Brentari suggests that a major distinction between theoretical models is whether they are "three-slot models" with a beginning, middle, and end—where M is the middle segment—or "two-slot models" with only a beginning and end (1998: 179) and containing the same categorical types of features.

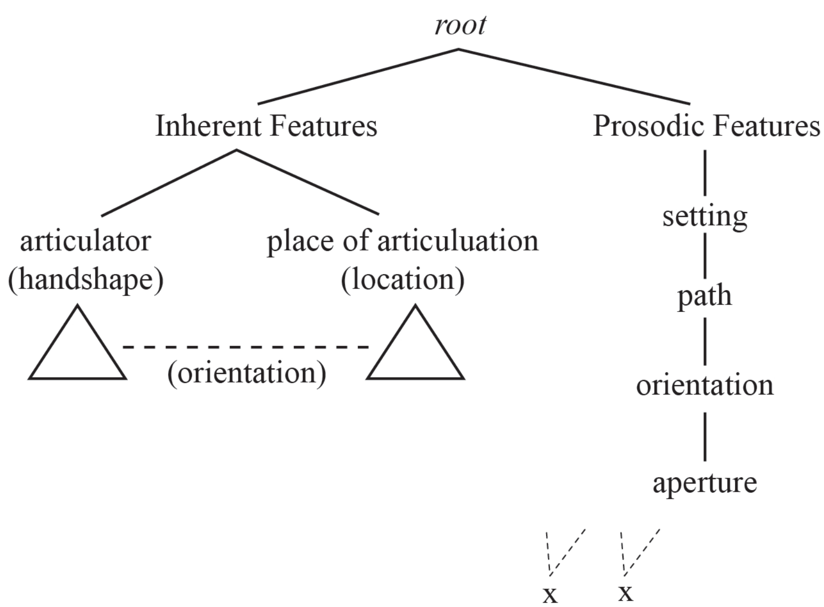


Figure 152. Reduced version of the *Prosodic Model*

In the Prosodic Model, the KSL sign KNOW-THAT has the prosodic features [direction: >|] to indicate a path movement toward a location, and [repeat] to indicate the repeated movement. In this model, a [direction] feature licenses one syllable (i.e., two x-slots), while the [repeat] feature licenses an additional identical syllable, which is shown by the prosodic form "[—], [—]" at the top of the PF branch. In this way, the prosodic features in this model (e.g., [direction], [repeat]) directly operationalize syllabic structure.

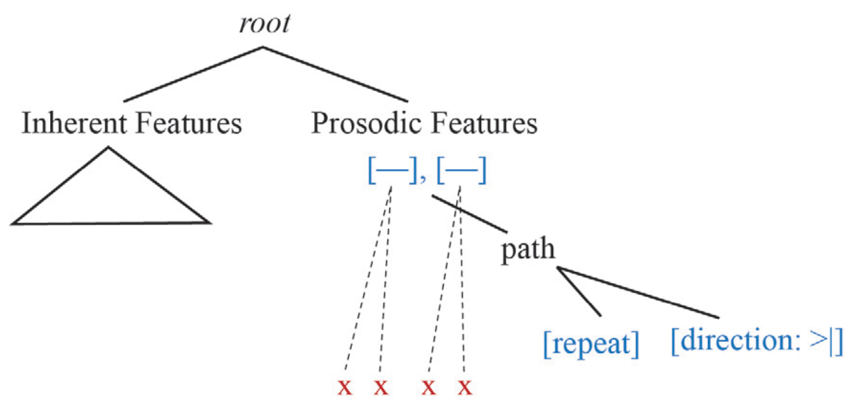


Figure 153. KNOW-THAT in the Prosodic Model

A third type of model was developed by linguists in The Netherlands: van der Hulst (1993, 1995), Crasborn (2001) and van der Kooij (1994, 1996, 2002), and has been called the Leiden Model (Crasborn 2001: 93) but in this thesis, I reference the most recent iteration by van der Kooij (2002), called the **Dependency Model**. A reduced version is shown in Figure 154 and the full version in Appendix 2. This model contains aspects of the *movement-as-transition/interpolation* proposals, but rather than following Stack's proposal that the beginning and end states are themselves static segments, the Dependency Model proposes that they are empty X positions on a skeletal tier to which *features*, not whole classes, associate. In this way, it is also a "two-slot model" like the Prosodic Model. And where Stack's model simply lists the content of formational classes (e.g., Location = [*chin*], Hand Configuration = [*flat-O*]), van der Hulst (1995) posited a branching dependency structure. The three parameters, location, hand configuration, and palm orientation, are represented by a binary branch in which the left branch is the head and contains inherent/non-changing[161] information ([i] positions in Fig. 154) while the dependent right branch contain any dynamic/prosodic information specified in the sign ([d] positions in Fig. 154). The features in the terminal nodes ([a] and [b]) of the dynamic branching structure then associate to two X-positions on a skeletal tier (van der Kooij 1994), which are

[161] Note: I use Brentari's term 'inherent' here, rather than van der Kooij's term 'static'.

linearly ordered on the basis of their head-dependency relation, with head features occurring first. This type of structure is otherwise the same as movement-as-transition between two positions and is what I refer to as *core articulatory movements* in this thesis.

However, a second type of movement, *manner of movement*, is represented in the Dependency Model in a specifier-like position familiar from many other depictions of dependency relations in linguistics. That is, features in this position, directly off of the topmost root node (to the left), command features lower in the hierarchical structure. In this way, manner features dictate how the core articulatory features specified in the branching end nodes manifest in different prosodic structures. This formal separation of movement types is specific to the Dependency Model.

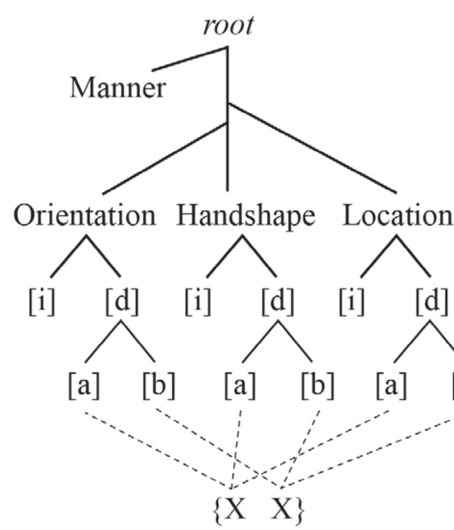


Figure 154. Reduced version of the *Dependency Model*

In the Dependency Model, the sign KNOW-THAT has the dynamic features [distal] and [proximal] located in the 'Passive Articulator' node (i.e., location) which represent the core articulatory movement as a change in location from a setting distal to the location and then proximal to that location (the forehead in this case). [distal] associates to the first X position and [proximal] associates to the second X position. In this model, [repeated] is a manner feature that dictates that this [distal]>[proximal] movement is repeated. Because there are no handshape or orientation movements in KNOW-THAT, only the unchanging/static features (e.g., [i] branch) in these class nodes fill the bipositional skeleton; i.e., *'X'* handshape, palm inward orientation—plus the unchanging ipsilateral forehead location.

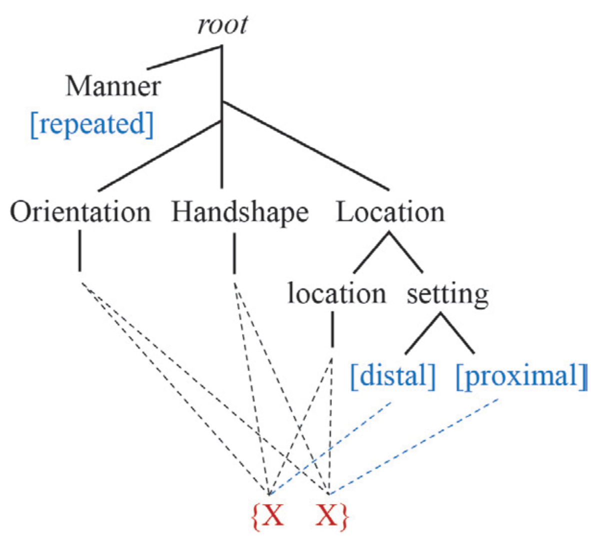


Figure 155. KNOW-THAT in the Dependency Model

Before explaining the approach to movement taken in this thesis, I offer the following comparison of features across the three models. Despite the significant conceptual divergence between two-slot and three-slot models with regard to movement, as well as very different structural representations, it is still possible to translate to some degree between models on the basis of the movement features they propose.[162] Table 19 show the features associated with movement in the three main models of sign phonology. These are grouped into four basic movement types: path (or location changes), handshape (or joint position changes), orientation, and other features (including manner). While many of the same feature labels are used across models, they may specify different phenomena. The most notable example are *setting features* like [proximal], [distal], [high], [low], etc., which are used very differently in each model, from

[162] Per Chapter 2, such "translatability" in features is also relevant for developing phonetic coding systems that are flexible and even intentionally redundant (Crasborn et al. 2001: 225-226).

being solely Location features in the Hand Tier model, to being how path features are encoded in the Dependency Model, to their narrow use in the Prosodic Model for the two sub-locations in double contact signs (e.g., HOME, DEAF, or COMMITTEE in ASL). All of the features in Table 19 are not described further here, but can be seen in context in the full representation of each model in Appendix 2.

Table 19. *Movement features in three models*

	PHONOLOGICAL MODEL		
	Hand-Tier Model (Sandler 1989)	**Prosodic Model** (Brentari 1998)	**Dependency Model** (van der Hulst 1993, 1995, van der Kooij 2002)
Path movement (changes in location)	([proximal], [distal], [hi], [low], [ipsi], [contra])*	[>|], [|>], [tracing], [pivot]	[proximal], [distal], [high], [low], [ipsi], [contra], [near], [far]
Handshape movement	[open], [closed], [bent], [curved]	[open], [closed][163]	[open], [close], [curve], [wide]
Palm Orientation movement	[prone], [contra], [up], [in][164]	[pronation], [supination], [extension], [flexion], [abduction]	[prone], [supine]
Other movement features	[contact], [arc], [trill], [tense] <u>*manner*</u>: [wiggle]	[trilled movement], [repeat], [arc], [circle], [straight] <u>*setting features*</u>: [proximal], [distal], [top], [bottom], [ipsi], [contra]	<u>*manner features*</u>: [tense], [repeated], [alternating], [bidirectional], [crossed], [circle]

* These are not formally movement features in the HT model, but location features

[163] In Brentari's model, each of these two aperture features occupies one of the two X segments in a syllable. The other X can be filled in either by the opposite aperture feature (e.g., [open]>[closed]) or by an inherent feature for joint specification (flexed, spread, stacked, or crossed); e.g., [flexed]>[closed]. This is meant to accommodate the phonemic handshape contours in ASL.

[164] Sandler (1989) uses these absolute orientation features to indicate dynamic changes in a sign, such as TO-DIE in ASL, in which the dominant hand starts as [-prone] and ends as [+prone] (1989: 88-89). However, in a revision of her model (Sandler & Lillo-Martin 2006: 163, 167-168), she adopts Crasborn and van der Kooij's features for *relative orientation* (1997). It is unclear how her updated model now treats dynamic changes in orientation.

6.3 Approach to Movement in this thesis using the Dependency Model

As explained in Chapter 3, this thesis adopts a model of the sign syllable as a bipositional {X X} skeleton on a timing tier. This notion of the syllable is shared between the Prosodic Model and the Dependency Model. Both of these also represent features in dominance hierarchies with branching tree structures and class nodes for major parameters (e.g., location, handshape, orientation) on autosegmental tiers. In both models, the root node is the top level of organization for all features in the sign, and the features that are uniquely specified in each sign associate to the X-slots (PM) or X-positions (DPM) on the skeletal tier.

Beyond these similarities, the previous section presented some differences between models when it comes to how movement is represented and how prosodic (PM) or dynamic (DPM) movement features correspond to the prosodic structure. That is, in the PM, all movement features are put on the Prosodic Features branch, while in the DPM, movements are structurally separated into manner of movement features and dynamic articulatory features. It is at this juncture that these models cease to be "translatable" with each other.

In order to provide a coherent description of Movement in KSL, I have adopted just one of these models, the Dependency Model, because I have found that the DPM accounts for more data and in a more perspicuous way. The specific reasons for this choice are listed in (12).

(12) *Reasons for choosing the Dependency Model for representing movement*

1. Manner of movement is best formally separated from articulatory features in a position of dominance rather than occupying the same local node (see Chapter 7)
2. Path features in the Prosodic Model (i.e., [direction: >|], [direction: |>], [tracing], [pivot]) have two critical shortcomings:
    a. The PM provides no way to signal different directions (e.g., upward movement versus downward movement), even though there are minimal pairs in KSL on the basis of opposite directionality (see §6.5)

(12, con't.) *Reasons for choosing the Dependency Model for representing movement*

b. In neutral space, the path features [direction: >|], [direction: |>] and [tracing]— a large proportion of signs in the lexicon—use orthogonal planes, which was shown in Chapter 5 (§5.10.1) to be an unreliable way to encode movements, especially compared to the directional axes of the DPM

3. In the PM, "setting features" on the Prosodic Branch are reserved for double contact signs (e.g, HOME, DEAF in ASL); however, certain signs previously considered double contact signs cannot be fully accounted for with these features in the PM; in §7.9, I explain this data and offer a new analysis using a manner feature, [dispersed]
4. The organization of prosodic features in the PM does not predict what is lexically contrastive as well as the DPM does; see §6.5
5. Handshape and orientation movements are implemented in the PM by associating some Inherent Features to the prosodic template (see footnote #163); this is adequate to account for these movements, but less perspicuous than the division in the DPM of static and dynamic features as daughters off of the same class node

However, one under-developed area of the Dependency Model regards how movement features relate to the prosodic output. I therefore make two amendments to the DPM in this thesis regarding prosodic structure. First, as mentioned in Chapter 3, I propose that the skeletal tier is specifically a *timing tier* because there are signs without movement in KSL (and other sign languages) that appear to be well-formed despite having no movement. Instead, these signs are held for a short duration of time, which seems to be sufficient to be well-formed. These signs are referred to as 'holds' and are described further in §6.6.

Second, in Chapter 7, I will propose that one of Brentari's innovations for prosodic features should be applied to manner features in the Dependency Model. In the PM, prosodic features license specific syllabic forms in the skeletal tier. For example, as shown in the representation of KNOW-THAT in Figure 153 above, the prosodic feature [repeat] licenses two syllables at the top of the Prosodic Features branch ([—], [—]), which subsequently create a two syllable template on the skeletal tier. The DPM currently has no similar mechanism for ensuring the correct syllabic output (beyond the bipositional skeleton). Proposing a similar operational role for manner features allows certain syllabic types to be better represented (e.g., [circle+straight] path signs). It also serves as further justification for the formal separation of manner features from core articulatory movements because manner features have a fundamentally different relationship to prosodic structure than core articulatory movements—that is, the former are directly linked to syllabic structure while the latter just fill X-slots on the skeletal/timing tier.

To conclude, the theoretical approach to Movement taken in this thesis follows the basic structures and assumptions of the Dependency Model, which largely overlap with the Prosodic Model regarding the nature of the skeletal tier, but differ when it comes to how movement features are organized within the sign. In the description of core articulatory movement types in KSL that follows, I use the movement features of the DPM, bringing the PM into the discussion at certain relevant points. In the next section, I turn the focus to the phonetics of core articulatory movements and how they relate to phonological categories.

6.4 Core articulatory movement in KSL: phonetics & phonology

At the level of articulatory phonetics, the *core articulatory movements* can be categorized in terms of the joints and muscle groups that produce them. The part of the body subsequently displaced through space[165] by specific joints/muscles determines what counts as the perceptible **articulator**. As shown in Table 20, at least ten different joints (or facial muscles) are implicated in phonetic movements found in the KSL signs collected for this project. These correspond to at least seven articulators: head, torso, arm, lower arm, hand, mouth, tongue, and lips. Yet the

[165] Or, if a "hold" sign without lexical movement, then the articulators are positioned and held for a unit of time; see §6.6.

overwhelming majority of signs in KSL—over 95% of the lexical database—feature the hands or lower arms (sometimes difficult to distinguish from each other) as the main articulators.

Table 20. *Phonetic articulators in KSL and their relation to phonological units*

<table>
<tr><th colspan="2">PHONETIC</th><th></th><th colspan="3">PHONOLOGICAL</th></tr>
<tr><th>Joints</th><th>Articulator</th><th>KSL examples</th><th>Basic Movement Types</th><th>Domain of movement</th><th></th></tr>
<tr><td>neck (cervical vertebrae)</td><td>head</td><td>ENTER (var), SLEEP (var)</td><td>(path?)</td><td rowspan="4">Change in LOCATION (along a path)</td><td rowspan="4">PRIMARY MOVEMENT</td></tr>
<tr><td>spine, hips</td><td>torso</td><td>HONOR, BEG-2, PRAY-2</td><td>(path?)</td></tr>
<tr><td>shoulder</td><td>arm</td><td>HAPPY, BABY-1, SOFA, ABUSE-1</td><td>path</td></tr>
<tr><td>elbow</td><td>lower arm or hand</td><td>CAMEL-1, MALARIA WAIT, WATCHMAN</td><td>path</td></tr>
<tr><td>ulnae</td><td>lower arm or hand</td><td>TREE-1, KENYA-1, SWEET, HOLIDAY-1</td><td>twisting</td><td rowspan="2">Change in PALM ORIENTATION</td><td rowspan="5">SECONDARY MOVEMENT</td></tr>
<tr><td>wrist</td><td>hand</td><td>STORY, MOTHER-1, WHEN-1, READY</td><td>nodding, pivoting (path*)</td></tr>
<tr><td>base joints (metacarpals)</td><td>hand</td><td>EASY-1, MUD-2, GROW, CONTRIBUTE</td><td>opening, closing, flattening, spreading straightening, fluttering, rubbing, pinching</td><td rowspan="2">Change in HANDSHAPE</td></tr>
<tr><td>non-base joints</td><td>hand</td><td>VIRUS, EVIL, SEARCH, WHITE</td><td>hooking</td></tr>
<tr><td>jaw, oral muscles</td><td>mouth, lips, tongue</td><td>CHEW-2, PIPE-2, 'BAP'</td><td>non-manual</td><td>Non-manuals</td></tr>
</table>

**wrist movements may be interpreted as path movements [van der Kooij 2002: 229]*

These phonetic articulations are interpreted by signers as phonological movement types in the grammar of sign languages. A movement at the elbow and/or shoulder are interpreted as a **path movement** (or a change in location); movement at the ulnar and/or wrist joints are interpreted as **palm orientation movement** (a change in orientation); and movements at the fingers and thumb joints are interpreted as **handshape movements** (a change in finger flexion and position).

The order of articulators and movement types in Table 20 also roughly correspond to Brentari's prosodic hierarchy, and additions made by Jantunen & Takkinen (2010). These rank the size of movement by most to least perceptually salient; that is, by their degree of "visual sonority," a term Brentari uses in analogy to auditory sonority in spoken languages (Brentari 1998: 75, 214-224). Using this hierarchy, shown in (13), path movements are more visually sonorous than orientation changes with articulation at the ulnae and/or wrist, which are in turn more perceptually salient than movements in the finger joints. Jantunen & Takkinen (2010) added movements of the upper-body and head at one end (treated as one category based on their analysis of Finnish Sign Language), and mouth movements at the other. Impressionistically, this hierarchy also seems to hold for Kenyan Sign Language.

(13) *Sonority hierarchy based on Brentari (1998) and Jantunen & Takkinen (2010)*
upper-body & head > shoulder > elbow > wrist > based joints > nonbase joints > mouth

While the three core articulatory movements in sign phonology—path, handshape, and orientation movements—are linked phonetically to specific articulators, they themselves are abstract phonological categories. Evidence for movement as categorical in the phonology comes from several places: (i) co-occurring movements, (ii) experimental evidence, and (iii) minimal pairs. The first two are discussed in this section, and the third is presented in the next section, §6.5.

First, in linguistics, the simultaneous co-occurrence of two items has been interpreted to mean that those items come from different categories, and movements can co-occur—both manner features that are discussed in Chapter 7 and the three types of core articulatory movements discussed here. Specifically, handshape and/or orientation movements can be produced at the same time as a path movement. For instance, the minimal pair PROVINCE-2 and COAST-1 in Figure 156 below both have a zigzag path movement but differ because the handshape aperture closes during the sign COAST-1. Path movements have been referred to as **primary movement** or **global movement**, and changes in handshape and orientation are referred to as **secondary movement**, **hand-internal movement**, or **local movement** (Klima & Bellugi 1979, Liddell & Johnson 1986). The reason that handshape and orientation are considered "secondary" comes from the observation that while handshape and orientation movements can each occur simultaneously with a path shape, there is no sign in ASL in which both *distinctive* handshape and orientation changes occur simultaneously (Wilbur 1993: 153). However, while this may be an accurate generalization for ASL, other sign languages—KSL included—seem to permit all three.

a.  b. 

Figure 156. Minimal pair for +/- secondary movement: a. primary movement only in PROVINCE-2, b. primary + secondary movement in COAST-1 (handshape is open>close)

The distribution of primary and secondary movement in the KSL Lexical Database, on the basis of phonetic coding, is shown in Table 21. This table is separated into signs without primary movement (-path in the top rows) and signs with primary movement (+path in the bottom rows). Each individual row contains possible secondary movements, from none/plain (i.e., a 'hold' sign when no path movement is present, or just a plain path movement without secondary movement) to only one type of local movement, to both types of local movement. The quantities show that primary movements without secondary movements are much more frequent in the lexicon: 59.5% of all signs have only path movements. And even secondary movements are more likely to appear with path movements than without them. Altogether, 14% of signs have only local movement, while 23.7% of signs have both path and local movements. As will be discussed in the section on orientation movements (§6.9), the number of signs with path movements would also increase if some orientation changes were reanalyzed as path movements. In general, this demonstrates the ubiquity of path movement in sign phonology, and may account for the number of manner features that apply to path movements (Chapter 7). A typologically and theoretically notable sign type here are signs have no movement at all ('hold' signs), which are discussed in the next section. Having more than one core articulatory movement in a sign is also considered a measure of syllable complexity, which is discussed at the end of the chapter in, §6.10.

Table 21. *Co-occurrences of core articulatory movements (primary & secondary movement)*[166]

Primary Movement	***Secondary Movement***	***Count***	***%***
- path	plain: 'hold'	52	2.8%
	palm orientation	162	8.7%
	HS change	96	5.2%
	HS change + palm orientation	2	0.1%
+ path	plain path	1,104	59.5%
	palm orientation	242	13.0%
	HS change	183	9.9%
	HS change + palm orientation	14	0.8%
		1,855	

[166] Twenty-five signs from the dataset of KSL signs are not included in Table 21. These include lexical entries with non-manual movements only (head shakes, torso movements, mouth movements, shoulder-only movements) and a few two-letter fingerspelled words.

A second type of evidence supporting movement as categorical comes from several behavioral studies and one neurolinguistics study suggesting that movement is distinct and separable from the other parameters in the mental lexicon of signers, and that the perception of movement is affected by sign language experience. First, Poizner (1981) tested whether experience with sign language shapes one's perception of movement by evaluating how hearing non-signers and deaf native ASL signers categorize movements. Movement stimuli was created by putting small lights on the hand and arm of a signer and recording one-handed movements (a selection of those listed by Stokoe as phonemic in ASL) in a darkened room so that only the movement of the hands and arms was visible. Each subject was asked to judge which two movements from a group of three were more similar to each other. The results showed that the two groups differed markedly in their perception, with deaf signers making many more determinations on the basis of repetition than the hearing group. In addition, the two groups performed statistically more like other members of their group (deaf or hearing) than members of the other group (using similarity matrices of both subject and stimuli). These results provide supporting evidence for the categorical perception of movement as a linguistic element.

Other supporting evidence for the importance of movement as a linguistic unit comes from sign perception done by Emmorey & Corina (1990) who used a timed gating technique. Signers were shown clips of signed words on video that were stopped at specific points from the beginning of the sign in order to evaluate at what temporal point a sign was conclusively recognized. The results found that while there was partial recognition after identifying handshape and location, it was only after the movement was identified that a sign could be unambiguously recognized. This suggests a two-stage lexical recognition process for signed words, which is very different from spoken words, in which there is no single type of element that is needed for identification.

Newkirk et al.'s analysis of "slips of the hands" was mentioned in the beginning of the Handshape and Location chapters. Here, too, signing errors in ASL collected from everyday communication show that sign errors can be based on a movement unit. For example, movement was metathesized in a slip based on the phrase 'TASTE GOOD.' TASTE has two short reduplicated inward path movements ending on the mouth and GOOD has a single longer path that begins on the body and ends away from it. One signer metathesized the movement so that TASTE (with a *mid-bend*/*bent-8* handshape) moved once away from the body and GOOD (*flat* handshape) bounced twice on the mouth. And several other signing errors involving solely movement features were also documented by the authors.

A study by Thompson et al (2005) explores another kind of speech/sign disfluency. When a person can't fully remember a word in a spoken language—usually a proper name—they can often still retrieve parts of that word, which is called the "tip of the tongue" phenomenon. Thompson et al. elicited such disfluencies in deaf ASL signers in a recall task of famous people and regular lexical items from photos, and found a similar phenomenon in sign languages, which they call "tip of the fingers": signers would occasionally remember all of the parameters (handshape, location, movement, palm orientation), except one. The results showed that all parameters including movement were susceptible to this type of recall error. This is interpreted as more evidence that movement is separable from the other parameters and must be considered its own category in the underlying phonological structure of signs.

Lastly, Corina et al. (1999) documented a case study of a deaf ASL signer undergoing direct cortical stimulation in order to map out the patient's language areas in the brain prior to surgery. The stimulation resulted in sign errors during object naming that appear to correspond to the same type of parameter independence as in the other two studies. With regard to movement, the patient showed replacement of one type of movement with another in several examples. One of these errors was in the ASL sign CANDY with an 'H' handshape in which the fingers brush downward twice on the chin. The subject replaced the repeated brushing movement with a repeated tapping movement in which the fingers moved perpendicular to the plane of the chin rather than parallel to it.

Taken altogether, then, this research evidence from ASL signers is consistent with a classification of movement as a distinct phonological parameter in sign languages. The third type of evidence for considering movement as categorical comes from minimal pairs, discussed in the next section.

6.5 Minimal pairs in core articulatory movements

In total, over 80 minimal pairs involving Movement were found in the KSL Lexical Database (see Table 5 in §3.6), although there are notable differences in the number of minimal pairs found in the two movement types, *core articulatory movements* and *manner features*. There are around 50 minimal pairs on the basis of manner features, but only around 24 pairs on the basis of changes in core articulatory movements.

A key issue with lexical contrast in core articulatory movements is how to define what constitutes a minimal pair. In this section, I first explain what is not considered a minimal pair for core articulatory movements in this thesis and then describe three acceptable minimal pair types: (i) "complexity" minimal pairs, (ii) dynamic feature reversal minimal pairs, and (iii) split coordinate pairs.

In this thesis, a pair that appears to differ only by core articulatory movement—i.e., a change in location, handshape, or palm orientation—is not considered a minimal pair. For example, the two signs KNOW-1 and STRESS-3 in Figure 157 both have the same handshape, location, and manner of movement (e.g., [repeated]), and they also share one orientation position (the ending position in STRESS-3 is the same as in KNOW-1).[167] However, these are not considered minimal because a basic principle for minimal contrast is that it involves paradigmatic replacement from items only within the same category. As mentioned above, the co-occurrence of handshape, orientation, and path (location) movements in the same sign indicates that they belong to different category types and should not be treated as minimally contrasting units. For example, the KSL sign DON'T-KNOW in Figure 158 contains both a change in location (path movement) with a change in palm orientation.

a. b.

Figure 157. Signs with same handshape, location, and manner features but different articulatory type: a. KNOW-1 (path movement), b. STRESS-3 (orientation movement)

Figure 158. KSL sign with path movement and palm orientation movement: DON'T-KNOW

[167] These two signs are unusually similar in appearance; other signs that differ by only one articulatory type can be quite different looking.

The first acceptable minimal pair type for core articulatory movements are those with the presence or absence of a simultaneous articulatory movement, such as the pair PROVINCE-2 and COAST-1 above (Fig. 156). I am calling these "complexity" minimal pairs because the difference of an articulatory movement also produces a difference in phonological complexity, as discussed further in §6.10. There are seven minimal pairs found in the database of this type, which in addition to PROVINCE-2 and COAST-1 also include HOLIDAY-1 vs. FOREST-1, ARGUE vs. SEND-DIGITAL-2, WEAR-2 vs. DRESS-2, and BOSS-1 vs. DIE-3. Note that these are presence/absence pairs, not replacement of one unit for another.

Second, there are dynamic feature reversal pairs, which refers to the transposition of the dynamic features at the end nodes of the dynamic features branch in the Dependency Model (as illustrated in Figures 154 and 155 above). These reversals can occur in any of the class nodes—location (path movement), handshape, and orientation. There are 11 pairs of this type. For example, the minimal pair LAZY-2 and LIGHT(WEIGHT) in Figure 159, has setting features ordered [high]>[low] in LAZY-2 is, while LIGHT(WEIGHT) is identical except for setting features ordered [low]>[high].[168] For handshape, there is a minimal pair for aperture change, DROP-2 and TAKE-OVER in Figure 160. In this pair, the order of aperture features is [closed]>[open] in DROP-2 and [open]>[closed] in TAKE-OVER. Finally, for orientation, there is a minimal pair for orientation change, FIRST and CORRECT in Figure 161. In this pair, the order of dynamic orientation features is [prone]>[supine] in FIRST and [supine]>[prone] in CORRECT. Given that phonological models should reflect in their structural representations those minimal pair contrasts found in a language, this 'dynamic feature reversal' pair is the most canonical type of minimal pair for core

[168] These also differ by *relative orientation*, which is a type of orientation feature not described in this thesis. However, the necessity to specify both absolute and relative orientation in KSL phonology has not been established, and no 'dynamic feature reversal pairs' for path movements were found in the KSL data that do not also involve differences in relative orientation.

articulatory movements in the Dependency Model. With that in mind, it is somewhat surprising that there are not more minimal pairs for these movement types.

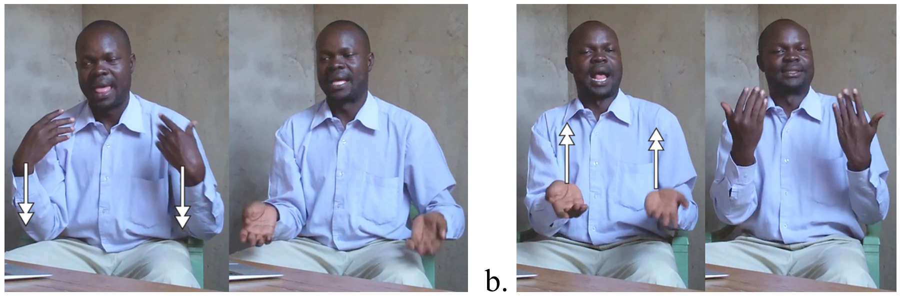
a. b.


Figure 159. Minimal pair for path direction: a. LAZY-2, b. LIGHT(WEIGHT)

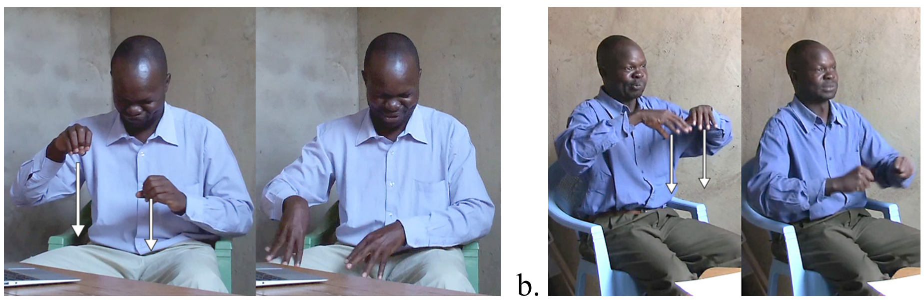
a. b.


Figure 160. Minimal pair for aperture change: a. DROP-2 (opening), b. TAKE-OVER (closing)

a. b.


Figure 161. Minimal pair for dynamic orientation: a. FIRST, b. CORRECT

A third category of minimal pairs for core articulatory movements involves the replacement dynamic feature types within the same articulatory type. That is, in the Dependency

Model, dynamic features manifest as “split coordinate values” (van der Hulst 1995: 17) that always occur together. For example, path movements have three types of coordinate features: {[high], [low]}, {[proximal], [distal]}, and {[ipsilateral], [contralateral]}. This third type of minimal pair replaces one coordinate set with another, and there are 12 of these types in the KSL Lexical Database (nine setting changes, three handshape changes, and no orientation changes). For instance, the two signs TOWN and HILL in Figure 162 differ only by the axis; TOWN is [proximal]>[distal] (i.e., on the midsagittal axis) and HILL is [contralateral]>[ipsilateral] (i.e., on the horizontal axis). Because (i) these split coordinate values do not co-occur as distinct categories (i.e., unlike primary and secondary movements)[169] and (ii) they occur in the same node in the phonological representation, they are considered of the same categorical type and therefore their replacement values are formally minimal.

a. b.

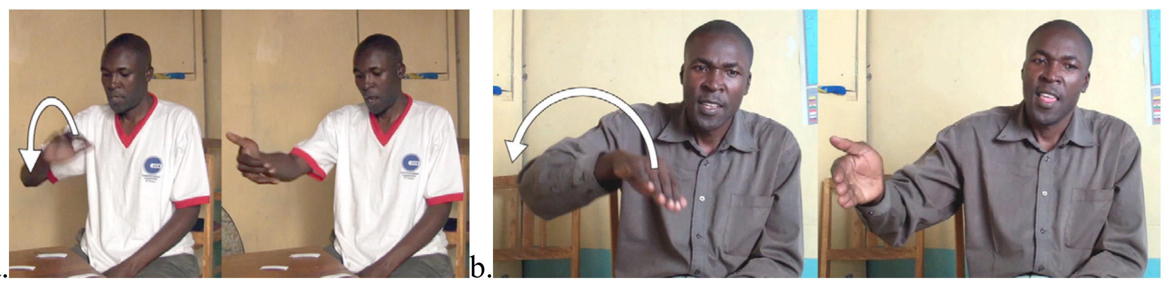


Figure 162. Signs with different sets of coordinate features: a. TOWN ([proximal]>[distal]), b. HILL ([contralateral]>[ipsilateral])

It should be mentioned that the Dependency Model provides a much clearer way to represent minimal pairs—or predict what should be minimal—in its structure compared to the Prosodic Model. If minimal pairs can be predicted by replacement of features within the same node or tier, then the Prosodic Model sets up contrasts that do not hold up as minimal pairs. For example, the *path* node in the Prosodic Features branch (see Appendix 2) contains the following

[169] In trying to account for diagonal path movements in §6.7 below, I propose that these path types could be represented by two simultaneous setting/axis features, but this would be a blended, additive treatment of setting features rather than two distinct categories co-occurring.

features: [pivot], [repeat], [tracing], [direction]. However, [repeat] and [direction] cannot be minimal pairs. Not only do these features co-occur in the same sign, but they are two different types of movement phenomena: [repeat] is a type of operation that applies to any articulation, while [direction] is itself a type of articulation (a movement of the hands to or from a location). This is one of the reasons given in §6.3 above for why the DPM was chosen instead of the PM. At the same time, it is acknowledged that these determinations about contrastive status have been made in a somewhat top-down way and independent evidence to determine contrast in articulatory types would be helpful, such as an analysis of signing errors in KSL (e.g., Newkirk, et al. 1980), or linguistic analyses of morphological processes (e.g. van der Kooij & Zwitserlood 2015).

In sum, the analysis of core articulatory movements that follows is based on evidence from these three minimal pair types. In addition, other supporting evidence is used where it is relevant, such as distributions in the lexicon and an analysis of conditioning environments. Also, because types of movement readily co-occur (unlike handshapes and locations, for the most part), the analysis in this chapter and the next one will report on the distribution of these co-occurrences in the lexicon.

The next section begins the analysis with a description of a somewhat novel type of sign found in KSL: signs without any phonological movement, or 'holds'. This is followed by path movements in §6.7, handshape movements in §6.8, and orientation movements in §6.9, and finally a discussion in §6.10 of prosodic complexity in KSL signs based on core articulatory movement.

6.6 Holds

There are 55 signs coded in the lexical database as “holds,” which are lexical signs without movement. Some of these are shown in Figure 163: STUDY, INCOME,[170] CARRY-ON-HEAD, ‘STONE-DEAF.’ It has been stated by sign phonologists that all signs require movement to be well-formed, so these hold signs raise issues for phonological models that are built on the assumption that all signs have movement. However, such signs have also been described in Hong Kong Sign Language (Mak & Tang 2011) and Hausa Sign Language (Schmaling 2000: 99) and listed as a movement type in Desa Kolok (sign language of Bali, Indonesia; Marsaja 2008), indicating that they may be more common than previously thought. I will first describe hold signs in KSL, then address the theoretical implications and make a proposal for how these signs can be integrated into the Dependency Model.

a. b. c. d.

Figure 163. Signs without lexical movement, marked as ‘holds’: a. STUDY, b. INCOME, c. CARRY-ON-HEAD, d. ‘STONE-DEAF’

In all hold signs in the KSL database, the hands move into a position and stay in that position for a short length of time, which appears to be approximately the duration of a standard lexical sign. Beyond this similarity, there are some differences between the hold signs. Several, like the ones shown in Figure 163, have no other non-manual movements during the sign, and

[170] This is a colloquial sign and the gloss “income” may need to be revised; it might be more like “jua kali” in Swahili, meaning the informal economy.

the movement made by the hand(s) to reach the location is purely transitional and not part of the sign.

However, in other signs, it isn't clear if the transitional movement would be interpreted as part of the sign by KSL signers.[171] For example, in the sign CHIEF in Figure 164, the hand moves upward in a salient way to get to the location in the armpit; yet it also is held for a short time once it reaches the position.

Figure 164. Hold sign with notable transitional movement: CHIEF

In other hold signs, as the hand reaches its position and stays there, some other accompanying movement takes place. These range from head nods to body leans to different types of mouthings. For example, in the Hold sign RETIRE, shown in Figure 165, two signers both exhibit a similar pattern: moving the hand into position, then leaving it in place while mouthing the English word (or a reduced form, 'tire'). In the KSL data, the mouthing of a spoken language word has been a reliable marker of word boundaries, so that the holding period in these signs is interpreted as the period of the sign's expression. This is reinforced by the mouthing pattern in the minimal pair HAVE-2 and RETIRE, described below.

[171] In HKSL, Mak and Tang were able to verify with signers whether they considered the movement was not a part of the sign, but access to signers during this stage of the analysis was not possible.

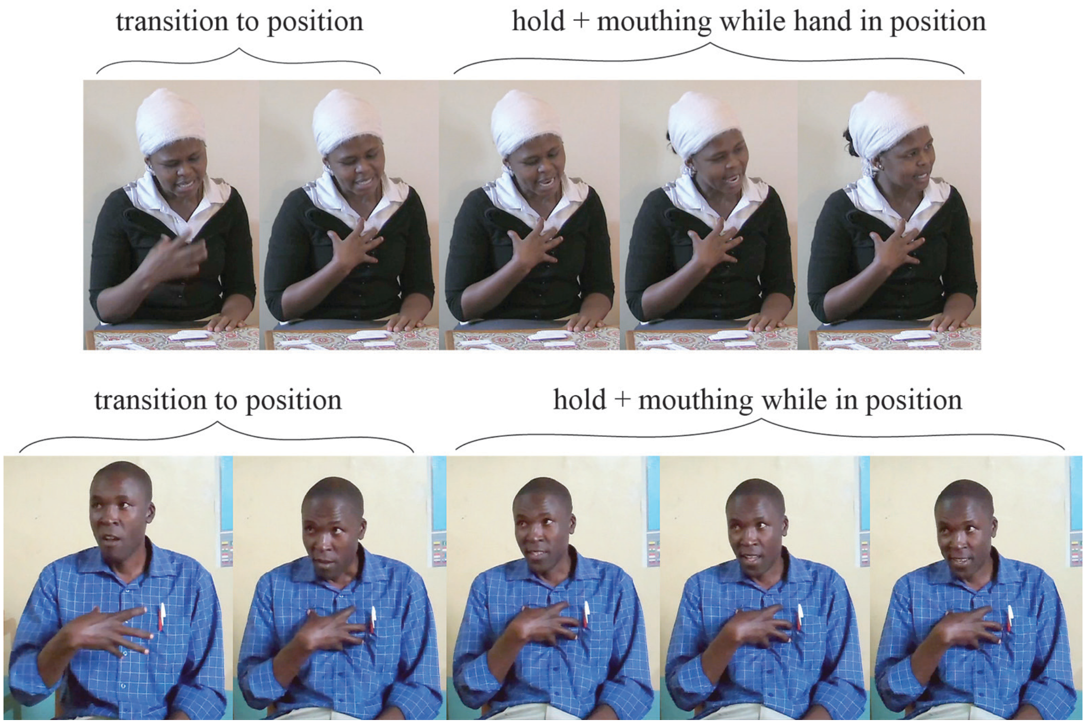


Figure 165. Two examples of hold sign RETIRE with mouthing after transitional movement

These non-manual articulations are variable and it isn't certain to what degree they are part of the lexical specification. For example, in production of RETIRE by the second signer, he adds a hunched position to the sign that the first signer doesn't use. Also, in the sign token for INCOME in Fig. 163b, the signer not only moves the dominant hand into position on the nose, but positions her arms in the configuration shown, which is unlike other productions of this sign, but does help to make the positioning of the body during the hold particularly salient. Thus, these variations appear to be added to meet some kind of requirement for signs to have a certain visual salience or prosodic weight, but their variability and optionality suggests it isn't something lexically specified.

Even more evidence that holds are a distinct sign type come from two minimal pairs. The sign RETIRE is a minimal pair with HAVE-2, whose movement to the chest location does seem to be a prosodic part of the sign, as evidenced by the mouthing of '*have*' starting before the hand reaches the body and ending when it lands on the body.[172] This is in contrast to the mouthing of RETIRE that, as just explained, only starts after the hands are in position. Note that this pair can be grouped with the "complexity" minimal pairs described above (§6.5) since it is +/- a core articulatory movement.

a. b.


Figure 166. Minimal pair for +/-path: a. HAVE-2 with path movement, b. RETIRE with no movement

The other minimal pair is CHICKEN and BLACK-KITE-2 (a bird of prey). Chicken is produced at the mouth with a repeated nodding movement, while BLACK-KITE-2 is held at the mouth for a short period of time.

a. b.


Figure 167. Minimal pair for +/-path: a. CHICKEN with path movement, b. BLACK-KITE-2 with no movement

At this point, it should be noted that what I have presented here is based on observations about signs captured on video that have been viewed carefully and repeatedly, but this data does come out of elicitation in fieldwork conditions, and the durational properties of these signs should be examined in a more controlled way. Nevertheless, it is clear that there is a class of

[172] Note that mouthing of different spoken language words has not been found to be contrastive in KSL, though it can be in other sign languages.

signs in KSL and probably other sign languages that lack lexically specified articulatory movement during the sign. I propose that these signs are well-formed because (i) just like any other sign, they are specified for unique handshape, location, and orientation features, and because (ii) the hands are held in a specific position for a meaningful duration of time (this is formalized below). Thus far, this duration appears to be at least the length of a normal sign, if not somewhat longer.[173]

These 'hold' signs have important implications for theoretical models. With regard to the Prosodic Model, multiple researchers working with ASL have observed that "no monomorphemic sign is well formed unless it has a movement of some type" (Brentari 1998: 74; see also Wilbur 1987, Stack 1988), and that "every syllable must have a movement" (Wilbur 2011: 1310). The ubiquity of movement in ASL signs has been used in the Prosodic Model in crucial ways. Not only is the definition of the syllable based on having movement (as well as prosodic weight, discussed in §3.3.2), but even more importantly, only prosodic features (which are movements, by definition) can license syllabic units on the timing tier (one syllable per two X-slots). It is therefore not clear how these signs could be considered prosodic because from the point of view of the PM, these hold signs have only Inherent Features. If no prosodic features are present in Hold signs, there is no way to license slots on the timing tier, yet these signs also have distinct temporal properties. To accommodate these signs, the Prosodic Model requires some important definitional changes. Otherwise, structurally, one solution would be to posit a [hold] feature in the Prosodic Features branch that licenses a syllable representing a duration of time, without movement.

[173] Note that a greater length of duration would help to differentiate a hold from the preceding transitional movement. It has been observed by ASL-fluent signers visiting Kenya that KSL has a slower rate of signing overall compared to ASL and a relatively fast rate of signing could presumably erode the salience of the hold duration by making it too short to be discernably different than the transitional movement to the location.

The Dependency Model has a different challenge to incorporating these signs, but is generally much more amenable to doing so than the Prosodic Model. In the DPM, all lexical signs are assumed to have a bipositional {X X} skeleton via the 'Sign Minimality Constraint'[174] (van der Kooij 1994) that functions as a syllabic unit or prosodic template (van der Kooij & Crasborn 2008).[175] Thus, the same mechanism that allows unchanging, inherent features in a sign to fill both X-positions would also allow a Hold sign to contain only unchanging features and to still be a syllabic unit. The only remaining issue is that van der Kooij has not explicitly recognize the skeletal tier as a timing tier ("the model proposed here has no specific claims with respect to timing" [van der Kooij 2002: 65]), and therefore has no mechanisms for engaging with the realization of these signs as temporal elements in natural stream of discourse. However, this is straightforwardly resolved by making a clarification about the Dependency Model: the skeletal tier in the Dependency Model *is* a timing tier and the X-positions are timing units, which is what others have already assumed about this model (i.e., Brentari 1998: 90; Wilbur 2011: 1321). These signs can therefore be represented in the DPM by only specifying unchanging/inherent features, and no branching nodes for dynamic features. These static features associate to both X-positions and are expressed as a well-formed syllable by occupying a duration of time while signing. Thus, this implementation uses the modified definition of the syllable from §3.3.2: *a syllable must contain at least one timing unit*.

To conclude, signs without lexically specified movement are attested in KSL and at least two other sign languages, but not in ASL, nor, presumably, NGT. These signs have

[174] The Sign Minimality Constraint specifically posits a bipositional skeleton. The notion that there are prosodic minimal word constraints on the sign, however, is long-established; e.g. Battison 1978, Klima & Bellugi 1979, Perlmutter 1992.

[175] Note that van der Kooij and Crasborn also imply that all signs have movement in NGT, referring to a "movement unit" of the syllable (2008: 1307-1308).

consequences for theories of prosodic structure, leading to a clarification about the Dependency Model; namely, that the skeletal tier must be a timing tier, and that the definition of a syllable in sign language should refer to properties of timing rather than simply movement. Typologically, a more thorough description of these “hold” signs is needed across sign languages, as well as a better understanding of the durational characteristics of these signs compared to those with lexically specified movement.

6.7 Path movement

Path movements are produced by moving the hands, lower arms, and/or whole arm from one place to another, by way of joint flexion at the shoulder and/or elbow. Yet, as explained in the Location chapter, the change in place almost always stays within a single phonemic location. As shown in Table 21 above, path movements are the most frequent type of movement in the KSL lexicon: 83% of all signs in the KSL Lexical Database (1,543 signs) feature a path movement, with 59% (1,104 signs) having path movement as the only movement in the sign. Figure 168 shows examples of KSL signs that have a single straight path movement (no secondary movements or additional manner features): DEAF-1, SOUP-1, HARD-2, CLEAN.

In this section, I first describe how path movements are represented in the Dependency Model, then provide the quantitative results from the KSL Lexical Database on the basis of the Dependency Model features, and where possible, I compare types of path movements in KSL with other sign languages. Finally, I provide a brief description of two types of signs that pose complications for phonological representations and propose how they might be accounted for in the Dependency Model—primarily—as well as the Prosodic Model. Finally, I end with a brief description of parallel path signs in KSL that cannot be accounted for in the PM, but can in the DPM.

Figure 168. Signs with single straight path movements: a. DEAF-1, b. SOUP-1, c. HARD-2, d. CLEAN

Theoretical representations of path movements diverge pointedly between the PM and the DPM, and as described at the end of this section, I have found that path features in the DPM provide better coverage of the KSL data for path movements compared to the PM. For these reasons, the description of path movements in KSL reported here is based on the DPM. Path movements in the Dependency Model are represented as split coordinate values, or **setting changes**, that encode one direction along one of three axes—the midsagittal axis (toward or away from the body), the vertical axis (up and down), and the horizontal axis (side-to-side). The midsagittal features are [proximal]< >[distal], the vertical features are [high]< >[low], and the horizontal features are [ipsi]< > [contra]. There are also two directional features for circular paths: [clockwise] and [counterclockwise].

These setting changes refer to directionality that is pegged to alignment with the body. That is, setting changes on the vertical axis would be parallel to a line that runs from head to foot, changes on the horizontal axis follow a line parallel to one that runs from shoulder to shoulder, and setting changes on the midsagittal axis are parallel to a line running from the back of the body to the front. Examples of setting changes on the vertical axis in both directions are PERSON for [high]>[low] and STRESS for [low]>[high] in Figure 169. Setting changes for both directions on the horizontal axis are MONTH ([ipsi]>[contra]), and KILL ([contra]>[ipsi]) in Figure 170. And setting changes on the midsagittal axis for both directions are WHEELBARROW ([proximal]>[distal]) and KNOW-2 ([distal]>[proximal]) in Figure 171.

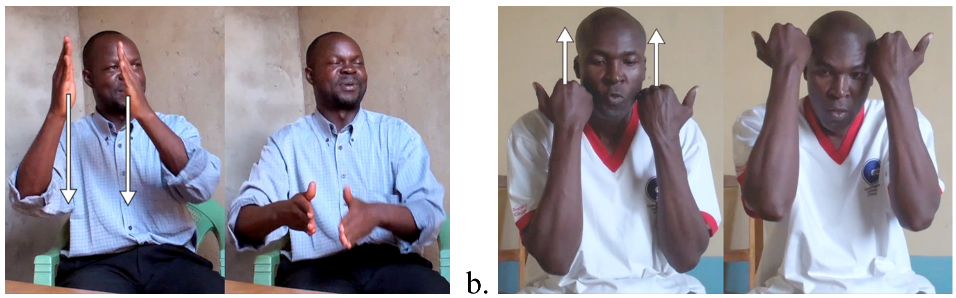
a. b.


Figure 169. Path movements on the vertical axis: a. PERSON [high]>[low], b. STRESS [low]>[high]

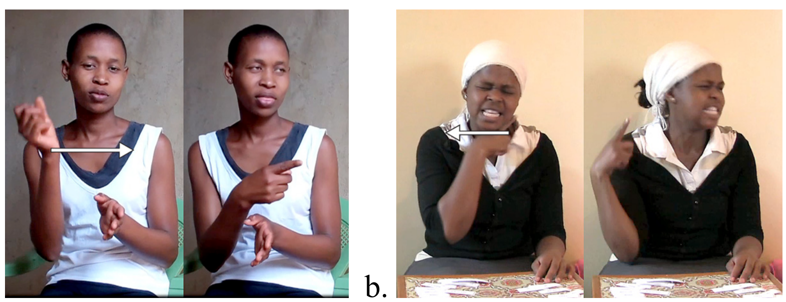
a. b.


Figure 170. Path movements on the horizontal axis: a. MONTH [ipsi]>[contra], b. KILL [contra]>[ipsi]

a. b.


Figure 171. Path movements on the midsagittal axis: a. WHEELBARROW [proximal]>[distal], b. KNOW-2 [distal]>[proximal]

With these distinctions in place, I turn to the quantitative data on path movements in the KSL Lexical Database. Table 22 below shows the number of path movements by directionality in the database for straight and arc paths; circular paths are discussed momentarily. This data sets aside three path types: those coded as ‘diagonal,’ ‘variable to referent,’ or ‘unsure’—meaning that either the whole axis was unsure, or the specific direction. These signs are discussed later in this section. Also, signs with a ‘dispersed’ manner were not included; path directions in dispersed signs are described in §7.9. The results are 1,019 signs with straight or arc path movements. As shown in Table 22, all three axes are relatively balanced in the lexicon, though there are somewhat fewer horizontal movements. Movements on the midsagittal axis account for 376 signs, or 37% of the dataset, those on the vertical axis account for 365 signs, or 36%, and horizontal movements are found in 278 signs, or 27% of the data.

Table 22. *Directionality of setting changes in 1,019 signs with a path*

Axis:	Setting change:		Total:
Midsagittal	*proximal>distal* **183**	*distal>proximal* **193**	**376**
Vertical	*high>low* **265**	*low>high* **100**	**365**
Horizontal	*ipsi>contra* **165**	*contra>ipsi* **113**	**278**

Within each axis in Table 22, the proportions of opposite setting changes are relatively balanced for the midsagittal and horizontal axes, but path movements with a vertical axis are more than twice as likely to move in a downward direction—i.e., [high]>[low]—than in an upward path. The same imbalance has been observed in several sign languages. NGT has a divergence of similar proportion, with 289 downward signs compared to 66 upward signs (van der Kooij 2002: 207). And Napoli et al. document the same imbalance in one-handed straight path signs in five sign languages: ASL, British SL, Italian SL, French SL, and Australian SL. They calculate that the difference between downward and upward movements is around 19-24% for all languages, though BSL has almost 30% more downward path movements (Napoli et al.

2011: 41-42). These consistent results presumably reflect some kind of phonetic bias, possibly against the relatively greater effort of moving the hands upward as opposed to downward. Yet aside from the particular imbalance in vertical direction, the fact that most of these values have relatively even frequency in the lexicon is what we might expect if the abstract formational system is using such values for contrast.

This leads to the minimal pair evidence for contrast on the basis of setting changes within the same axis. As it will be seen for all the core articulatory types, minimal pair evidence is scarce. Only five minimal pair candidates have been identified in the KSL Lexical Database from the set of 1,880 signs used in the phonemic analysis. Out of the five candidates, four are on the vertical axis, one is on the midsagittal axis, and none on the horizontal axis have been found. The clearest candidate is LAZY-2 ([high]>[low]) vs. LIGHT(WEIGHT) ([low]>[high]) in Figure 172. Yet the other four require some caveats. BEFORE-2 and AFTER-2 in Figure 173 are both arc paths on the midsagittal axis (arrows not shown), but the position of the hands is not perfectly identical in each sign. YOUNG and GROW-UP in Figure 174 also differ in that the final handshape in GROW-UP is *flat*, not *bent*, which would be problematic if the *flat* and *bent* are categorically different handshapes (as discussed in Chapter 4). The third pair, GLUCOSE-1 vs. MANGO-2 in Figure 175, is also a very close pair, but do differ by tongue protrusion in GLUCOSE-1 (MANGO-2 has a biting mouth movement).[176] Since tongue protrusion has been contrastive in other signs (CANDY vs. SHOP, RED vs. WHITE), this may be a near-minimal pair. And the fourth pair, TO-SINK vs. PLANT (n.) in Figure 176, is hard to determine because video tokens by the same signer were not available, and the token for TO-SINK is exaggerated.

[176] American readers will know 'glucose' as 'powdered sugar.' It is used at school sporting events to provide a jolt of energy in performance.

a.  b. 

Figure 172. Minimal pair for path direction: a. LAZY-2, b. LIGHT(WEIGHT)


a.

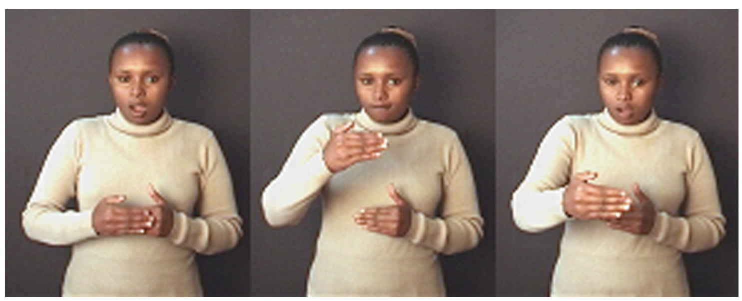

b.

Figure 173. Possible minimal pair for path direction: a. BEFORE-2, b. AFTER-2

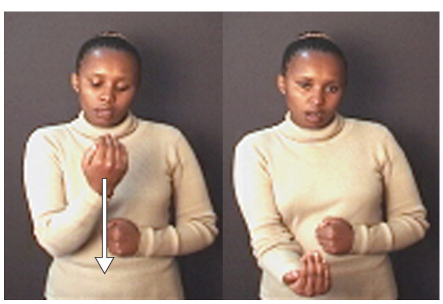
a.  b. 

Figure 174. Possible minimal pair for path direction: a. YOUNG, b. GROW-UP

a.

b.

Figure 175. Possible minimal pair for path direction: a. GLUCOSE-1, b. MANGO-2

a.

b.

Figure 176. Possible minimal pair for path direction: a. TO-SINK, b. PLANT

Moving to circle path movements, opposite setting changes are also found in these path types, using the features [clockwise] and [counterclockwise].[177] As described in the section on *neutral space* location (§5.11.1), circle paths can be evaluated using the same labels for

[177] Following Napoli et al. (2011: 73), a clockwise direction was determined as if looking at a signer from the following perspectives: (i) looking at the midsagittal plane from the signer's right hand side; (ii) looking at the vertical/frontal plane from the signer's perspective; and (iii) looking at the horizontal plane from above the signer.

directional axes in straight paths—midsagittal, vertical, and horizontal—but for circular movements, these refer to three-dimensional flat planes rather than linear directions. For example, as shown in Figure 177, the sign HISTORY has a circular path on the midsagittal plane, LUCKY is on the vertical/frontal plane, and MUMIAS is on the horizontal plane.

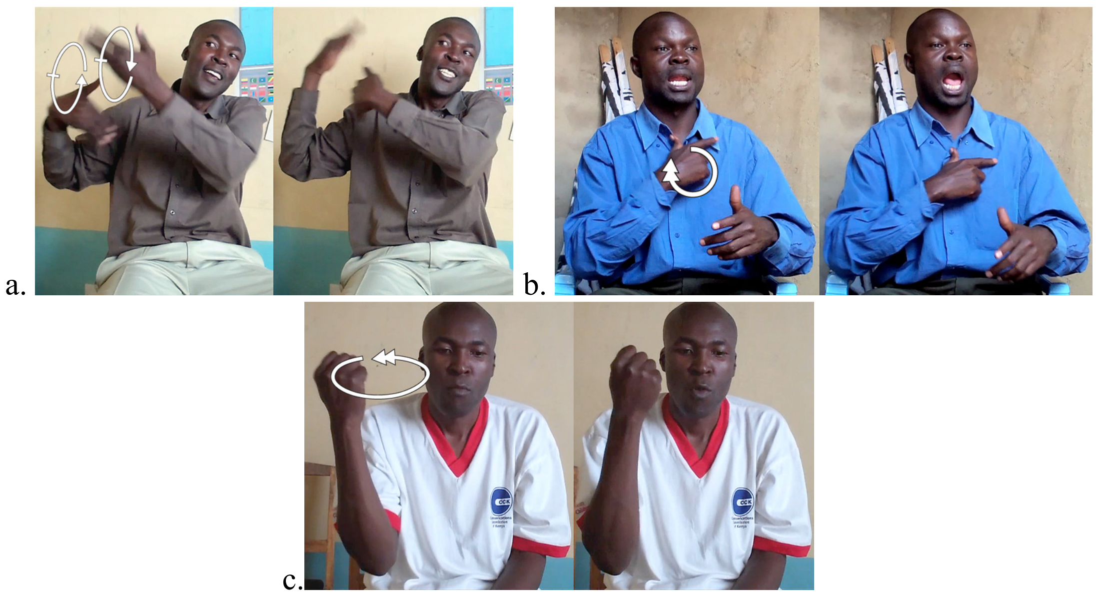


Figure 177. Circle path movements: a. HISTORY (midsagittal plane), b. LUCKY (vertical/frontal plane), c. MUMIAS (horizontal plane)

The distribution of circle direction for each plane is shown in Table 23. Unlike straight and arc paths, distributions for directionality in circle paths are much more lopsided. In the midsagittal plane, circles tend to rotate forward (clockwise) (e.g., BICYCLE), rather than backwards (counter-clockwise) (e.g., HISTORY). On the vertical plane, nearly all circles move counter-clockwise (e.g., LUCKY)—as if looking at a clock in front of the signer—than clockwise (e.g., FACTORY). And on the horizontal plane, twice as many circle paths move counterclockwise (e.g., MUMIAS)—as if looking down from above the signer—than clockwise (e.g., HOUR).

A closer look shows that unlike straight and arc paths, the direction of movement is predictable in most circle signs. For those on the vertical and horizontal planes, locations predict direction, as follows. If a circle is made on the vertical plane *on the body*, it will be counterclockwise; *in neutral space*, it is clockwise. If a circle is made on the horizontal plane *on the non-dominant hand*, it will be clockwise; *in neutral space*, it will be counterclockwise.[178]

Table 23. *Directionality of circle paths by plane*

Plane:	Clockwise	Counter-clockwise
Midsagittal	40	8
Vertical	3	15
Horizontal	10	25

However, for circles on the midsagittal plane, directionality can be contrastive in the minimal pair TO-GO-2 (clockwise/forward) and TO-COME-3 (counter-clockwise/backward). That said, the phonological default appears to be circling forward (clockwise), whereas all counterclockwise circles on this plane have a semantic motivation for doing so. For example, HISTORY has to do with going back in time, and in ECONOMY—also with two-handed alternating circles—the 'backwards' movement relates to income (literally) and exchange. Thus, we can say that circle paths have relatively robust phonetic defaults, and that only the midsagittal plane has lexically-specified directions; the other two planes are predictable by location.

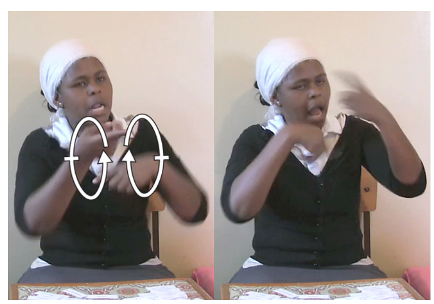
a. 
b. 

Figure 178. Minimal pair for circular path direction: a. TO-GO-2, b. TO-COME-3

These patterns are broadly in line with those found in other sign languages. That is, there is often a preference for one direction over another. Perhaps for this reason, Uyechi states that direction of circle paths is not contrastive in ASL (1996: 125). Napoli et al. analyzed path movements across five languages, and although they combine arc and circle paths, they find that

[178] Only one exception: the sign BASIC on the non-dominant palm moves counterclockwise.

in most sign types (following Battison's typology based on number of hands and movement properties), both clockwise and counterclockwise are usually attested in each plane, but one direction is nearly always preferred. One noteworthy pattern stands out. The direction of circling on the non-dominant hand (a Type 2 or Type 3 sign) shows language-specific differences: circling is overwhelmingly counterclockwise in ASL, mostly counterclockwise in British and Italian Sign Language, evenly distributed in French Sign Language, and mostly clockwise in Auslan (Australian SL). By comparison, the video tokens from KSL are mainly clockwise, like BIOLOGY in Figure 179. This may be one area where sign language phonologies differ by language.

Figure 179. Clockwise circle path on non-dominant hand: BIOLOGY

With the possibility that environments could condition directionality, it was necessary to evaluate whether some axes or directions are only found in certain types of location. However, as Figure 180 shows, path movements in each of the three axes and circle paths are found in all major areas for Location (head, neck, trunk, non-dominant limb, and neutral space), with one exception: no circle paths are found on the neck. This is probably due to the smaller number of circle signs in general, combined with to the small number of signs on the neck. Worth noting is the relatively large proportion of paths on the midsagittal axis in head locations, which are those that move perpendicularly toward or away from the head. It was also found that within each axis, both directions of setting features are attested (not depicted).

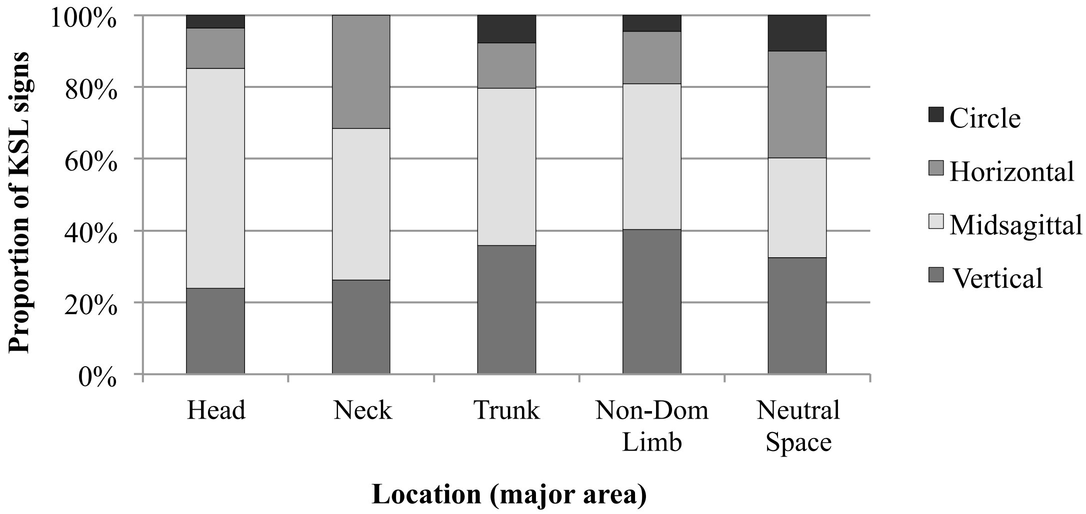


Figure 180. Proportion of path axes by 'major area' location

I now turn to a description of two sign types that present complications for representing path features, and proposals for how to integrate them into the Dependency Model: (i) diagonal movements and (ii) path movements toward a referent whose location can vary. The first sign type are those with diagonal paths, for which a single directional axis are not sufficient; there are about 80 signs with this description in the database. This includes such signs as TO-TRAVEL, HOUSE, and FOX-1, shown in Figure 181. While many of these diagonal paths refer to iconic referents, the position taken in this thesis is that they should be able to be represented by the phonology. Also, in some cases the diagonal paths do not have an obvious iconic referent; for example, TO-TRAVEL, FINISH, or ANY. Both Brentari for the PM and van der Kooij (2002) for the DPM have a means of handling certain iconic cases; i.e., those signs that trace a shape, like HOUSE, would have a [tracing] path in the Prosodic Model, and in the Dependency Model would be handled with "semantic pre-specification rules" (see §3.5.3) because the path references the peaked shape of a roof.

Figure 181. Diagonal path movements: a. TO-TRAVEL, b. HOUSE, c. FOX-1

For the other signs with diagonal paths, however, the Prosodic Model does not provide a means of representing them. In comparison, the structure of the Dependency Model has a way to accommodate diagonal paths by specifying two axes simultaneously. For example, the sign FOX-1 (Fig. 181c) can be assigned the combined path features [contra]>[ipsi] plus [high]>[low] to produce a path that moves both downward and toward the ipsilateral side at the same time. Van der Kooij mentions this briefly in a footnote ("Diagonal movements are represented as transitions between two complex settings" [2002: 237]), though further information about diagonal signs in NGT are not provided. In the KSL Lexical Database, many of the possible combinations attested; i.e., combinations of each direction of the settings features [proximal~[distal], [high]~[low], and [ipsi]~[contra], but the largest proportion found (12%) are those that move downward and outward simultaneously ([high>low]+[prox>dist]); see FOCUS-1 in Figure 82b and HONEST-1 in Figure 199b.

The second type of sign that presents complications for a phonological representation are those with path movements toward a referent that can be positioned in various locations. These signs are typically verbs that move toward a semantic argument. For example, the sign ASK can change direction depending on where the referent is located; in Figure 182a it moves the to signer's contralateral side along the horizontal axis, while in Figure 182b it moves forward on the midsagittal axis. Altogether, 38 KSL signs were found whose path axis can vary when moving toward a referent. These include eight pronouns (e.g., YOU, YOUR, YOURSELF, THEMSELVES), 29 verbs (e.g., PAY, LEAVE [A THING, PERSON], SCRUTINIZE, CURSE, SEND, IGNORE, SHOW, SEND-DIGITALLY, CRITICIZE, etc.), and four other signs (FROM, THERE, OUTSIDE, 'OOH-WHEE' [type of exclamation]).

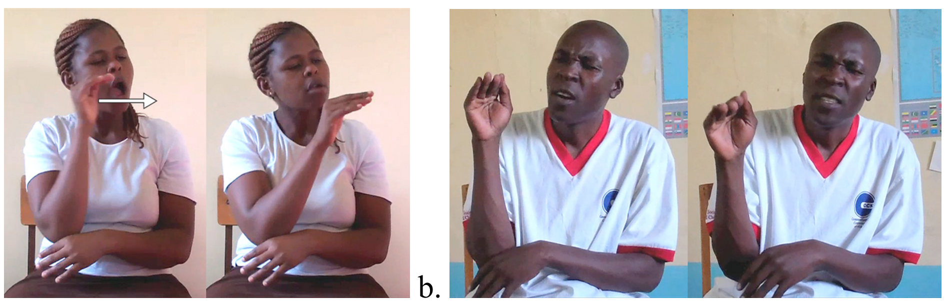
a. b.


Figure 182. Sign ASK with variable directionality: a. signer K1, b. signer B1

These signs are accommodated in the Prosodic Model with the direction feature [>|], which terminates at the referent, no matter its location. In the Dependency Model, van der Kooij again appeals to semantic pre-specification, arguing that directionality in these signs is dictated by semantics and therefore does not need to be specified in the phonology. The question for this analysis is: how can the DPM account for these signs without semantic pre-specification? One possibility comes from the way that this model structures path movements; that is, it specifies the endpoints of the path through setting features that occupy the terminal nodes of a binary branch. Thus, instead of features like [high]>[low] filling these terminal positions, settings that correspond to grammatical loci could fill them. For example, in Figure 182a, the signer is saying, "I [the actor/subject] ask you [the patient/object]," and these roles are associated to physical places, loci, that are assigned with grammatical markers in the discourse, rather than being dictated by the phonology. Thus, the settings could be labeled as [$locus_1$] and [$locus_2$], or more specifically [$locus_A$] for the actor and [$locus_P$] for the patient, or by their syntactic roles, subject [$locus_S$] and object [$locus_O$]. For the purposes of the phonology, any of these are sufficient as long as the loci are matched to actual locations. The hands then move between these locations, just as with any other path movement.

Before concluding this section, it is important to briefly describe a critical shortcoming in how the Prosodic Model encodes directionality in path movements, which was mentioned in §6.3 above as one reason for choosing the DPM. The PM uses a [tracing] feature to encode those path movements that move parallel along a body location or a plane in neutral space, or which trace a shape in neutral space. The issue with these signs is that a path movement parallel to the body can move along two different axes, and in any one of four distinct directions. For example, the KSL signs MEAT-2 and BREAD-1 would both be assigned a [tracing] feature in the Prosodic Model, but the hand moves along different axes: MEAT-2 has a vertical path movement and BREAD-1 has a horizontal path movement. The Prosodic Model appears to have no way to distinguish between these different directional axes.

a. b.

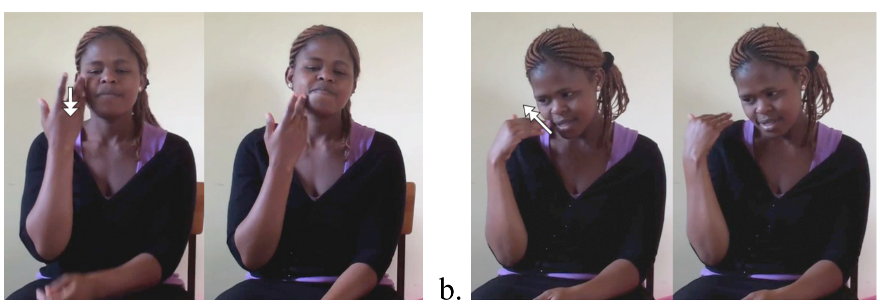


Figure 183. 'Tracing' signs that require more directional features: a. MEAT-2, b. BREAD-1

Further, within each axis there are two possible directions. For example, the near-minimal pairs ALL-1 and STRESS-1 in (Fig. 184) move along the vertical axis; ALL-1 has a downward movement and STRESS-1 has an upward movement. Other than the difference in number of hands, the difference in the direction of the vertical movement is the only way of distinguishing these signs. Again, the PM provides no means of differentiating them.

a. b.

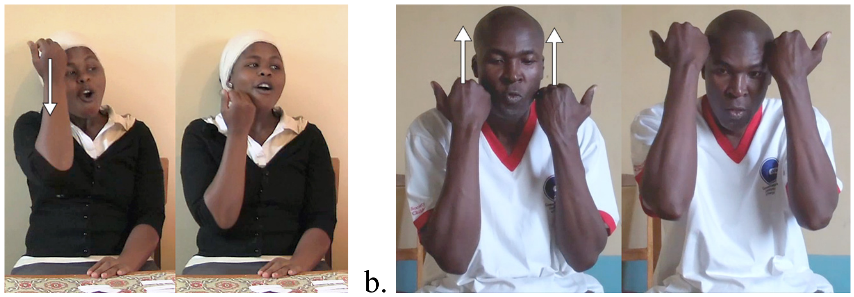


Figure 184. 'Tracing' signs that require directional features along the same axis: a. ALL-1, b. STRESS-1

To conclude, the analysis of path movements in Kenyan Sign Language has found a relatively equal distribution in the lexicon for straight and arc path movements on the basis of directional axes, and relatively equal distributions of setting changes within each axis for midsagittal and horizontal path movements, but a lopsided distribution for vertical movements; i.e., downward movements in the vertical axis are much more frequently attested in KSL, and other sign languages as well. These distributions can be seen as some evidence that setting changes are distinctive features of sign phonology. This is particularly important because the evidence from minimal pairs is scant. At the same time, correctly articulated setting changes (path directions) are necessary for signs to be recognizable and well-formed. For circle paths, it was discovered that even though this path shape occurs in all major areas, the specific directionality (e.g., clockwise vs. counterclockwise) is conditioned by location in KSL. Further, cross-linguistic differences were discovered in the directionality of circle paths on the non-dominant hand.

Finally, an effort to incorporate different sign types into theoretical models highlighted the Prosodic Model's difficulty with parallel path ([tracing]) signs, and led to a proposal to accommodate diagonal paths and variable path movements that move between grammatical loci in the Dependency Model. In closing, it is important to highlight that path movements in general have received much less attention by sign phonologists than might be expected based on their ubiquity in the lexicon,[179] and this is an area that deserves more attention by sign phonologists.[180]

6.8 Handshape movement

Articulation of the joints in the hand (Table 20) produce distinct types of handshape changes that are lexically-specific. As shown in Table 21, handshape movements, or *dynamic handshapes* (van der Kooij 2002) can be the sole movement in a sign—e.g., EAT-2 (Fig. 185a)—or can be simultaneously combined with a path shape movement (or orientation movement)—e.g., TO-KNOW-2 (Fig. 185b). Indeed, the minimal pair PROVINCE-2 and COAST-1 in Figure 156 shows that handshape movements are distinct class of movement because adding a dynamic handshape to the path in that pair changes the meaning.

a. b.

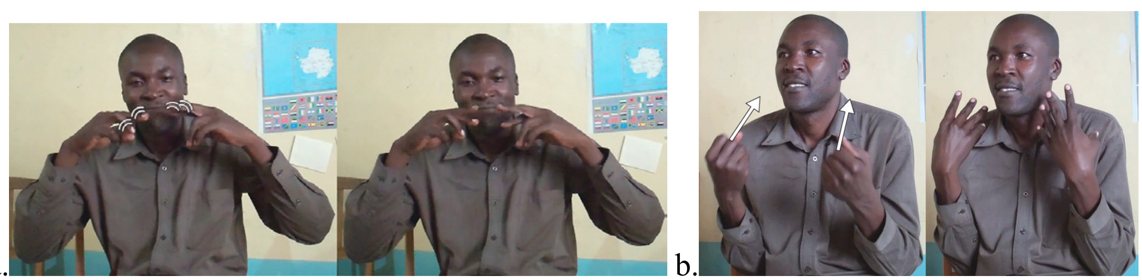


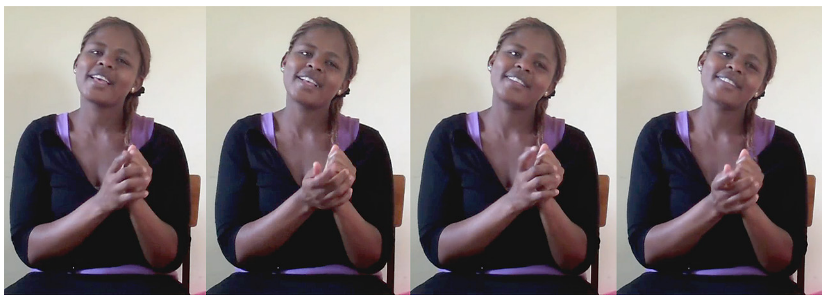
Figure 185. Examples of dynamic handshapes: a. EAT-2 (-path), b. TO-KNOW-2 (+path),

There are a total of 302 signs in the KSL Lexical Database marked as having handshape changes during the sign. This includes 96 signs in which handshape movement is the only movement (e.g., TO-EAT-2), 183 signs that combine with a path movement (e.g., TO-KNOW-2), three signs that combine with dynamic orientation (e.g., MAIZE-2, Fig. 186a), and 15 signs that

[179] For example, van der Kooij notes that she "did not investigate in depth the other setting pairs, ipsi-contra and proximal-distal" (2002: 208).

[180] The unique cross-linguistic analysis of path movement by Napoli, Gaw, & Mai (2011) is notable in this respect, though its classifications are not situated within an existing phonological framework, which makes comparisons with their data difficult in some cases.

exhibit changes to all three core articulatory types (e.g, TO-MAKE-3, Fig. 186b). For the last two types, some of these movements may be phonetic variations; this is discussed further in the next section on orientation movements (§6.5.4). Also, there are less than a dozen other signs that are unclear for their status; e.g., short fingerspelled words, and signs in which it is unclear if handshape movement is specified.

a. 

b. 

Figure 186. Signs with dynamic handshapes in complex syllables: a. MAIZE-2 (pinching thumb movement repeats on ulnar rotation), b. TO-MAKE-3 (path, wrist, and handshape movement)

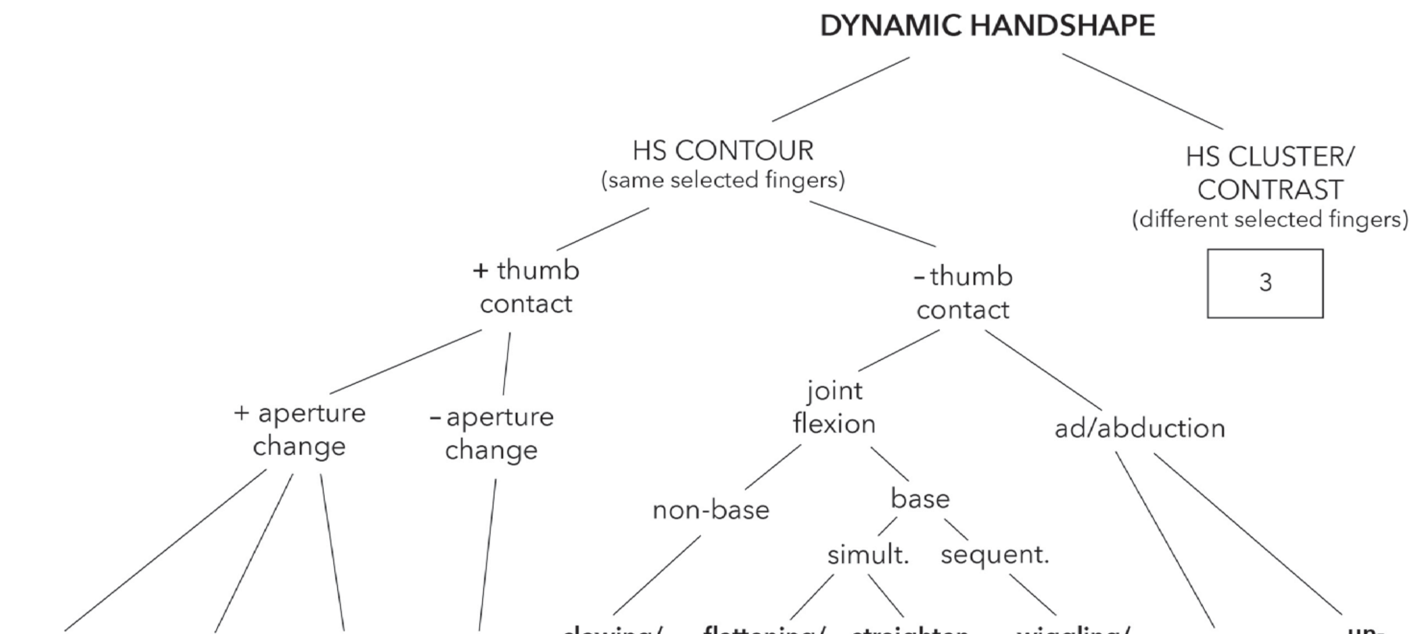
Several descriptive generalizations about handshape changes have been made, which I recapitulate based on Brentari's summary (1998: 159). First, there are two types of dynamic handshapes: **handshape contours** and **handshape contrasts** (Perlmutter 1992). Handshape contours are the interpolation between two different variants of a single underlying handshape, most often an open and a closed variant (e.g., closed *fist* and open *spray* in Figs. 185b and 186b). The underlying shape is one of these variants, and usually the one that is the most frequent in the lexicon (van der Kooij 2002). Handshape contrasts have two distinctive handshapes with different sets of selected fingers; e.g., WITHDRAW in ASL that starts with a *W* handshape and ends with a *D* handshape.[181] Handshape contrasts are much less frequent, occur in a more restricted set of contexts, and derive from borrowings with the fingerspelling alphabet (Brentari & Padden 2001). In the more common handshape contours, one of the handshapes is underlying and the other is redundant, and the order of the underlying and redundant shapes are not systematic/predictable but rather lexically specified (Corina 1993).

The three models of sign phonology propose different ways of accounting for the various handshape changes in sign languages. I will first offer a descriptive analysis of dynamic handshapes found in the KSL Lexical Database, then discuss what counts as lexical contrast given the variety of articulatory types in dynamic handshapes, and how different models encode this.

The full picture of dynamic handshapes in the KSL data is shown in the classification chart in Figure 187. In total, there are 292 dynamic handshapes in this chart,[182] with 3 signs that have handshape **contrasts** and 10 different types of handshape **contours**: *closing*, *opening*, *pinching*, *rubbing*, *hooking*, *flattening*, *straightening*, *wiggling*, *spreading*, and *un-spreading*. Six of these belong to binary pairs: closing & opening; flattening & straightening; spreading & un-spreading. The other four do not have an opposite counterpart: pinching, rubbing, hooking, and wiggling. Examples of each type are shown in Figure 188.

[181] To see an example of this sign, see https://www.handspeak.com/word/search/index.php?id=2846

[182] This number doesn't include a few sings uncertain for the phonological status of the handshape change and six signs with bidirectional aperture change: open>close>open (5 signs) and close>open>close (1 sign).



	closing	opening	pinching	rubbing	clawing/ hooking	flattening/ hinging	straighten-ing	wiggling/ fluttering	spreading	un-spreading	
all fingers	67 (UGALI)	48 signs (SHOCK)	1 (SEX-5)	11 (SOIL-1)	3 (EXPLOIT)	15 (WHY-1)	4 (SEND-1)	24 (REST-2)	1 (SPREAD)	0	174
index	26 (MILK-1)	19 (MONTH)	4 (EASY-2)	9 (PAY)	18 (VIRUS)	4 (RED-1)	0	n/a	n/a	n/a	78
middle finger	0	2 (SACK/FIRE-1)	0	0	0	0	0	n/a	n/a	n/a	2
2 fingers	2 (STEAL-2)	4 (DECEMBER)	0	2 (ALL-DAY)	7 (SEARCH)	1 (NTIMARU)	0	3 (SNAKE-1)	0	1 (PICK-POCKET)	20
other	8 (GRAMMAR)	3 (ARROW)	0	0	3 (TORTOISE)	1 (THEY-2)	0	0	0	0	15
	103	74	5	22	31	21	4	27	1	1	289
minimal pair candidates:	4	1	0	2	2	1	0	0	0	0	

Figure 187. Classification & quantification of dynamic handshapes in KSL

Figure 188. Examples of 10 different dynamic handshape types: a. UGALI-1 (closing), b. MONTH (opening), c. SEX-5 (pinching), d. SOIL-1 (rubbing), e. WHITE (hooking), f. HOPE (flattening), g. TO-SEND-1 (straightening), h. RANK (wiggling), i. SPREAD-2 (spreading), j. PICKPOCKET-2 (unspreading)

j. 

Figure 188 (continued). Examples of 10 different dynamic handshape types: a. UGALI-1 (closing), b. MONTH (opening), c. SEX-5 (pinching), d. SOIL-1 (rubbing), e. WHITE (hooking), f. HOPE (flattening), g. TO-SEND-1 (straightening), h. RANK (wiggling), i. SPREAD-2 (spreading), j. PICKPOCKET-2 (unspreading)

Note that grouped within the category *rubbing* are a few signs that contain a ‘snap’ movement in which the thumb hits the middle finger once (TO-BEAT, TO-CANE, FUNNY, DOLL-1) or rubs past it repeatedly (WANDER-3, ALL-DAY in Fig. 216). Here, I follow Schmaling (2000: 81), in interpreting these movements as the same type of handshape change that is either produced once with force (TO-BEAT) or repeatedly with less force (ALL-DAY). This type of snapping movement appears to originate from a gesture used in the general hearing population in western Kenya that is described by Creider, who reports that it carries the meaning “beating,” as in ‘I’ll beat you,’ or ‘I wish I was at that fight’ (1977: 9).[183] This snapping handshape movement is also described in the phonologies of two other African sign languages, Hausa Sign Language in Nigeria (Schmaling 2000) and Adamorobe Sign Language in Ghana (Nyst 2007), but is not attested in ASL or NGT. Thus, it may therefore turn out to be an areal feature of African sign languages. However, this gesture is also used in various hearing populations all over the world (Victoria Nyst, p.c.), so it may be attested in many other sign languages—potentially making the European sign languages (ASL included) the typologically unusual languages.

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[183] In KSL, it not only means to literally “beat” (either TO-BEAT in general, or specifically with a branch or stick, as in TO-CANE), but shows evidence of becoming an emphatic, such as in the constructions PRIVATE^BEAT, meaning “confidential” and especially HOT^BEAT, meaning “very hot.”

There are also three signs that are listed in Figure 187 (at the top of the classification) as handshape contrasts: T.V., OKAY, and OR-2. All three of these consist of two letters from the fingerspelling alphabet: #T-V, #O-K, and presumably #O-R.[184] However, the final 'K' and 'R' handshapes in OKAY and OR-2 are often simplified. Tokens of OR-2 are shown in Figure 189. Interestingly, no person was ever recorded on video producing the 'R' handshape with crossed index and middle fingers. This is reminiscent of a pattern in Ugandan Sign Language described by Nyst (1999), in which *H* handshapes freely vary with *R* handshapes. And in a third token (Fig. 189c), even the two selected fingers are neutralized, becoming [all] fingers.

a. b. c.

Figure 189. Tokens show simplification of *R* in OR-2: a. *H-thumb* handshape, b. *V* handshape, *open* or *spray* handshape

Similarly, the sign OKAY can reduce to *V* (Fig. 190c) or even be neutralized to *open/spray* handshape just like OR-2 (Fig. 190d), though it also surfaces with as clearly defined *O* and *K* (Fig. 190a). Thus, there is some tendency for KSL signers to reduce handshape contrasts to

[184] The fingerspelling alphabet used in Kenya is modeled after the one used in the United States. There are two main differences: the letter 'T' uses a different configuration (see Appendix 3) and the letter 'S' adds an S-shaped path movement in neutral space. In primary schools, students tend to add other movements for different letters, but adult signers rarely use those (e.g., the 'U' handshape moves upward).

contours, using the same set of selected fingers throughout the sign (i.e., all fingers). And in fact, there are no signs like ASL's WITHDRAW, which has a lexically specified path movement to which the contrast is synced. These three signs do not have any specific movement associated with them, though the hands tend to move outward.[185] In general, KSL has significantly less handshape complexity as a result of incorporating borrowed fingerspelled letters compared to languages like ASL and the BANZSL family (the sign languages of the Great Britain, Australia, & New Zealand) (Cormier, et al. 2008).[186]

Figure 190. Tokens show variation in *K* handshape in OKAY: a. *K* handshape, b. *K* and *V* on different hands, c. *V* on both hands, d. *open/spray*

An analysis of handshape changes that is in accord with theoretical proposals from the literature requires first identifying the underlying handshape in the contour and then finding the various types of joint articulations that result in categorically different contours (e.g., van der

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[185] Interestingly, all but one of the 56 signs in the database that has both path movement and a [close]>[open] dynamic handshape moves in the direction of the extended fingers; e.g., TO-KNOW-2, in Fig. 185b. And the one exception, PRACTICE, has a variant with [open]>[close] handshape movement. This is likely related to a motoric bias.

[186] A full accounting of fingerspelling borrowings is not presented in this thesis, but some analysis has already been done—some of which is found in the handshape chapter and Appendix 3.

Kooij for dynamic handshapes in NGT [2002: 104-105]). However, determining the underlying handshape proved to be extremely difficult, which prevented this type of analysis. It is currently uncertain whether this difficulty is related to the fact that handshapes in KSL resist being decomposed into features (described in Chapter 4), whether the difficulty is found in all sign languages and the theoretical literature has over-simplified the data pertaining to these contours, or there is some other explanation. This is an area that would benefit from further investigation.

Having provided a snapshot of the dynamic handshapes found in KSL, I now turn to the phonemic contrasts found in handshape movements. This requires revisiting the discussion about what is contrastive in movement types from §6.4. The situation for dynamic handshapes is parallel to the issue of whether one core articulatory type can be replaced with another (e.g., KNOW-1 vs. STRESS-3 in Figure 157), but here the replacement is within the structure of handshape only. More specifically, this entails changes in *joint configuration* (a.k.a. *finger position*) because *selected fingers* do not change in handshape contours. All three phonological models have devised ways to account for the majority of contours shown in the classification chart above, with two exceptions: *rubbing* is not given a dedicated feature in any model, though it is recognized as a phonetic type (and accounted for in various ways); and *pinching* is unique to the present analysis.[187]

In the Hand Tier model, there are six handshape features for *finger position*, each with possible +/- values: [open], [closed], [curved], [bent], [spread], and [wiggle]. [wiggle] occupies its own node, *manner*, while the other four occupy the Position node in the Hand Configuration branch (see Appendix 2). The structure of this representation alone would create a very large

[187] It is not clear how cross-linguistically unique this phonetic type *pinching* is. It might be classified as 'hinging' or 'flattening' of the thumb in other analyses. But because it involves the thumb alone, and the position of the thumb is crucial in different handshape types, I thought it should be classified separately.

number of possible contrasts, but Sandler adds an additional rule that greatly limits the number of contours.[188] By comparison, the structure of the Prosodic Model is more limited. It has only two prosodic handshape features, [open] and [closed], but the range of phonemic handshape contours in ASL can be represented by pairing these two either with each other (e.g., [closed]>[open]) or one of them and one of the four joint configuration features in the inherent features branch ([flexed], [spread], [crossed], [stacked]); e.g., [flexed]>[closed]. Finally, the Dependency Model has four dynamic handshape features: [close], [open], [wide], and [curve]. [wide] is for finger spreading and [curve] covers flexion in both the base joints of the hand (at the base of the fingers) and the non-base joints, which she finds are not contrastive.

For all three models, the most straightforward handshape contour to encode is an opening or closing aperture ([close]>[open]; [open]>[close]). An example of a minimal pair from ASL is shown in Figure 191, from Brentari (1998: 161), although more examples of minimal pairs for handshape contours are not easy to find in the literature.

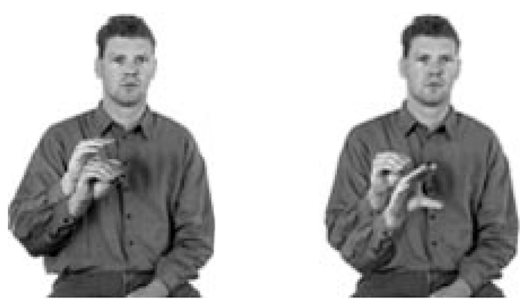
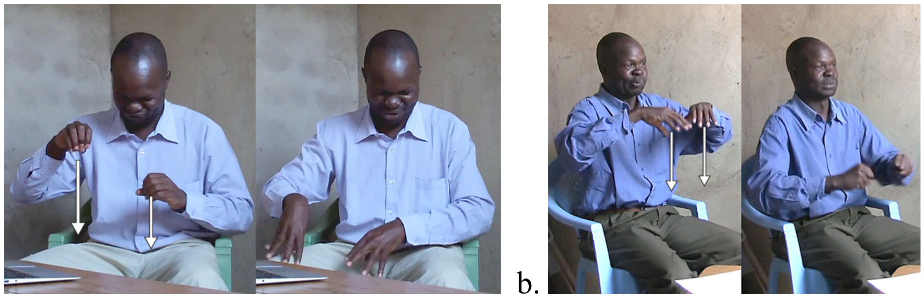


Figure 191. Minimal pairs for aperture change in ASL: SHUT-UP vs. TO-SEND (reprinted form Brentari 1998: 161)

In the KSL data, I found two possible minimal pairs that have a reversal of the aperture features [open] and [close]: (i) DROP-2 (opening) vs. TAKE-OVER (closing) in Figure 192, and (ii) FEAR (opening) vs. PATIENCE (closing) in Figure 193. In the second example, the movement in the sign PATIENCE is often modified in different ways (e.g., with a single 'waving' finger closure,

[188] Sandler's Handshape Sequence Constraint (1989: 83) reduces handshape contours to only four types, which may be too few for ASL phonology, according to Corina (1993: 91).

with the fist circling on the chest, with an arc path movement added, etc.), so this pair should be evaluated with feedback from KSL signers.



a. b.

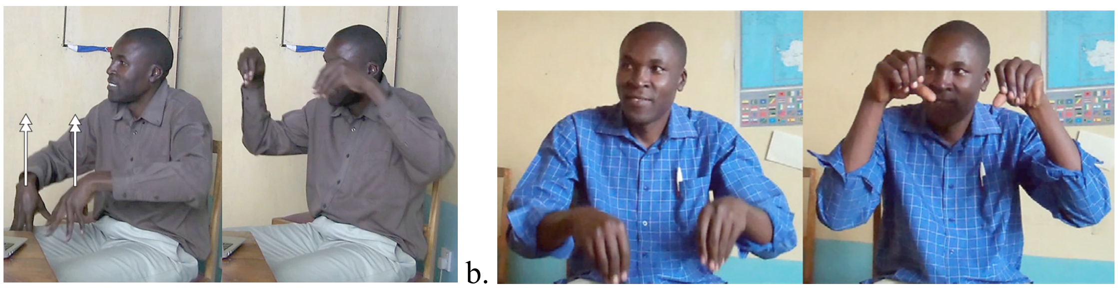
Figure 192. Minimal pair for aperture change: a. DROP-2 (opening), b. TAKE-OVER (closing)

a. b.

Figure 193. Possible minimal pair for aperture change: a. FEAR (opening), b. PATIENCE (closing)

At the same time, there are a few pairs that would be minimal if handshape contours were treated as whole types rather than changes from one featural type to another; that is, [opening] as opposed to [close]>[open]. These pairs include MITUMBA (‘used clothing’) and TO-DIE-3, in which both signs have the same repeated upward movement, orientation, and selected fingers, but MITUMBA has a closing aperture and TO-DIE-3 has a rubbing movement. There is another pair, SOIL-2 and SOFT with the same *closing* vs. *rubbing* contrast, but the hands are facing palm up and there is no added path movement. And there is third potential pair, ORANGE-3 and TO-SPEAK-2 in

Figure 195 that would differ by *hooking* vs. *flattening*. Yet under the existing three models, this pair would be categorized as having both different underlying handshapes (*claw* and *flat-o*) as well as different handshape movements; i.e., [open]>[curve] for ORANGE-3 and [open]>[close] for SPEAK-2. These examples serve to illustrate where the dividing line is for minimal contrast when following the structure in the main phonological models.



a. b.

Figure 194. Possible minimal pair for dynamic handshape: a. MITUMBA (closing aperture), b. TO-DIE-3 (rubbing)

a. b.

Figure 195. Possible minimal pair for dynamic handshape: a. ORANGE-3 (hooking), b. TO-SPEAK-2 (flattening)

Altogether, there are relatively few minimal contrasts made on the basis of dynamic handshape changes in KSL. This is especially noteworthy when considering the large number of inherent/static handshape contrasts. What could account for this disparity? There are a few possibilities. It could be related to the lack of contrasts found in several handshape features, namely joint configuration, thumb position, and spreading. Since it is exactly these features that are implicated in dynamic handshapes, perhaps the pattern here is an extension of the pattern for inherent handshapes. Yet a concomitant explanation based on perceptibility doesn't seem likely since dynamic handshape changes should make the joint, thumb, and spreading features more visually salient. Another reasonable hypothesis is that there are so many possible types of handshape contours that the 'combinatoric space' is simply sparsely populated. Consider that in Figure 187, 26 cells are filled in, representing at least this many different combinations of selected fingers and aperture changes, but this doesn't account for different permutations of thumb position and other joint position for some dynamic types—that is, the 'underlying handshape' involved in the movement. In fact, over 60 unique phonetic contours and contrasts are documented for the 292 signs. Thus, finding any two signs that are perfectly symmetric minimal pairs may just be mathematically unlikely. Despite the lack of contrast, however, the large number of phonetic types shows that dynamic handshapes are a productive part of the lexicon.

6.9 Orientation movement

As shown in Table 20, a change in palm orientation, or *dynamic orientation*, is the perceptual outcome resulting from movement of the ulnae in the forearm or in the wrist joints. Phonetically, ulnar articulation produces *rotation* movement; e.g., SWEET in Figure 196a, while articulation of the wrist joints can produce two types of movement: *nodding* as in BLACK-KITE-1 in Figure 196b, and *pivoting* (side-to-side) as in PARAFFIN/KEROSENE in Figure 196c.

Figure 196. Three types of orientation movements: a. SWEET (rotation), b. BLACK-KITE-1 (nodding), c. PARAFFIN/KEROSENE (pivoting)

However, these phonetic types manifest differently in the phonology. For example, only rotation and nodding alter the visible palm orientation (pivoting only changes finger orientation). Subsequently, only those two are encoded as orientation features in Sandler's Hand Tier Model (1989). Van der Kooij (2002) further restricts the phonology to ulnar rotation, finding that nodding and pivoting are not distinctive in NGT for several reasons: (i) no minimal pairs are found based on orientation changes from nodding or pivoting; (ii) there is much variation in their realization; (iii) these two articulations alternate with regular path movements; and (iv) rotation is less restricted, appearing in more environments than nodding and pivoting. Therefore, in the Dependency Model, van der Kooij uses path setting features for nodding and pivoting articulations, and dynamic orientation features are limited to ulnar rotation (2002: 229). In contrast, Brentari's Prosodic Model encodes all three types, though she limits pivoting to one direction ("abduction", explained below) and hedges somewhat on whether all of the prosodic/dynamic orientation features are truly contrastive ("possible contrastive prosodic orientation features" [1998: 156]).

The KSL data is similar to what van der Kooij finds in NGT, with contrasts lacking for nodding and pivoting. I will first provide a description of the phonetic distributions of dynamic orientation in the KSL lexicon, and then discuss the phonemic qualities.

Each of the three types of dynamic orientation, *rotation* (ulnar rotation), *nodding* (wrist flexion), and *pivoting* (side-to-side movement) can be produced in two different directions. Rotation can either involve **pronation** (or [supine]>[prone]) as in HOW in Figure 197a, or **supination** ([prone]>[supine]) as in SUGAR-1 in Figure 197b.

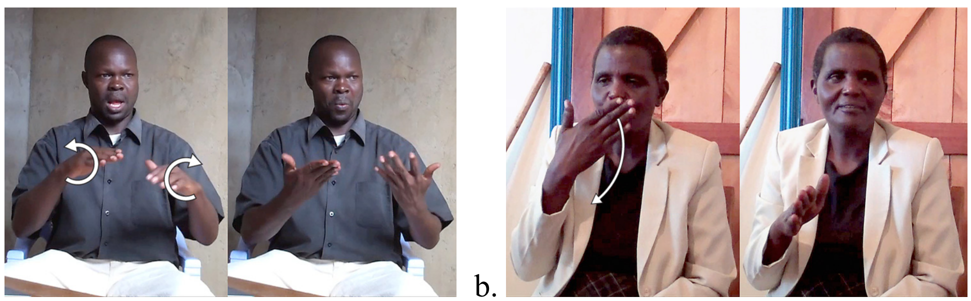
a. b.


Figure 197. Dynamic orientation with two directions of ulnar rotation: a. HOW (supination), b. SUGAR-1 (pronation)

Wrist nodding can either exhibit **flexion** (or [back]>[palm]) as in RAM in Figure 198a, or **extension** ([palm]>[back]) as in EXECUTIVE-1 in Figure 198b.

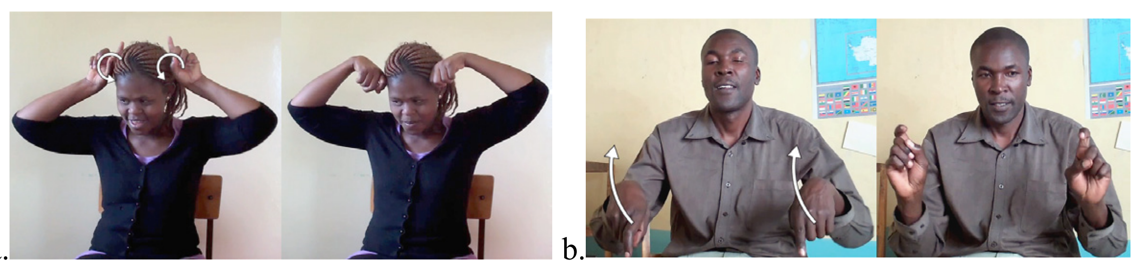
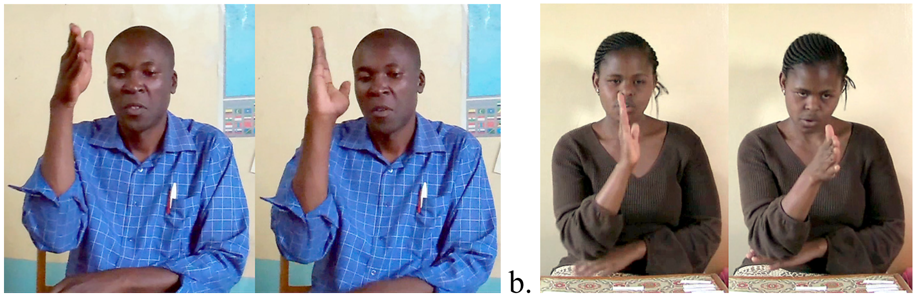
a. b.


Figure 198. Dynamic orientation with two directions of wrist flexion: a. RAM (flexion), b. EXECUTIVE-1 (extension)

Finally, wrist pivoting can be either in the direction of **abduction** (or [ulnar]>[radial]) as in GOD-1 (Fig. 199a), or **adduction** ([radial]>[ulnar]) as in HONEST-1 (Fig. 199b).



a. b.

Figure 199. Dynamic orientation with two directions of wrist pivoting: a. GOD-1 (abduction), b. HONEST-1 (adduction)

The distribution of dynamic orientation in the lexicon is shown in Table 24. This includes all signs that were coded as having a phonetic change in ulnar or wrist movement, including those that also have path movements and handshape changes—a total of 418 signs (22.2% of the database).[189] The largest number of signs with dynamic orientation, 201 signs, have ulnar rotation, followed by wrist nods at 150 signs and wrist pivots at 48 signs. There is a roughly 50/30 proportion split favoring one direction of articulation for ulnar rotation signs (favoring supination) and wrist nods (favoring flexion), while the majority of wrist pivots favor bidirectional articulation (63%; e.g., PARAFFIN/KEROSENE in Fig. 196c).

Table 24. *Phonetic distribution of dynamic orientation**

Dynamic orientation:	Count:	Direction of movement (%):
Ulnar – rotation	201	supination: 53% pronation: 30% bidirectional: 17%
Wrist – nodding	150	flexion: 55% extension: 35% bidirectional: 9%
Wrist – pivoting	48	radial>ulnar: 15% ulnar>radial: 23% bidirectional: 63%

* includes complex signs with path and/or handshape changes

There are only two minimal pairs found in the KSL Lexical Database that contrast by dynamic orientation, and both involve ulnar rotation: FIRST vs. CORRECT shown in Figure 200,

[189] The 19 signs not accounted for in Table 24 are ones in which signers vary, or the source of dynamic orientation is difficult to determine (e.g., the hand moves along a spiraling path in one variant of ELEPHANT), or those with both ulnar and wrist movements.

and NEWS vs. PLAY-3, shown in Figure 201. The one caveat about the first pair is that there is some wrist movement in the sign CORRECT because its semantic mapping is to the visual symbol of a checkmark (see path shape, §6.6.1); yet the bulk of visual information appears to be carried by the change in palm orientation via ulnar rotation. Note that GOD-1 and HONEST-1 (Fig. 199) are also potentially minimal pairs, but the same signer didn't produce each sign and the ending position of HONEST-1 seems categorically different than the starting position of GOD-1.[190]

a.

b.

Figure 200. Minimal pair for dynamic orientation: a. FIRST, b. CORRECT

a.

Figure 201. Minimal pair for dynamic orientation: a. NEWS, b. PLAY-3

[190] Inherent/non-dynamic orientation features can also be contrastive. This thesis has not provided a full accounting of inherent orientation features in KSL, but both absolute and relative orientation are contrastive in the lexicon collected in southwestern Kenya. Counts are provided in §3.6)

b. 

Figure 201 (continued). Minimal pair for dynamic orientation: a. NEWS, b. PLAY-3

Phonetic orientation changes are not that rare in the KSL lexicon, but there are surprisingly few minimal contrasts on the basis of this featural category. For comparison, consider that there are 337 signs in the dataset with the handshape *flat* (i.e., fewer than the number of signs with phonetic dynamic orientation), and 32 minimal pairs that contrast *flat* with another handshape. Thus, dynamic orientation doesn't carry much contrastive potential in KSL. Put together the fact that Brentari (1998) is hesitant about its contrastiveness in ASL, no unambiguous ASL minimal pairs for dynamic orientation are provided in the literature, and van der Kooij also finds limited contrastiveness for orientation in NGT—all this suggests that this is probably a general characteristic of sign language phonology—dynamic orientation is not highly contrastive in sign languages.

It would be interesting to use experimental means to understand why this is the case. Are these orientation movements not sufficiently perceptible enough? Another hypothesis (also compatible with a perceptibility explanation) is that well-formed articulation of path movements requires some ulnar and wrist movements, and phonologies prioritize path movements. Thus, wrist and ulnar movements are often produced in service to a path shape. And note that it is those articulations least tied to a path—i.e., ulnar rotations—that are the ones found in contrasts.

Lastly, a further point should be made about the type of features used for dynamic orientation. Brentari prefers unary features, such as [supination], [flexion], [abduction], etc., while Sandler and van der Kooij prefer two features that represent different positions. For example, the KSL sign NEWS in Figure 201a would be assigned the prosodic feature [supination] by Brentari, the features [out]>[in] by Sandler, and the dynamic features [prone]>[supine] by van der Kooij. The database was coded for orientation features compatible with all three theories. This includes coding setting changes for some signs with dynamic orientation when they appear to reference a path movement, as van der Kooij suggests for nodding and pivoting movements.

6.10 Complex movements (primary + secondary movement)

Signs with more than one type of core articulatory movement in the same syllable (where a syllable is a single continuous movement) are seen as more complex than those with only one articulatory movement. There are three reasons cited for this. First, signs with only one core articulatory movement are much more frequent in sign language lexicons than those with two or more simultaneous movements. Second, it has been observed—on the basis of the ASL lexicon—that signs are restricted to only two simultaneous movements per syllable (Wilbur 1993, Uyechi 1996, Brentari 1998). Wilbur writes that a “syllable may contain change of handshape, location, or orientation, or a combination of location and either handshape change or orientation change. But no forms exist with simultaneous DISTINCTIVE combinations of change in handshape and change in orientation” (1993: 154; Wilbur’s capitalization). And third, any representation of sign phonology requires specifying more information to account for these signs. Thus, some phonological models—particularly the Prosodic & Dependency Models—have been designed to represent this informational complexity structurally via branching structures.

The same tendencies described by Wilbur for ASL are found in Kenyan Sign Language. The pie chart in Figure 202 shows that the majority of signs, 77% (in teal), are “simple”, i.e., comprised of only one core articulatory movement, while 22% (in orange), are "complex" with two types of simultaneous core articulatory movements. And, there is a third group with all three articulatory movements: 1%, in red. By comparison, Brentari reports that 82% of ASL signs (from the *Dictionary of American Sign Language*, Stokoe 1965) are simple and 18% are complex. Thus, the KSL Lexical Database contains signs with somewhat more articulatory complexity.

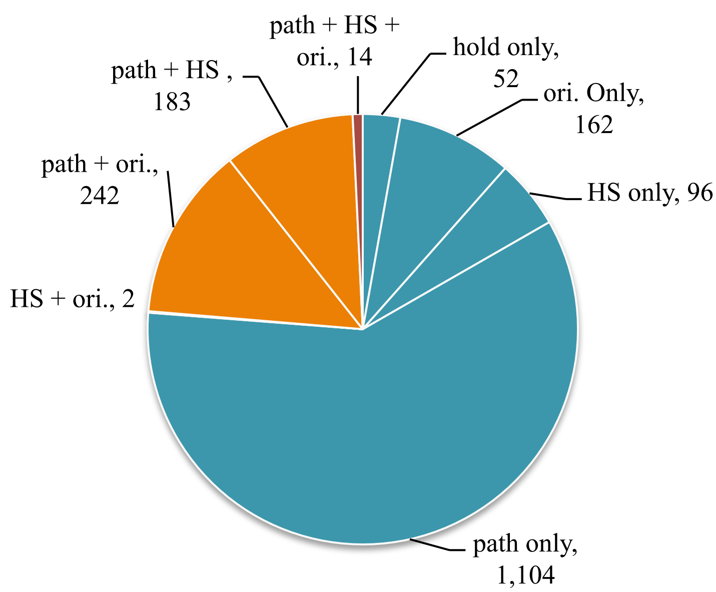


Figure 202. Complexity of movement in the KSL lexicon: 77% simple (teal), 22% complex (orange), 1% supercomplex (red)

In the KSL database, 14 signs had all three types of core articulatory movements co-occurring in the same syllable. These signs do not conform to the constraint on syllable complexity stated above. While there is some question about the distinctiveness of certain orientation changes in KSL (explained in the previous section), the secondary movements in at least some of these signs with complex syllables do seem to be distinctive—that is, all movements are necessary to produce a well-formed sign. Examples include TO-MAKE-3 (Fig. 186b), LOST and ROOSTER-3 in Figure 203, TO-FIND, TO-SELL, EMPTY-4, etc.[191]

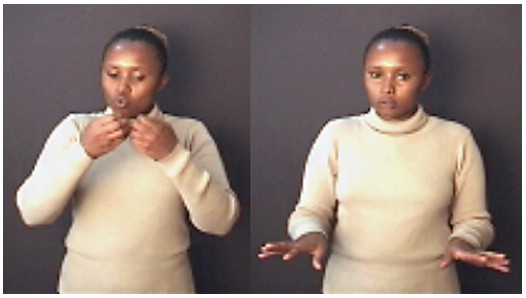
a.  b. 

Figure 203. Signs with all three articulatory movements (path, handshape, orientation): a. LOST, b. ROOSTER-3

There are also at least two signs with handshape *and* orientation changes: MAIZE-2 (Fig. 186a) and SEND-DIGITALLY-2. Also, at least one three-movement sign, TO-ACQUIESCE in Figure 204, would be ill-formed if not produced with both handshape and orientation change, though the path movement could be deleted. Although few in number, these signs show that both types of local movement can be specified in the same sign, contra to the observations from ASL.

Figure 204. Sign that require both handshape and orientation changes: TO-ACQUIESCE[192]

Highly complex signs have also been documented in other sign languages. In Finnish Sign Language, Jantunen finds that around 60% of FinSL signs (from 231 signs in a video

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[191] Note that ROOSTER-3 has a quick handshape change at the beginning of the sign that is prosodically unusual (and hard to capture in a picture). This fits an observation found in the KSL data that complex signs can be unusual in several dimensions at the same time. Such signs are discussed at the end of the chapter, in §6.7.

[192] This English gloss fits the lexical semantics well, but is not a frequently used word in Kenyan English, providing one reason why glosses are a poor fit for representing signs. The opacity of this gloss to most Kenyans also exemplifies why it would be crucial for proper ID-glosses (§2.8) in a KSL corpus to be developed based on careful discussions and decisions by KSL signers (Hochgesang 2015).

dictionary) consist of simple syllables, around 34% are complex, and around 6% are "supercomplex" (2006: 340). In addition, he takes non-manual movements into account (i.e., mouth, head, torso) and finds that at least one FinSL sign is "hypercomplex" (EI-TUNNE, 'does not know him/her'), with all three manual articulations plus a lexically-specified non-manual articulation. For this project, non-manuals were coded phonetically, but require further research to know what is lexically specified, so the data is not available for KSL.

In Hong Kong Sign Language, Mak & Tang describe simultaneous core articulatory types in 1,376 HKSL signs and find that 1% (15 signs) are supercomplex, containing path, handshape, and orientation movement—the same proportion in the KSL dataset. They also document 6 signs that have simultaneous handshape + orientation movement. Just as in KSL, this is proportionally smaller than the supercomplex signs.

Finally, Schmaling reports that Hausa Sign Language has three signs that contain all three movement types. However, she does not mention signs with only handshape and orientation changes.

When considered altogether, the data from KSL, FinSL, HKSL, and HSL provide more support for the overall tendency that languages prefer simplicity, while at the same time suggesting that there is tolerance for a very small number of "supercomplex" signs compared to ASL. Jantunen proposes that sign languages follow the same principle of *Zipf's Law* formulated for spoken languages, which says that simpler linguistic structures will be more frequent than complex ones. He further hypothesizes that this bias against complexity may assert itself on a sign language lexicon over time, resulting in simpler syllables than currently attested in FinSL.

This is not an unreasonable hypothesis, although it should be noted that there is still much we do not know about the cross-linguistic typology of sign language phonologies (Crasborn et al.

2002). It may be the case that certain types of complex forms are in fact characteristic of different sign languages. Also, spoken languages are certainly not equally complex either and analogy with them would actually predict *more* cross-linguistic variation in complexity.

Lastly, I will address another observed constraint on complexity, even though it involves a manner feature, *path shape*, which has not yet been described (see §6.6.1). van der Kooij writes that in Sign Language of the Netherlands, "(w)hen combined with a local movement, the path movement cannot have a distinctive shape. It takes the default 'straight' shape." (2002: 236). However, KSL does not conform to this constraint. Leaving aside orientation changes, at least nine KSL signs have handshape changes on non-straight paths; that is, on *arc*, *circular*, or *zigzag* paths. Three of these have trilled fingers (WANDER-3 in Fig. 205a, RIVER-3, ALL-DAY) and six have single handshape changes: WEIRD in Fig. 205b, COAST-1 in Fig. 156b, BUFFALO, JAPAN, AFRICA-3, and MOVIE. Again, this seems to indicate a greater phonological complexity allowed in KSL signs.

a. 

b. 

Figure 205. Signs with local movement and non-straight path: a. WANDER-3, b. WEIRD

To conclude, simultaneous syllabic complexity is generally restricted in sign languages cross-linguistically. However, there are some differences at the periphery. KSL appears to have somewhat greater complexity than ASL for simultaneous core articulatory movements, but is equally complex as FinSL and HKSL in this respect. KSL is also more complex than NGT for combinations of different path shapes and local movement.

It is interesting to consider that without the FinSL and HKSL data, the greater complexity in KSL might have been interpreted as a characteristic of a relatively young sign language that is somehow less systematic or less phonetically constrained than 'older' sign languages like ASL and NGT. However, FinSL has been used in Finland for around 150 years, but exhibits a similar pattern as KSL. This suggests that much more cross-linguistic data is needed to understand the complete picture. Is ASL the odd language out in having no supercomplex forms? Or perhaps all these languages are (even) more similar than they appear and the difference is due the analysis? Alternately, do these differences simply reflect the normal manifestation of language-specific characteristics? Only further research can satisfactorily answer these questions.

6.11 Conclusion

In this chapter, I provided a background of Movement in the theoretical literature and specifically a description of the model used in this thesis, the Dependency Model, and why it was chosen. Following the DPM framework, I have separated the description of movement in KSL into core articulatory movements in this chapter and manner of movement in the next chapter. For core articulatory movement, I discussed the phonetic underpinnings of these movements and provided evidence for their categorical nature. This included defining three types of minimal pairs for core articulatory movements.

Altogether, it was found that articulatory movements in KSL are largely similar to those in other sign languages, with path movements are the most common articulatory type overall, and the most complex forms with both primary and secondary movements being the least common. However, KSL has some signs without phonological movement, which are not attested in all signs languages, and has somewhat greater allowance for syllabic complexity than is attested in NGT and ASL. Also, only around two dozen minimal pairs were found on the basis of changes to core articulatory movements, which is relatively much smaller compared to the lexical contrast in handshapes and in locations.

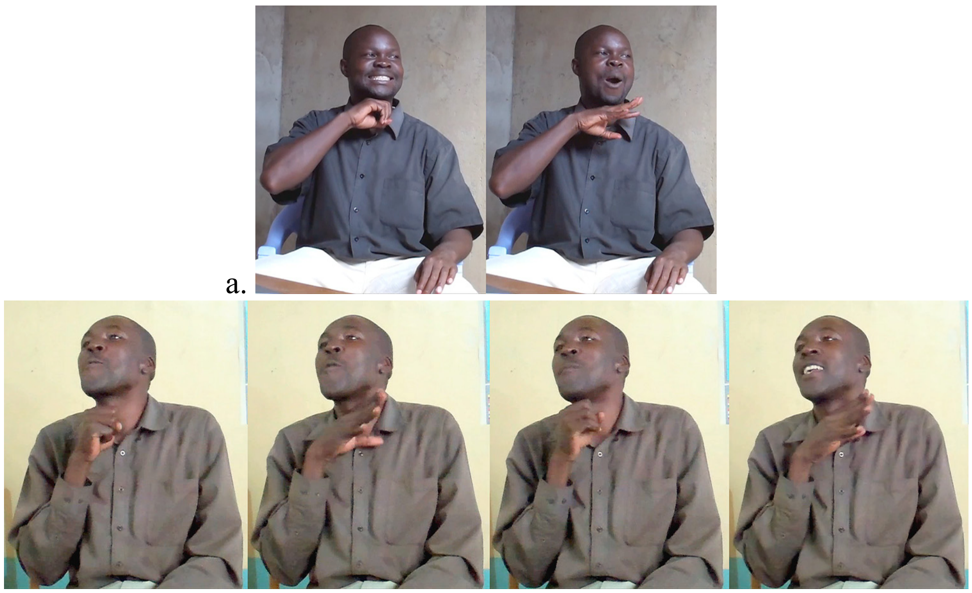
Chapter 7:
Manner of movement

7.1 Introduction

The previous chapter described one major type of movement in sign language phonology, *core articulatory movements*, in which specific joint articulations map to phonological movements; namely, path movements, handshape changes, and changes in palm orientation. The second major category of movement features are *manner of movement*, which are those features that dictate how the core articulatory movements are realized. Wilbur writes, "(m)anner of movement is probably the most understudied area of sign language formation" (Wilbur 2013: 233). This chapter seeks to fill in some of the gaps about these features, in both descriptive detail (for this southwestern dialect of KSL) and in their phonological representation in a theoretical model.

In this chapter, I profile 21 manner features in KSL using minimal pairs and other supporting evidence. Here in the introduction, I provide an overview of these features and their phonological structure before addressing how they interact with prosodic structure in models of sign phonology in §7.2. After that, the description of each type of manner feature in KSL is organized in the following way: path shape features (§7.3); path size (§7.4), single, repeated, and trill (§7.5); unidirectional vs. bidirectional (§7.6); simultaneous vs. alternating (§7.7), switch dominance (§7.8), dispersed (§7.9) and other movement types (§7.10). Special emphasis is given to the feature [dispersed] because it is newly proposed in this thesis and describes a distinct class of signs whose properties have not been sufficiently addressed in previous literature.

An example of two of the most common manner features are [single] and [repeated] in which the same articulatory movement is produced once or is repeated—a difference that can result in a change in meaning. For example, the KSL sign SOUND has a single handshape change at the neck (Fig. 206a), while the sign COMPLAIN-1 is identical in all features except that it is repeated twice (Fig. 206b).[193]



a. b.

Figure 206. Minimal pair for manner features [single] vs. [repeated] with only handshape change: a. SOUND, b. COMPLAIN-1

Crucially, [single] and [repeated] can be applied to any core articulatory movement. SOUND and COMPLAIN-1 have only handshape change, while the signs DO and WORK in Figure 207 also contrast by number of repetitions, but have path movement. And though there isn't a true minimal pair for orientation changes on the basis of repetition, there are many signs in the KSL lexicon with orientation changes that must either be articulated once (e.g., NICE in Fig. 208a) or repeated (e.g., BADO ['not yet'] in Fig. 208b) to be well-formed.

[193] Video with the same signer from the data collection area was not available, but both signs are standard in KSL and are a minimal pair with the same signer appears in a KSL video dictionary (Mjitoleaji Productions 2004).


a.


b.

Figure 207. Minimal pair for manner features [single] vs. [repeated] with path movement: a. DO, b. WORK


a.


b.

Figure 208. Manner features applied to palm orientation movements: a. NICE [single], b. BADO [repeated]

Because (some) manner features can apply to any articulatory type, it has been argued that they should be placed in a position of dominance over the core articulatory tiers (Ahn 1990, Wilbur 1993, van der Hulst 1993). A simplified version is shown in Figure 209, based on Ahn (1990) and Wilbur (1993). The Dependency Model follows this structure and places the Manner tier in the 'specifier' position, as the left-branching daughter of the root node.

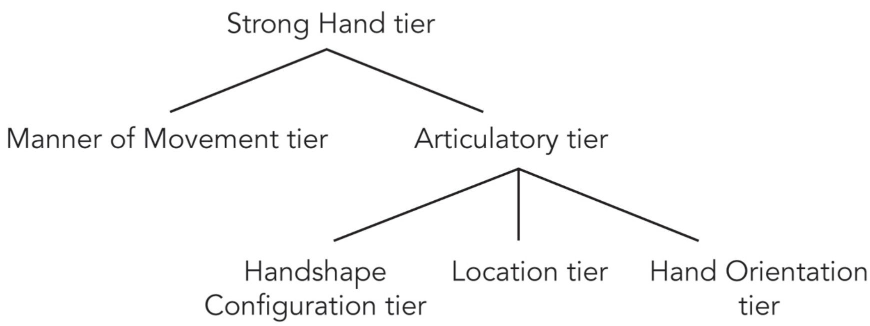


Figure 209. Manner of movement features in a c-command relation to the core articulatory movements; Wilbur's (1993) representation of Ahn (1990)

Some early proposals for manner features separated them into different tiers, such as those shown in Figure 210 by Wilbur (1993: 155) with five categories: size, shape, speed, tension, and manner. In the Dependency Model, however, manner features are listed altogether in a single tier.

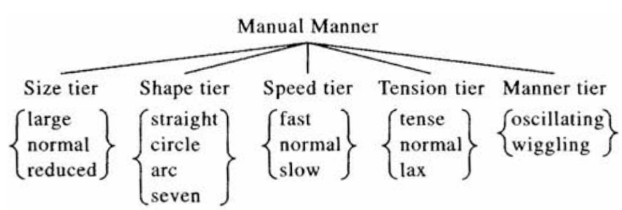


Figure 210. Categories of manner features (reprinted from Wilbur 1993: 155)

Like core articulatory features, manner features can also co-occur with each other. For example, the sign KERICHO (Kenyan town) in Figure 211 has two core articulatory movements, path and handshape movement, as well as three manner features: [repeated], [alternating], and [unidirectional]. However, not all manner features co-occur with each other. Only one manner feature from a category is allowed in a sign; i.e., *[arc] and [circle]; *[single] + [repeated].

Figure 211. KSL sign KERICHO with multiple articulatory movements and manner features

In this project, I have identified 21 manner features for KSL, which are shown in Table 25 and described in more detail in this chapter. These can be grouped into five categories using co-occurrence in the same sign as a marker that features are in different categories. *Repetition* refers to the number of times a movement is repeated; *return* refers to whether the sign ends in the second articulatory position (of a core articulatory movement; see Chapter 6) or whether the core articulatory movement returns to its beginning position; *dispersed* refers to an identical movement produced in two sub-locations; *shape* refers to the shape of a path movement through space; *size* refers to the size of the path movement; and *hand configuration* refers to how the hands move relative to each other. The combinatorial patterns in KSL argue for creating a structural separation in the Manner tier, akin to the one in Figure 210, with each category as its own tier.[194,195]

Table 25. *Manner features in KSL, by type (21 total)*

repetition	return	dispersed	shape	size	hand config.
[single]	[unidirectional]	[dispersed]	[straight]	[small]	[simultaneous]
[repeated]	[bidirectional]		[arc]	[large]	[alternating]
[trill]			[circle]		[switch dom.]
			[zigzag]		
			[circle+straight]		
			[angle]		
			[x-shape]		
			[s-shape]		
			[u-shape]		
			[?-shape]		

194 No evidence was found in the KSL lexicon that *speed* or *tension* features (from the classification in Fig. 210) are contrastive in this language. A field for 'tense' was used in the phonetic coding, and at least 28 signs were flagged for this hard-to-define quality, including BITTER-1, AWAKE, AGGRESSIVE, PORCUPINE, etc. However, they are not phonetically distinct and none of these had anything resembling a non-tense counterpart as a minimal pair. Speed was not coded.

195 [dispersed] would have been grouped in the repetition category except for one sign, PARENTS-2, with a trilled movement repeated in two locations; for this sign, [trill] and [dispersed] co-occur.

What about the patterns of co-occurrence with manner features and different core articulatory features? Table 26 shows these distributions related to different combinations of core articulatory types (LOC = path movement; HS = handshape change; ORI = orientation change). A checkmark means that there is at least one attested KSL sign. It is found that, *repetition*, *return* and *dispersed* can apply to any of the articulatory types; *trill* applies only to secondary movements; *shape* applies to signs with a perceptible path, which includes path movements and some orientation movements, but not handshape movements; *size* applies only to plain path movements; and *hand configuration* features apply to signs with two hands. Note that there are fewer attestations in highly complex signs; i.e., those with all articulatory types (LOC+HS+ORI). This could be due to the relative infrequency of these signs and/or to limits on overall formational complexity in the sign.

Table 26. *Manner features that occur with core articulatory features*

	Manner:	**LOC (path)**	**HS**	**ORI**	**LOC+HS**	**LOC+ORI**	**LOC+HS+ORI**
1	single	✓	✓	✓	✓	✓	✓
2	repeated	✓	✓	✓	✓	✓	✓
3	dispersed	✓	✓	✓	✓	✓	✓
4	trill		✓	✓	✓	✓	✓
5	unidirectional	✓	✓	✓	✓	✓	
6	bidirectional	✓		✓	✓	✓	✓
7	straight	✓	?	✓	✓	✓	✓
8	arc	✓		✓	✓	✓	
9	circle	✓		✓	✓	✓	
10	(other shapes)	✓		✓	✓	✓	✓
11	small	✓					
12	large	✓					
13	simultaneous	✓	✓	✓	✓	✓	✓
14	alternating	✓		✓	✓	✓	✓
15	switch dominance	✓	?			✓	

Also, there are relatively fewer manner features that apply to handshape movements. While Brentari suggests that handshape contours can have path shapes in ASL (e.g., BEAUTY in ASL is said to have a circle shape [1998: 132]), there isn't enough evidence that signers perceive these categorically as path shapes in KSL; follow-up with signers would be necessary to determine this.

These patterns of co-occurrence show that not every manner feature applies to every core articulatory movement. However, their position in the model (off the root node) is still justified because (i) some manner features do apply to all of them, and (ii) manner features have a fundamentally different relationship to prosodic structure than core articulatory movements—that is, the former are directly linked to syllabic structure (see next section) while the latter just fill X-slots on the skeletal/timing tier. Most of those manner features that don't apply to certain core articulatory movements (e.g., [z-shape] not applying to handshape movement) are blocked for articulatory reasons.

To summarize, there are five categories of manner features in this dialect of KSL that dictate how core articulatory movements are realized. These movements can co-occur with each other (e.g., [unidirectional] and [alternating]), though not within the same category (e.g., *[alternating] and [switch dominance]). And while some categories of manner features are targeted to specific articulatory types (e.g., *size*), others can be matched to all types of articulation (e.g., *repetition*, *hand configuration*). In the next section, I explore the relationship between manner features and prosodic structure on the skeletal/timing tier.

7.2 Representing manner features and prosodic structure

When it comes to the representation of manner features in the main phonological models (i.e., Hand Tier, Prosodic, Dependency), the Dependency Model (DPM) is the only one that divides movement into the two types used in this thesis. In contrast, the Prosodic Model (PM) uses many of the same features as those shown in Table 25 (e.g., [repeated], [circle], [trilled movement], etc.), but it places them in the Prosodic Features branch, in five tiers on the basis of visual sonority, shown in Figure 212. For example, [repeated] is in the path tier, while [trilled movement] and path shapes ([straight], [arc], [circle]) are in the top tier. While this grouping has the benefit of reflecting visual sonority, it comes at the expense of being able to represent the most minimal categories of lexical contrast. For instance, [direction: >|] and [repeat] appear as feature types in the same tier in the PM and presumably have similar sonority, but one cannot be replaced with the other to create a new sign. In comparison, the organization of features in the DPM is better able to reflect contrastive structure, by grouping contrasting core articulatory features into the same tier.

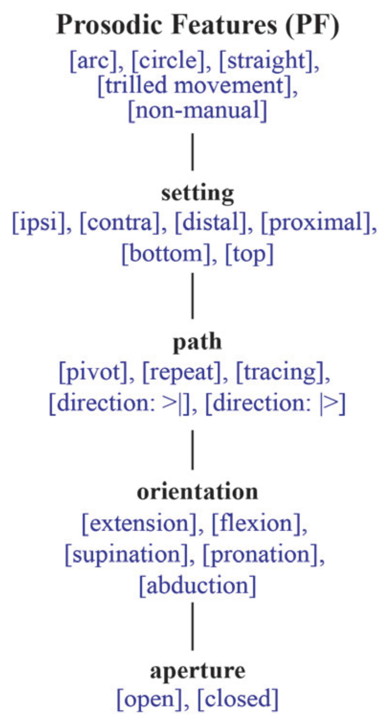


Figure 212. Prosodic features branch in the Prosodic Model (Brentari 1998)

In this thesis, I have largely adopted the representation of phonological structure in the Dependency Model, with modifications or clarifications where necessary. One of these gaps regards how some prosodic forms manifest on the skeletal/timing tier. Here I propose to apply an idea from the Prosodic Model in order to clarify the relationship between manner features and prosodic structure. Before doing so, I first describe the differences between the Prosodic Model (PM) and Dependency Model (DPM) regarding prosodic structure on the skeletal tier.

In the Prosodic Model, based on ASL, all signs require movement to be well-formed, and prosodic features are movements by definition. Thus, all signs have prosodic features. All prosodic features also license some number of x-slots on the timing tier in the PM, though some license more x-slots than others. For example, [repeat] licenses four x-slots, or two adjacent syllables. Further, the "class node with the highest potential number of x-slots determines the number of x-slots for a particular lexeme" (Brentari 1998: 183), so that the correct number of syllables is assured. In this way, the PM has operationalized prosodic features so that all well-formed signs have appropriate prosodic structure on the skeletal tier.[196]

By contrast, van der Kooij posits a well-formedness constraint, the Sign Minimality Constraint, which says that a "sign's content has to be associated to at least two positions on the skeleton" (van der Kooij 1994; 2002: 241). This bipositional skeleton is therefore already present in all lexical signs. The association of core articulatory movements (as well as unchanging/inherent features) to the bipositional skeleton (i.e., with two X-positions) is straightforward in the DPM. However, manner features and their relationship to the timing tier has not been fully elaborated in the Dependency Model, and a particular gap exists for disyllabic signs, such as [repeated], [bidirectional] (a.k.a., [+return]), and others. That is, how are two syllables created on the timing tier in these signs?

[196] As long as they have movement, that is. The assumption that all signs have movement presents a problem for signs that are well-formed in KSL without movement, discussed further in §6.6.

To address this gap, I propose incorporating one aspect of the Prosodic Model into the Dependency Model: the licensing of skeletal positions on the timing tier with manner features (instead of prosodic features). The depictions of KNOW-THAT in the PM and DPM shown at the beginning of Chapter 6, and repeated here in Figure 213, show how the prosodic feature [repeat] in the PM licenses two syllables at the top of the Prosodic Features branch ([—], [—]), which subsequently creates a two-syllable template on the skeletal tier (Figure 213a). In comparison, the DPM simply specifies [repeated] whose operation involves duplicating an identical copy of the syllable.

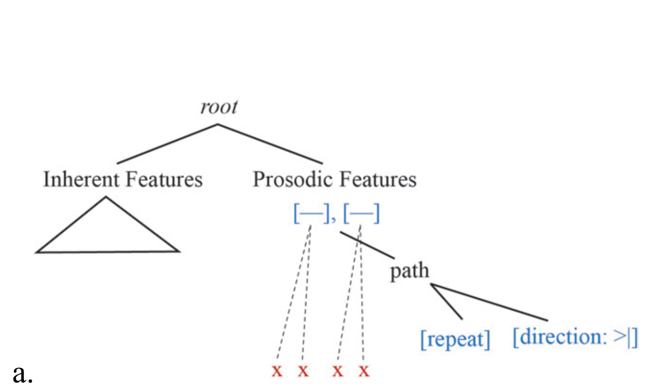


Figure 213. Representation of KNOW-THAT in two models: a. the Prosodic Model, b. the Dependency Model

It is straightforward to posit that the feature [repeated] results in a disyllabic structure; however, the mechanism for this is not explicit in the DPM. Also, several other manner features are inherently disyllabic, too. This includes path shapes with two syllables (e.g., [angle], [circle+straight]), 'dispersed' signs in which an identical syllable repeats in two sub-locations within a phonological location, and other manner features. I therefore propose that certain manner features license two syllables on the skeletal/timing tier as part of their featural characteristics, in the same way that the PM's prosodic features do. There are eleven of such features in KSL, which are listed in (14). All other manner features are monosyllabic, following the default Sign Minimality Constraint.

(14) *Manner features that license two syllables ({X X}{X X})*

1. [repeated]
2. [angle]
3. [circle+straight]
4. [zigzag]
5. [x-shape]
6. [s-shape]
7. [u-shape]
8. [?-shape]
9. [switch dominance]
10. [bidirectional]
11. [dispersed]

In addition to this clarification about manner features and how they produce different structures on the skeletal tier, this thesis makes four other modifications to the Dependency Model. These are discussed at other points in the thesis and in this chapter, and are briefly summarized here. First, in §3.3.2, I clarify that the skeletal tier in the Dependency Model is a timing tier. Second, I propose to separate the Manner tier into five separate dependent tiers to better account for the patterns of lexical contrast and co-occurrence of manner features (as discussed in the previous section). Third, in order to account for signs with a trilled secondary movement during a path movement, an unbranching dynamic node is proposed that contains both dynamic features and spreads throughout the syllable (discussed in §7.5). And fourth, dispersed signs require an additional level of branching in the dynamic Location node (i.e., Settings node) in order to create two separate axes—a syllable level and a word level axis (presented in §7.9.5).

Another difference with van der Kooij (2002) are the specific manner features listed in the model. These originate in part from differences in analysis, but also in real linguistic differences between NGT and KSL. In her final model, van der Kooij lists only six manner features, which do not include unmarked features: [tense], [repeated], [alternating], [bidirectional], [crossed], and [circle]. Unmarked counterparts to these features are presumably: /non-tense/, /single/, /simultaneous/, /unidirectional/, and /straight/. Even with the unmarked features, there are many fewer features for NGT than the 21 features proposed for KSL here. The biggest reason for this difference is that I include many path shapes as separate phonological types, while van der Kooij names only [circle] and /straight/, and the rest are attributed to ‘semantic prespecification rules’.

At the same time, there are some language-specific differences in manner features between NGT and KSL. These are discussed further in each section below, but in brief, it appears that KSL has path size differences ([small], [large]) while NGT does not. Also, NGT may not have the same type of signs that necessitate a [dispersed] feature. Finally, there are two other differences for which it is difficult to determine whether the language data is truly different or whether it is only the analysis that differs; these are [trill] and [switch dominance], and are discussed more below.

One consequence of clarifying the relationship of manner features to syllabic structure is that it calls for a re-evaluation of the DPM’s status with regard to movement. Brentari has written that the Dependency Model “contains no movement features, although the manner tier could potentially dominate such features” (Brentari 1998: 90). As discussed at the beginning of Chapter 6, this is because core articulatory movements are interpreted as transitions between articulatory states, not phonological movements (something that van der Hulst and van der Kooij would agree with). However, I argue that the role of manner features in the Dependency Model, especially with clarifications made in this thesis, means that the DPM cannot be said to be fully “movement-less.” Here, manner features take on a key function of prosodic features in the PM: they license prosodic structure on the skeletal/timing tier. Therefore, manner features have as much of a role in movement as many of the prosodic features in the PM[197] and all of the features that associate to the M-segment in the Hand Tier Model (Sandler 1989).

To conclude the introductory part of the chapter, this thesis adopts the separation of manner features from core articulatory features following the Dependency Model, but makes some further clarifications (addressed in this chapter) in order to account for (i) how manner features relate to the skeletal/timing tier and (ii) how manner features temporally distribute core articulatory movements on the timing tier. While this chapter offers implementations for certain types of KSL signs, the field would benefit from a more thorough treatment of manner features cross-linguistically.

In each of the seven sections that follow, the manner feature will be described with examples in KSL and quantitative results from the KSL Lexical Database. Also, minimal pairs will be presented, if available, and some contextualization about the feature in different models will be provided as relevant. Finally, any unusual or unique data in KSL will be highlighted. The last descriptive section (§7.10) profiles signs with exceptional or difficult to categorize manner types. In the next section, the first and largest category of manner features is described, *path shape*.

7.3 Path shape

In the KSL Lexical Database there are a total of 1,505 signs with path movement, and the overwhelming number of these, 78%, are straight path shapes.[198] The remaining 22% consist of: arc path (11%), circle path (7%), zigzag path (1.4%), repeat-90º path (cross, X, angle; 1.2%), circle+straight path (0.7%), and other path shapes (1.3%). These are described in turn below,

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[197] Technically, Brentari's argument is that the features [direction], [tracing], and [pivot] are the truest movement features because they refer to the actual movement rather than the end points of a transition. It is therefore still possible to argue that the DPM does not encode movement on those grounds.

[198] This is very close to the 75% of paths in NGT that are straight (van der Kooij 2002: 243).

followed by a brief review at the end of this section regarding how phonological models encode path shape.

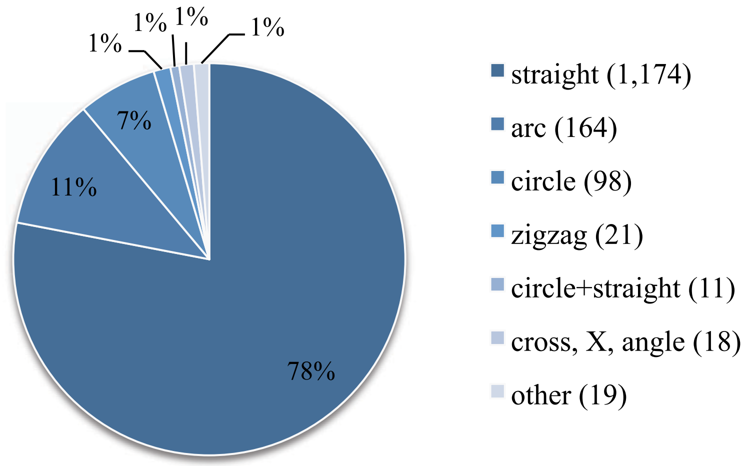


Figure 214. Proportion of path shapes in the KSL Lexical Database, with counts of signs in parentheses (1,505 total signs with a path movement)

There are at least three minimal pairs that contrast by path shape. Two of these are [straight] vs. [circle] paths: AFRICA-1 vs. BIOLOGY in Figure 215, and WHICH vs. MILK-2. The other is an [arc] vs. [circle] path: WANDER-3 vs. ALL-DAY in Figure 216 (note that the fingers 'snap' repeatedly during the path movement in the two signs).


a. b.

Figure 215. Minimal pairs for path shape: a. AFRICA-1 ([straight]), b. BIOLOGY ([circle]),


a.

Figure 216. Minimal pairs for path shape: a. WANDER-3 ([circle]), b. ALL-DAY ([arc])

b. 

Figure 216 (continued). Minimal pairs for path shape: a. WANDER-3 ([circle]), b. ALL-DAY ([arc])

There are also a few likely or possible minimal pairs. First, there is a near-certain minimal pair, IF-1 and THIRTY-THREE that also contrasts straight and circle paths, but video representation for THIRTY-THREE was not procured. Second, circle+straight contrasts with straight+straight in EXACT vs. SIGNED-ENGLISH-1, shown in Figure 43 in §3.7. This could be considered a contrast of only the shape in the first syllable, circle vs. straight.[199] And third, the pair ROAD and RIVER-1, shown in Figure 217, is believed to be minimal; however, there is some uncertainty about the path shape in ROAD. This sign's etymology references the straight line of a road moving away from the signer along the midsagittal axis. However, in KSL, unlike most other sign languages with similar signs for ROAD (see spreadthesign.com), the hands move upward at the end.[200] The same upward trajectory is seen in RIVER-1, but somewhat less so, and also the relative orientation may be different, requiring this pair to be double-checked with signers.

[199] This could also be seen as a contrast in manner features; that is, [straight] & [repeated] in SIGNED-ENGLISH-1 vs. [circle+straight] in EXACT.

[200] There is both an articulatory as well as a cultural explanation for this. Phonetically, the tracing of a virtual road in the KSL sign for ROAD happens more on the tips of the fingers (somewhat similar to German Sign Language in spreadthesign.com) than on the ulnar blade of the hands. This may force an upward movement at the end for articulatory ease. Yet I have also observed that in the gestural traditions of this area, when a person (hearing or deaf) references a path that has been traveled, they will produce a tracing movement (with index finger) with an upward flick at the end. This upward movement seems to indicate something about distance. This is what appears to be picked up in signs for ROAD, PATH, and RIVER, and in modified verbal constructions for "to walk off/away," which also flicks up at the end.

Figure 217. Possible minimal pairs for path shape: a. ROAD (straight), b. RIVER-1 (zigzag)

If all these pairs are counted, *straight* and *circle* contrast in four pairs, *circle* and *arc* in one pair, *straight* and *arc* in no pairs, and *zigzag* may contrast with *straight* or *arc* in one pair. This lexical contrast data, in conjunction with frequency of path shapes in the lexicon seems to indicate that the first three shapes are the most basic types, with zigzag a possible fourth type.

In the remainder of this section, I describe each of the path types, then end with a brief discussion of how path shape has been represented in phonological models and how the KSL data could be accounted for in a theoretical model.

7.3.1 Straight path shape

The overwhelming proportion of signs with path movements in the lexical database are those with straight paths: 1,174 signs or 78% of all paths. [straight] is therefore the most frequently occurring feature in the lexicon, among all parameters and feature types. Note that this count also includes paths that are combined with movement in handshape and palm orientation (see Table 21). In fact, the ability for a straight path to combine with other core articulatory movements, participate in other manner feature contrasts, and be modified for any location and with any handshape is what probably accounts for its ubiquity as a combinatoric unit of sign phonology.

Note that straight paths have also been proposed as an epenthetic default, inserted to make signs fit well-formedness constraints—specifically, that all signs require movement to be well-formed (Brentari 1998). That is, a short straight path that would otherwise be a transitional movement to or from a location is reinterpreted as a phonological movement. However, because KSL allows signs without movement (i.e., 'holds', §6.6), epenthetic movement cannot be assumed in KSL and requires more study.

7.3.2 Arc path shape

The next most frequent path shape is [arc], with 164 signs marked with this shape in the database. However, [arc] paths are quite heterogeneous, and deserve further investigation. Here I will simply report on the subtypes of arc signs found in the lexicon. First, there are straightforward arc shapes that trace a two- or- three-dimensional shape as seen by a viewer: MOON, HILL, PREGNANT, CAR-2, etc. These have clearly recognizable beginning and end points and tend to move along a cardinal directional axis (vertical, horizontal, midsagittal), either in neutral space or on the body.

a. b.

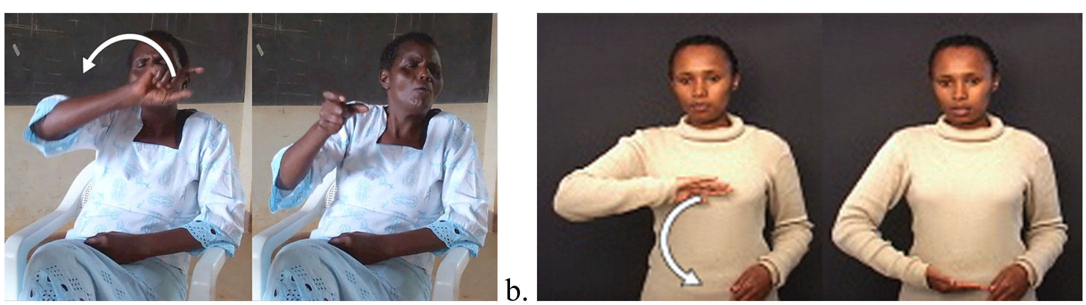


Figure 218. Arc path with tracing: a. MOON, b. PREGNANT

Second, there are 14 symmetrical two-handed signs in which each hand makes an arc path in neutral space, creating the visual appearance of a full circle. The directionality of these signs is lexically specified in KSL so that six of them start away from the body and move inward (*proximal>distal*), including FAMILY-2 (Fig. 219a),[201] COMPOUND, ROOM-2, PLACE, etc. Another six start close to the body and move outward, including TRIBE (Fig. 219b), GROUP-2, WORLD-1 (Fig. 229a), etc. And two move *high>low*: BALL-2, ORGANIZATION-3.

a. b.

Figure 219. Symmetrical arc paths in neutral space: a. FAMILY-2 (dist>prox), b. TRIBE-1 (prox>dist)

Third, there are arc paths in which the hand/arm move in the same trajectory of an arced path through space, such as the curved path of a plane taking off in AIRPORT-2, the curved path of the legs of a stool in STOOL (Fig. 242), or the curved path of a baby exiting the womb in BIRTH. Because of the relative orientation of the hands, in line with the arc, these movements are phonetically less distinct/crisp than the first arc type described.

[201] Note that in FAMILY-2, the extended fingers in the 'F' handshape contact each other. This would violate a phonotactic rule in ASL, which states that only the closed fingers (thumb & index finger) in the 'F' handshape make contact with the body (including h2). This phonotactic difference between the languages may be due to the phonotactics of the KSL numbering system, in which THREE with an *F* handshape contacts the h2 *fist* (meaning FIVE) to make the sign EIGHT (and other numeral incorporation derivatives; e.g., AUGUST, EIGHTY, EIGHT-HUNDRED, etc.

Figure 220 panel labels: a. b.

Figure 220. Arc path tracing a traveled path: a. BORN/BIRTH, b. AIRPORT-2

Fourth, there are many signs whose arc-shaped path may be the by-product of the motorics of the lower arm, due to the rotation of the ulnae and wrist joints during articulation (sometimes involving distinct pronation or supination, and sometimes not). As shown above, the ulnar rotation in the sign ROAD in Figure 217a creates a visual arc path through space, but references a road with a straight line. The crucial question is what signers perceive to be the categorical shape: a straight path (analogized from the visual referent) or the arced phonetic realization—or possibly some blend of both that creates its own category. This question is left for future research. Other examples of this type of arc path include ADD-3 and HIVI-HIVI ('*fair*', '*so-so*') in Figure 221, RETURN, ENTER-1, CAREFUL-1, WELCOME, etc.

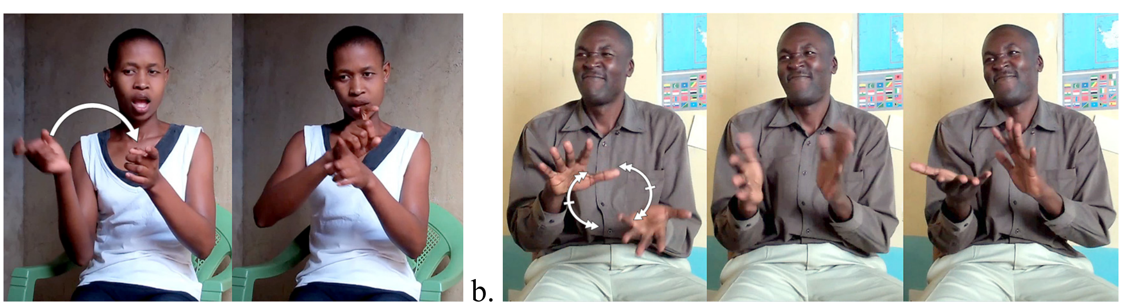


Figure 221. Arc as the outcome of motorics of the lower arm?: a. ADD, b. HIVI-HIVI

Also, it should be mentioned that I find no examples of contrasting *convex* vs. *concave* arc paths in KSL to-date, which Sandler has identified in ASL and Israeli Sign Language (Sandler & Lillo-Martin 2006: 199-201). This is therefore believed to be a cross-linguistic difference between languages.

7.3.3 Circle path shape

There are 98 signs in the database with a circle path. Compared to arc paths, there is no ambiguity in circle path signs; producing a circle is not a motoric result of moving between two locations and requires intentional movement. Circle paths are found in all major areas of the body in KSL except the neck, with 51% produced in neutral space. As explained in the location chapter, when produced in a phonological location on the body, the diameter of a circle path is constrained to the size of that location. In neutral space, circle paths are less constrained (as shown in the drawings in §5.11.5). Some examples are MUMIAS and FACTORY in Figure 222, as well as MANY-2 (Appendix 9, #14), CLOTH/MATERIAL (Fig. 123), MALINDI (Appendix 9, #21), DANCE, AREA, TRAIN, etc.

a. b.

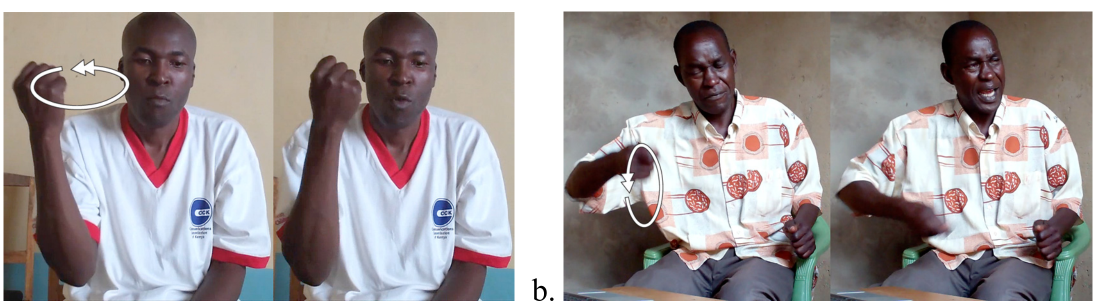


Figure 222. Circle paths: a. MUMIAS (town & deaf school), b. FACTORY

7.3.4 Zig-zag shape

There are 22 signs with a z-shape or zigzag in the database; including plough-2 and K.I.S.E.[202] shown in Figure 223, COAST-1, PROVINCE-2 (Fig. 156), ZIWANI-SCHOOL-FOR-THE-

[202] Kenya Institute of Special Education

DEAF, OLD-2, MOP, etc. The possible minimal pair, ROAD and RIVER-1 in Figure 217 show that this shape, or some additional manner feature that produces it, may be distinctive in KSL.

a.
b.

Figure 223. Zigzag path signs: a. PLOUGH-2, b. K.I.S.E.

Instead of classifying these as a holistic shape, an alternate interpretation is that this shape actually consists of two path movements that are perpendicular to each other, with one realized at the word level and one at the syllable level. For example, in K.I.S.E., the word-level directional axis is horizontal (contra>ipsi) and the secondary/syllable-level axis is vertical (high>low). However, in order to support a separation of features in this way, we would ideally see minimal pairs that differ on the basis of the syllable-level direction, such as a zigzag that moves across the chest, contra>ipsi, but the hand would zigzag in and out from the body along the midsagittal axis as it moves laterally (for example, as if depicting a shirt with spikes on it). This type of minimal pair evidence isn't found in KSL; however, I mention it here because it is later argued in §6.6.7 that such a separation of word- and syllable-level directional axes is required for another manner feature, '[dispersed]. If the architecture for two different levels of path direction were available in the representation, a feature [zigzag] would be able to fill them.

In addition to straight, arc, circle, and zigzag, there are disyllabic signs that are combinations of some of these types. In all these cases, the second path movement is perpendicular to the axis or plane of the first path: circle+straight signs and 90º path signs.

7.3.5 Circle+straight path

Eleven signs in the database have a disyllabic movement consisting of a circle path followed by a straight path; e.g., NATIONAL, PRETEND-2, and FOREVER-2 in Figure 224, MALE-CIRCUMCISION-2, PROVINCE, etc.

Figure 224. Disyllabic circle+straight signs: a. NATIONAL, b. PRETEND-2, b. FOREVER-2

These signs are unusual because they can be viewed as the combination of two out of the three basic path types (straight, circle, arc), yet none of the other possible five sequences are attested in KSL; i.e., *straight+circle, *straight+arc, *arc+straight, *circle+arc, *arc+circle. The same pattern is observed in ASL, with circle+straight being the only possible sequence of two different shapes. One explanation for why only this sequence is attested is that it is the only one possible to produce with enough ease and rapidity to conform to prosodic word length constraints. This does not seem to have been tested before, but instrumental measures could be used to evaluate how much force and time are needed to produce different sequences.

What is still unresolved is whether this sequence is phonologically one shape or two. My hypothesis for KSL is that circle+straight is categorically a single shape, akin to lexically-specified contour tones in some spoken languages, so that while it is phonetically separable into two types of path shape, it is only one categorical unit in KSL phonology. Unfortunately, there is no concise English label for this shape, so it is called circle+straight here.

It can also be argued that what facilitates two unique phonetic sequences being interpreted phonologically as one shape is the fact that features dominate syllables in the sign modality, while syllables dominate features in the spoken language modality (as discussed in §3.3.2). Thus a prosodic sequence of two shapes becomes encoded as a single feature—in this case, a manner feature that encodes this particular shape of path movement. More research is needed to know how widely attested this circle+straight sequence is in other sign languages, whether other sequences are attested cross-linguistically, and what are the phonetic constraints on various sequences that might prevent them from appearing in sign language lexicons.

7.3.6 90º path

There are 12 disyllabic signs in the database in which the hand(s) produce a straight path followed by another straight path at 90º, perpendicular to the first path. These have two basic realizations: (i) a cross or ‘x’ shape, or (ii) an angle shape. An example of ‘x’ shape is TIRE-SHOES-1 and a cross shape is NETWORK-1 (homophonous with SCHEDULE), both in Figure 225.

Note that all five cross or '+' shaped signs are produced with the first path/syllable being along the vertical axis, and all ordered *high>low*.

a.  b.

Figure 225. Cross or X path signs: a. TIRE-SHOES-1 (X), b. NETWORK-1 (cross),

In the other type, the paths are not symmetrical, but trace an angular path, as in TABLE-1 and COFFIN-1. There are only four of these signs; the other two are phonological variants of SYLLABUS.

a. b. 

Figure 226. Angle path signs: a. TABLE-1, b. COFFIN-1

7.3.7 Other path shapes

Finally, there are 26 signs with a variety of other path shapes. Seven of these have shapes that trace a symbol: a checkmark (CORRECT, TO-MARK, APPROVE-1), a question mark (QUESTION, EXAM-2, WHY-3), and (part of) a percentage sign (PERCENT). Five signs have a u-shape that traces the path of an object through space: TWINS-1 (Fig. 227a), WAKE-UP-1, VANQUISHED, JEALOUS. And several more signs trace somewhat unique paths that don't occur more than once in the lexicon: e.g., CAR-1 (Fig. 137a), CAMEL-2, POT-1 (small pot; Fig. 227b), POT-2 (large pot),[203] etc. However, in all cases, the path shape is essentially s-shaped; therefore these are encoded with the feature [s-shaped].

a. b.

Figure 227. Other path shapes: a. TWINS-1 [u-shape], b. POT-1 (a small pot) [s-shape]

Lastly, there are some cases that were marked in the database as having special paths, but are more likely to be special prosodic realizations; specifically, these are signs with a 'hooking' path movement (e.g., ARREST-2, REFUGEE-2), and a final snap movement (e.g., FUNNY, DOLL-1). These are addressed as "other movement types" in §7.10.

[203] These pot sizes are not idiosyncratic; they correspond to established types of traditional ceramic pots/jugs; e.g., for water, porridge, etc.

To return to the phonological representation for path shape, it is important to note that KSL is relatively similar to other sign languages in the types and frequencies of path shapes, with the exception of not (yet?) finding a concave/convex distinction for arc paths in KSL. However, despite the descriptive similarities between languages, each phonological model proposes slightly different path shape features.

The Prosodic Model includes three path shapes in the underlying representation, [straight], [arc], and [circle]. Brentari lists a few other descriptive types for ASL: repeat 90º: '7', repeat 90º: 'X', and 'circle, straight' (1998: 132). It is partially, but not fully explained how the non-basic types are realized in the phonological representation; for example, it is not clear how the zigzag path in the ASL sign SNAKE would be represented in the Prosodic Model.

In NGT, seven different *phonetic* path shape types are recognized: straight, arc, circle, 7-shape, z-shape, +-shape, and iconic shapes (van der Kooij 2002: 242). Yet, the Dependency Model proposes only [circle] and [crossed] features in the phonological representation, finding that /straight/ is unmarked, and that *arc* path is predictable for phonetic reasons (2002: 242-245). van der Kooij further suggests that some paths may be unmarked for shape at all, or "shapeless" (243).

And in the Hand Tier Model, Sandler posits [-arc] for straight paths and argues that [+arc] is sufficient for both arc and circle paths (Sandler 1989: 128). This model also posits a specified [convex] feature that is a dependent of [arc] feature node, as well as an unspecified /concave/ counterpart, based on lexical contrast in ASL and Israeli Sign Language (Sandler & Lillo-Martin 2006: 200).

In KSL, because [circle] and [arc] are contrastive in one minimal pair (and several contrasts with [straight]), it seems that all three of these basic signs should have featural representations (leaving aside the issue of unmarked features as defaults). With regard to the unique disyllabic types (i.e., zigzag, circle+path, repeat 90º) these could be accounted for in both Brentari's prosodic features and van der Kooij's manner features, though it would require adding new features. There is also the issue of whether a single path shape such as CAR-2 or POT-1 should have a dedicated feature, let alone a type with more tokens, like u-shaped paths.

These rare but particular types are reminiscent of the many infrequent handshapes and locations and other features (mouthing, hand arrangement, etc.) present in sign phonologies and described throughout this thesis. These idiosyncratic types have often been dismissed as peripheral and outside the more constrained abstract system of forms. However, it is worth considering that these relative oddities may actually serve a function in the phonology. That is, having relatively large and open inventories may be how signs that are essentially simultaneous constellations of features can preserve the infiniteness required of lexicons. Under this scenario, phonological representations are challenged to properly represent the most frequent units (e.g., *straight* path shapes, *flat* handshape, *neutral space* location), the most highly contrastive units (e.g., *circle* path shape, *1* handshape, *mouth* location), and also the rare, but clearly distinguishable units (e.g. *s-shaped* path shape, *H-thumb* handshape, *thigh* location). Therefore, despite being rare, I propose that KSL has the path shapes [s-shape] and [u-shape].

To summarize this section, the shape of a path movement can be distinctive in KSL, though only among the core shapes: *straight*, *circle*, and *arc*—and possibly *zigzag*. These four shapes—and primarily *straight* paths—account for 98% of all paths. These path shapes can also be combined sequentially as phonetic types to create the phonological types *cross/X*, *angle*, and *circle+straight*. A small proportion of signs use other shapes that trace written symbols, the trajectory of objects, or the characteristic shape of an object. The final inventory of path shapes in KSL as manner features are as follows: [straight], [arc], [circle], [zigzag], [angle], [circle+straight], [x-shape], [s-shape], [u-shape], and [?-shape].

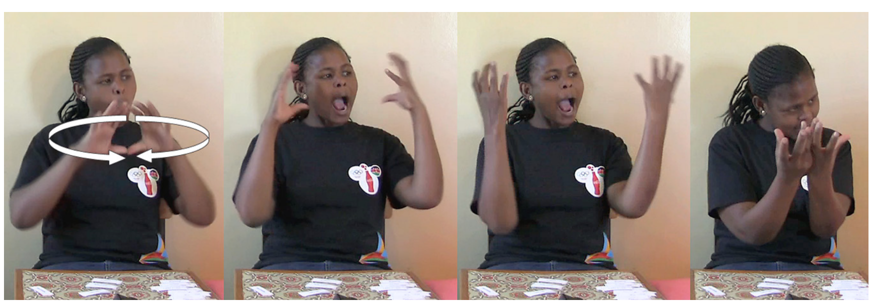
7.4 Path size

The size of a path movement can be contrastive in KSL, as shown in two minimal pairs in the KSL database: HILL (large path) vs. TOWN (small path) in Figure 228, and WORLD-1 (large) vs. CLASS-2 (small) in Figure 229.

a. 

b. 

Figure 228. Minimal pairs for path size: a. HILL (large path), b. TOWN (small path),

a. 

b. 

Figure 229. Minimal pairs for path size: a. WORLD-1 (large path), b. CLASS-2 (small path),

While two data points are few, it may be significant that in all these pairs, the paths are (i) produced off the body and (ii) are curved shapes. In the analysis of phonological locations in KSL, it was found that the size of a path movement *on the body* is highly predictable on the basis of the size of the phonological location (§5.5). This may prevent body locations from allowing different phonologically contrastive path sizes, but the same constraint does not exist in neutral space. With regard to curved paths, one speculation is that a curved path may telegraph its diameter all throughout the sign because of the position of the hand at any one moment, and this would make it visually stable enough for lexical contrast, as opposed to a straight path which is ambiguous to path length at any given moment. It should also be noted that there is a difference in the vertical position in neutral space for the HILL~TOWN and WORLD-1~CLASS-2 pairs, with the bigger one being signed higher. This has been interpreted as a phonetic difference, but could in principle be contributing to the distinctiveness by reinforcing the path size. On its own, height in neutral space is not found to be contrastive in KSL (see §5.11.3).

Path size has not been mentioned as a contrastive feature of ASL, and van der Kooij reports that in NGT, "no sign pairs need an underlying size distinction" (2002: 248). However, path size was found to be contrastive in several minimal pairs in Hausa Sign Language (Schmaling 2000). For example, Schmaling lists the pairs SILIMA ('*cinema*') and TALIBIJIN ('*television*'), which both have a bidirectional path with a *flat* handshape (palm in) moving back and forth in front of the face, but SILIMA has a large path and TALIBIJIN has a small path. Like the two pairs in KSL, this HSL pair does contact the body, but the path shape is straight. Three other minimal pairs for path size are listed in HSL (2000: 104-105), but the locations and path shape for these pairs aren't provided.[204]

It is difficult to draw conclusions from such a small set of data, but these contrasts do raise empirical questions that could be addressed by further research. How widely attested is path size as a distinctive feature in other sign languages around world? Is it common among African sign languages? For those languages in which it is attested, is it only found in neutral space? And in what type of path shapes?

7.5 Single, repeated, and trill

Signs can differ by whether a movement is produced once, [single], resulting in a monosyllabic sign, or whether the exact movement is repeated, [repeated], creating a disyllabic sign. For example, the signs TO-DO and TO-WORK in Figure 230 are minimal pairs that differ only by the number of times the path movement is produced: once or twice.[205] There are 632 signs with [single] movements in the database and approximately 650 signs with [repeated] movement and no other additional manner features (e.g., bidirectional, alternating, etc).[206] These two manner features can occur with all different core articulatory types and combinations of articulatory types, as shown in Table 26.

---

[204] Curiously, the signs for '*chicken*' and '*kite (bird)*' are minimal pairs in both Hausa SL and KSL, but on the basis of different features: path size in Hausa SL and +/- movement in KSL (see §6.5.1)

[205] Note that the length/size of the movement differs in TO-DO and WORK/TO-WORK, but this is not contrastive, as disyllabic signs in general have somewhat shorter path shapes than monosyllabic signs (path size that is contrastive is discussed in §6.6.2).

[206] There are around 60 more repeated signs with additional manner features.

a. 

b. 

Figure 230. Minimal pair for [single] vs. [repeated] manner: a. TO-DO, b. WORK

Altogether, 30 minimal pairs were found in the KSL Lexical Database that differ by whether the movement is signed once or is repeated, which is by far the most frequent type of movement contrast out of all types. The relatively equal frequencies of [single] and [repeated] in the lexicon, the fact that they can occur with any articulatory type, and the relatively high number of minimal pairs all seem to signify that single and repeated are highly accessible means of distinguishing signs from each other —perceptually, productively, or both. Note that the Poizner study referenced at the beginning of this chapter (§6.1.1) provides further evidence that repetition is phonological since people with signing experience were statistically more likely to categorize movements by repetition than non-signers (Poizner 1981).

Indeed, the single vs. repeated contrast is picked up as a morphological distinction in dozens of noun/verb pairs in ASL, first documented by Supalla & Newport (1978); verbs have [single] movement and nouns have [repeated] movement; e.g., TO-EAT vs. FOOD; TO-FLY-ON-PLANE vs. AIRPLANE; TO-PAINT vs. PAINT, etc. However, the same morphological type does not emerge from the lexicon collected for this project. Among the 30 KSL pairs, only around half, 17 out of 30, have any kind of semantic relationship; and among those, there is no discernable morphological patterning.[207] That is, these cases are purely phonological, not morphological.[208]

When it comes to applying the features [single] and [repeated] in the KSL lexicon, there are two issues that require further explanation. The first issue involves ~35 signs in the KSL Lexical Database that are well-formed as either [single] or [repeated]. Some examples include FRIEND and SHOP-1 (n.) in Figure 231, TO-WANT, GOOD, BEFORE-1, PRISON, etc. Given the amount of information available for these signs, the factors that might explain the data could not be thoroughly evaluated, but the three most likely factors are as follows: (i) different idiolectal grammars assign different features to these signs (as in the TOWN~HILL cluster in §3.5.1); or (ii) these signs lose or gain repetitions in different environments based on phrasal prosody, such as being truncated to one syllable within a phrase and being repeated at the end of phrases or in citation forms; or (iiii) different tokens are actually different lexical items. Sorting out these factors for each sign will require further investigation, and it is likely that all three factors will be relevant, for different signs.

a. b.


Figure 231. Signs that can be either single or repeated: a. FRIEND, b. SHOP-1 (n.)

[207] Only two pairs have a noun/verb pattern like the one in ASL; i.e., TO-MEET [single] vs. MEETING [repeated], and TO-DRINK [single] vs. WATER-1 [repeated].

[208] A survey of the database shows that there are prosodic tendencies that characterize nouns and verbs that are similar to tendencies in other sign languages (Tkachman & Sandler 2013). That is, out of 943 nouns, 59% are disyllabic (repeated and/or other manner features) and 30% are monosyllabic; whereas out of 293 verbs, only 25% are disyllabic and 65% are monosyllabic.

The second issue regards “trilled movement”, which is defined by Brentari as consisting of “small, rapidly repeated dynamic elements during the production of signs” (1996: 45). She argues that trilled movements can apply to any joint/articulator, fingers, wrist, arm, and even tongue.[209] Here I address two questions with regard to trilled movement: (i) are these rapid, uncountable movements categorically different than signs with two distinct repetitions; and (ii) how can trilled movements be represented in the phonology? To preview the conclusion, I propose a [trill] manner feature that applies only to ‘secondary movements’—i.e., handshape and orientation changes—and a modification to the representation of dynamic features in signs with trilled movement.

There are 118 signs in the lexical database that were coded phonetically as having trilled movement. For example, in DOG (Fig. 232), the hand is held under the chin and the fingers wiggle back and forth repeatedly; and GREEN-1, with a wrist nod that repeats an uncountable number of times. Neither of these signs contains a perceptibly discrete number of movement syllables, in contrast to WORK (Fig. 230b), which is clearly disyllabic.

a.  b. 

Figure 232. Signs with trilled movement: a. DOG, b. GREEN-1

Thus, there is a distinguishable phonetic difference between disyllabic repeated movements and trilled movements with uncountable movements, but there are at least some arguments against treating these as two distinct movement types in KSL that must be mentioned.

[209] While these “uncounted repeated local movements” (van der Hulst 1993) have received much previous attention in the literature, Brentari’s 1996 account is a good summary of the literature to that point.

First, there are no minimal pairs that contrast solely on the basis of two repetitions vs. more-than-two or 'an uncountable number' of repetitions. Second, trilled movements can become disyllabic in rapid signing or when they are prosodically reduced in compound signs; e.g., GREEN-1 becomes disyllabic in the compound GREEN^DARK ('dark green'). Third, many movements that are marked as trilled in the database would probably be interpretable if produced with only two repetitions. By the same token, it is unlikely a change in this type of movement would be interpreted as producing a distinctly different sign. And fourth, there is a consistent phonetic regularity that trilled movements are produced only with articulations that can comfortably produce such rapid movements in the timespan of a lexical sign, so that trilling is driven by phonetic-prosodic affordances rather than a distinct phonological category. This conclusion appears to be consistent with what van der Kooij finds in NGT (2002: 236-237) and Stack's view of secondary movements (1988).

However, a single feature, [repeated], cannot handle all the attested data in KSL, specifically in some signs with complex articulatory movement—that is, signs with both primary (path) and secondary (handshape and/or orientation) movements. In most KSL signs with complex movement, [repeated] would be sufficient because the secondary movement is timed to alignment with the end points of the path movement, as in BLOOD-TEST-3 and EAT-BIG-FISH in Figure 233. Notice that the handshape returns to its beginning position at the start of the second syllable/path movement. There are at least 300 signs of this variety in the lexical database.[210] These can be straightforwardly handled with a [repeated] feature that simply repeats the entire first syllable as a perfect copy (i.e., "Base-Copy reduplication"; see Wilbur 2009)

[210] The exact number is hard to measure because of the difficulty in determining the categorical nature of some orientation changes during path movements; see §6.9.

a. 

b. 

Figure 233. Signs with secondary movement synchronized to repeated path movement: a. BLOOD-TEST-3 (handshape change), b. EAT-BIG-FISH (orientation change)

In contrast, there are other signs with complex movements whose secondary movements are not timed to the end points of a location change (path movement), but instead repeat several times along the path. For example, STARS-1 in Figure 234a has repeated aperture change ([closed]>[open]) on a single path and FOREST -1 in Figure 234b has repeated orientation change ([supine]>[prone]), on the same [contra]>[ipsi] path. There are 38 of these signs in the database, with either repeated handshape movements (23 signs) or repeated orientation changes (15 signs) during the path movement.

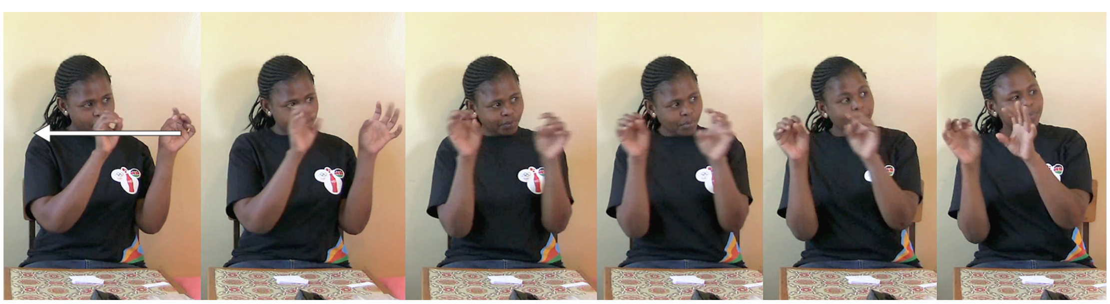
a. 

Figure 234. Signs with secondary movement repeated on a path: a. STARS-1, b. FOREST-1

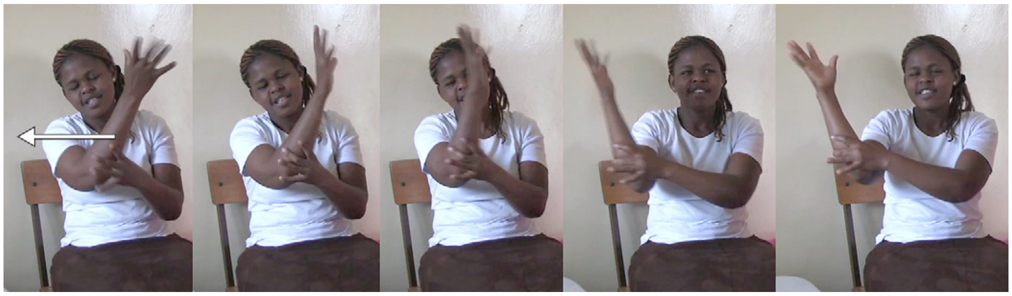
b. 

Figure 234 (continued). Signs with secondary movement repeated on a path: a. STARS-1, b. FOREST-1

Crucially, there is a near-minimal pair, DREAM and TO-MUSE, shown in Figure 235 that highlights the necessity of having a distinct representation for each type. In DREAM, a hooking handshape movement ([straight]>[bent]) is repeated along a single smooth movement of the hand away from the temple and is considered monosyllabic, while in TO-MUSE, an aperture change handshape movement ([open]>[closed]) is repeated on the same type path away from the temple, but this time, the whole syllable with secondary movement is repeated. This pair demonstrates the need to distinguish between the 'base-copy' type of repetition and secondary-movement-only repetition.[211]

a. 

Figure 235. Signs with secondary movements at different levels: a. DREAM, b. TO-MUSE

[211] It is worth recalling that the functional definition of a syllable, from §3.3.2: "the number of sequential phonological movements in a string equals the number of syllables in that string. When several shorter dynamic elements co-occur with a single dynamic element of longer duration, the single movement defines the syllable" (1998: 205). Following this definition, DREAM is monosyllabic and TO-MUSE is disyllabic.

b. 

Figure 235 (continued). Signs with secondary movements at different levels: a. DREAM, b. TO-MUSE

In the representing of NGT using the Dependency Model, van der Kooij sidesteps the issue of representing these signs in the model, explaining that signs with repeated handshape changes on a single path are not widely attested in NGT and hints that they might be morphologically complex forms (2002: 237). Yet in KSL, there are several of these signs and they are monomorphemic, thus requiring some type of representation. The solution that I propose here is to use [trill] as a special type of repetition only for secondary movements and reserve [repeated] for base-copy type repetition. This allows the repetition to manifest in the right class node. It is also justifiable considering that other manner features also entail specific types of repetition. For example, signs with 90º angles have been referred to as 'repeat: 90º', and the feature [bidirectional] also entails a special type of repetition.

It is also necessary to address exactly how this will be represented in the Dependency Model because features at the terminus of the binary branching dynamic features node automatically associate to X-slots/positions on the timing tier. Yet, trilled movements are not timed to the path movement. Therefore, I posit a modification to the structure of the dynamic branch in the DPM, which is similar to a proposed modification for the implementation of dispersed signs in §7.9. Figure 236 below shows the proposed representations for DREAM and TO-MUSE. The two key differences are the manner features ([trill] vs. [repeated]) and the dynamic branch, *joints*, of the Handshape class node. In TO-MUSE, the joints node branches, with [open] and [closed] at the terminal points. These aperture features then associate to different X-positions, and the entire syllable is repeated. In DREAM, the dynamic features [straight] and [bent] are in a non-branching node that associates to both X-positions, to capture the fact that the secondary movement starts and ends with the path movement, but during the path there is no temporal alignment. The operation of the trill manner feature is to dictate the repeated interpolation between the two dynamic features during the syllable.

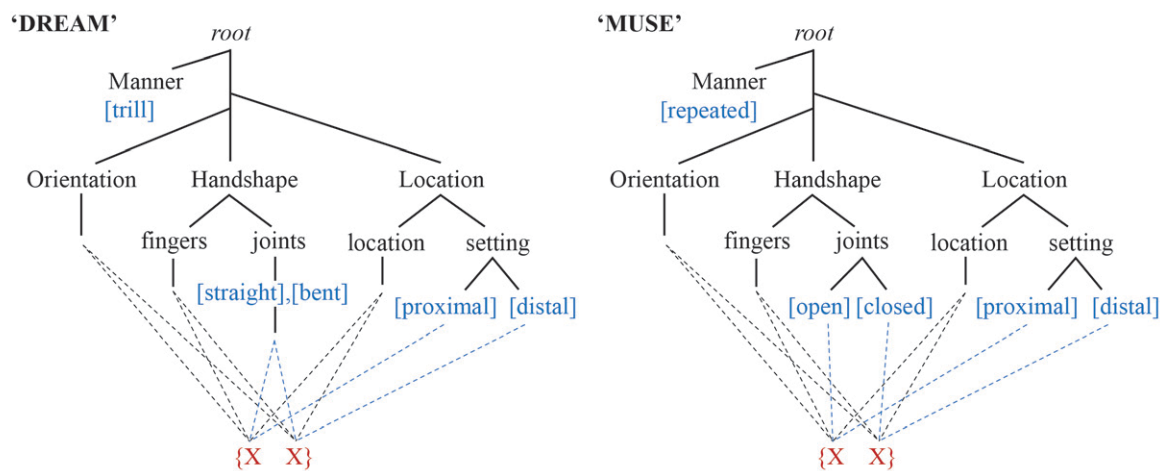


Figure 236. Representation in the Dependency Model of DREAM and TO-MUSE

To conclude, this section, [single] and [repeated] are manner features that can apply to any type of core articulatory movement, are distributed relatively evenly in the lexicon, and account for more movement minimal pairs than any other movement type. In this section, I also posited a feature for KSL, [trill], to account for signs with secondary movements that are repeated more than once during a single path movement. In addition, I proposed a structural modification to the dynamic features branch in the DPM for articulatory movements that spread throughout the sign, but whose endpoints are not timed to the endpoints of the path movement.

7.6 Return (unidirectional vs. bidirectional)

A sign with path movement can either be unidirectional or bidirectional (Supalla & Newport 1978). In a *unidirectional* sign the hand(s) moves from one location to another, as in

VISION (Fig. 237a), where the hand starts in front of the eyes and moves outward (proximal>distal). In a *bidirectional* sign, the movement is reversed in the second path and the hand ends up at the same location and in the same position, as in SEEM (Fig. 237b).

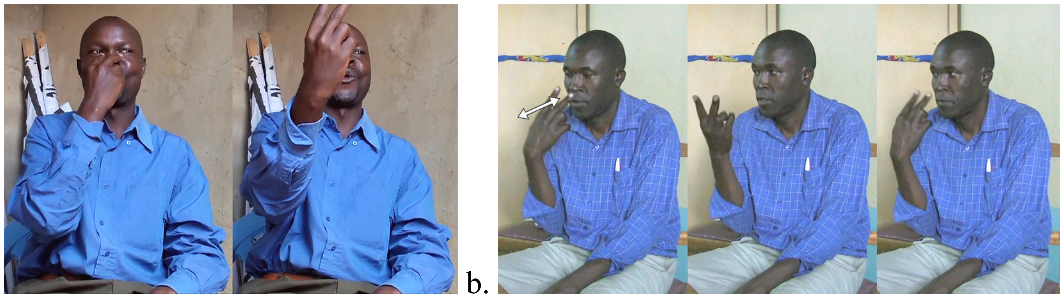
a. b.


Figure 237. Sign with a single unidirectional path movement (a. VISION) and a bidirectional path movement at the same location (b. SEEM)

These signs are not considered a minimal pair for a couple reasons,[212] but provide a good illustration of why bidirectional movement has also been referred to as [repeat: 180º] by Brentari (1998) and [return] by others (Wilbur 2009, Mak & Tang 2011). Mak & Tang define [return] as "movement that returns to the original configuration after displacement or any dynamic changes" (2011: 320). This definition accounts for secondary movements that align with a path movement, such as NETWORK-7 in Figure 238, in which the aperture of h1 begins closed, then opens at the end of the first path and closes again in the return back to the same position. For the phonological representation, I prefer the features [-return] for unidirectional movement and [+return] for bidirectional movement, but use the terms unidirectional and bidirectional interchangeably here.[213]

[212] There aren't tokens of each sign from the same signer. Yet also VISION is monosyllabic and SEEM is disyllabic; this difference in prosodic structure could be considered an additional difference.

[213] One downside to using [+/-return] is that the negative value, [-return], is overwhelmingly more frequent in the lexicon. However, 'return' better captures the fact that the dynamic values at the endpoint of the sign are identical to those at the starting point.

Figure 238. [+return] sign with primary and secondary movement: NETWORK-7

There are 125 signs in the database that are marked as bidirectional or [+return]. These include three signs with unidirectional counterparts, shown in Figures 239 through 241. The two pairs AFRICA-1 vs. KIKUYU-1 (ethnic group in Kenya) and BROWN-2 vs. WHEAT-1 both have a similar prosodic pattern whereby the repeated unidirectional [-return] path takes on an arc shape, with some ulnar rotation at the end of path. However, this is not believed to be a lexically-specified arc, but rather a consequence of articulatory factors.

a. b.

Figure 239. Minimal pair for +/-return: a. WORD-SWIPE[214] [-return], b. CONFUSE/DECEIVE [+return]

a. b.

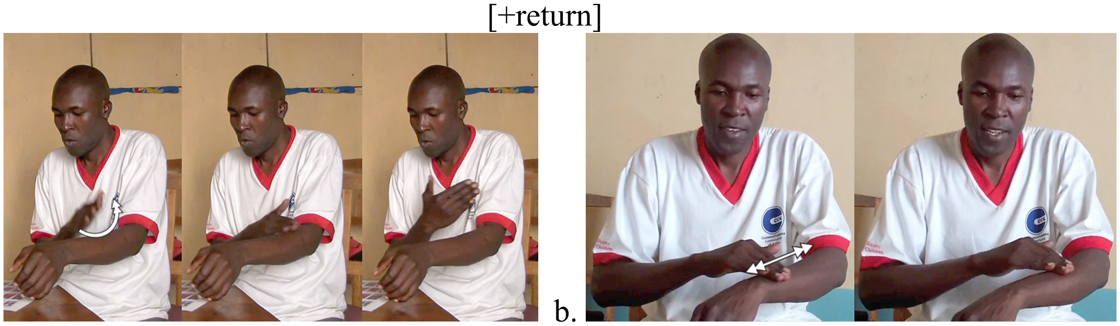


Figure 240. Minimal pair for +/-return: a. AFRICA-1 [-return], b.KIKUYU-1 [+return],

[214] WORD-SWIPE is my gloss for this 'punctuation' in KSL made between fingerspelled words.


a. b.

Figure 241. Minimal pairs for +/-return: a. BROWN-2 [-return], b. WHEAT-1 [+return],

Four [+return] signs have path and handshape change, including NETWORK-7, but there are no bidirectional/return signs in the dataset with only handshape change, although there is presumably no phonotactic constraint against this.[215] Also, the [+return] signs that have only wrist or ulnar movements are those that can also be interpreted as path shapes (e.g., SEEM, CONFUSE/DECEIVE, PAINT, DONKEY-1, etc.). Altogether, this indicates that [+/-return] is primarily a feature associated with path movements.

In the coding, four diagnostics were used to disambiguate unidirectional signs from bidirectional ones: (i) contact, (ii) velocity/force, (iii) sequentiality, and (iv) the distribution of secondary movement. First, if the path shape is parallel to the body, then the hand in the bidirectional sign will maintain contact with the body throughout (KIKUYU-1, WHEAT-1), while in a unidirectional repeated sign, the hand will lose contact in the transition back to the first location (AFRICA-1, BROWN-2).

Second, the velocity and/or the force of each path movement in the sign also provides a clue to uni-/bi-directionality. If the initial path has a different velocity than the return path, then it is more likely to be unidirectional. For example, in the sign LORRY (Fig. 148) the initial path

[215] One dynamic handshape 'return' sign has been observed in ASL, meaning 'the turning of lights on and off': two hands with *flat-o* handshapes (palms facing down) are positioned high in neutral space, then open and close once. This type of 3-part handshape change does happen in a few highly complex KSL signs; i.e., MOVIE, EXPOSE-1, SUBTRACT-1, AUSTRALIA, BEAUTIFUL.

(proximal>distal) is signed more forcefully than the return path, which is a transitional movement. However, this is not always clear.

A third clue to uni-/bi-directionality is found in two-handed signs with alternating movement (see next section). In coding the KSL signs, it was observed that in some alternating signs, the hands moved simultaneously (e.g., MAYBE, FIGHT-1, COMPARE-2) while in other signs each hand moved in sequence, one after the other (e.g., BURIAL, CONTRIBUTE, MILK-1, SEND-DIGITALLY-2). Upon closer inspection, it appears that this difference in sequentiality/simultaneity of the two hands is due to the uni-/bi-directionality of the path. That is, if path movement is underlyingly unidirectional, it will often surface in a two-handed alternating sign as sequential movement (e.g., BURIAL, CONTRIBUTE).

A fourth potential diagnostic is the distribution of secondary movement at the same time as path movement (van der Kooij 2002: 249). For example, in the ASL signs FINGERSPELLING and PIANO both have a path movement with wiggling fingers (trilled movement) that repeat during the path. FINGERSPELLING is unidirectional and the finger wiggling stops briefly during the transitional movement, while piano is bidirectional and the finger wiggling continues on the return path. However, in KSL, all of the six signs in the database with trilled movements on a repeated path are bidirectional like PIANO; i.e., SHINY, SMS-1, SMS-2, DIRTY-2, FOREST-2, LEARN-2.

It should be noted that there are several signs among those flagged as [+return] that require follow-up. In some cases the directionality isn't clear, but could be discovered through further elicitation; e.g., TALK, WALK, BEAUTIFUL-2. And in other cases, different signers appear to apply different [+/-return] features as part of their own idiolects; e.g., ORIGINAL, WRITE-2.

Lastly, there is a small cluster of signs not included here, but which exhibit a type of bidirectional path movement. I am referring to these as "bounce" signs, and they are discussed further in §7.10.

7.7 Simultaneous vs. alternating

In two-handed signs where the movement of the non-dominant hand matches the dominant hand, the movement phase(s) of the hands can be coordinated *simultaneously* or can be offset and *alternating*. For example, the signs BLOUSE and BEHAVIOR in Figure 242 are minimal pairs that differ in this respect, with both hands in BLOUSE moving upward at the same time, while the hands in BEHAVIOR alternate the same movement. Two other minimal pairs for simultaneous vs. alternating are found in the database: LORRY vs. LITEIN (see Figure 148), and GENERAL vs. JUNCTION-2.

a.

b.

Figure 242. Minimal pair for simultaneous (a. BLOUSE) vs. alternating movement (b. BEHAVIOR)

Such signs have ben referred to as "echo articulator" signs (Sandler (1993) because the non-dominant hand copies the movement of the dominant hand. There are 651 echo-articulator signs in the KSL Lexical Database. Among these, 146 are alternating (22%; 7.7% of full database), and the remainder are simultaneous (505 signs or 76%; 26.8% of full database).

The most common type of alternating sign is when the hands are positioned at different ends of a path movement phase and both move alternatingly at the same time. For example, in signs like RUN-1 and OPPOSITE-1 in Figure 243, as opposed to simultaneous movement in WANDER-1 and STOOL in Figure 244.

a. 

b. 

Figure 243. Alternating signs with both hands moving at the same time: a. RUN-1, b. OPPOSITE-1

a. 

Figure 244. Simultaneous two-handed signs: a. WANDER-1, b. STOOL

b. 

Figure 244 (continued). Simultaneous two-handed signs: a. WANDER-1, b. STOOL

However, there is another realization of alternating movement, as mentioned in the previous section. Alternating movement can have different prosodic structure depending on whether it occurs with movements that are unidirectional or bidirectional and if it is repeated or not. For example, the movement in the alternating signs BURIAL and LESO (a fabric wrap) in Figure 245 are produced sequentially and with only one movement per hand. This is in contrast to RUN-1 and OPPOSITE-1, which are bidirectional and the hands move simultaneously and repeatedly. There are no attested signs in which one hand produces a bidirectional movement followed by the other hand in an alternating sequence, presumably because it would break prosodic constraints on word length, but also possibly due to motoric constraints.

a. 

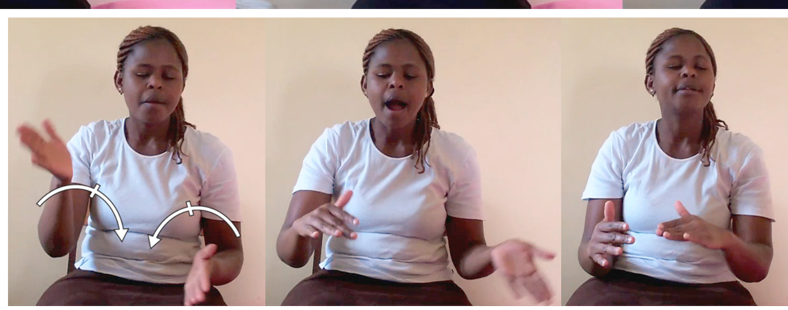
b. 

Figure 245. ‘Sequential’ alternating sign without repetition: a. LESO, b. BURIAL

Lastly, alternating signs with circular paths should be mentioned briefly; for example, BICYCLE and HISTORY in Figure 246. There are 24 alternating circle path signs in which the hands are ‘out of phase’ with each other, but in all these, the movement is fluid and simultaneous—i.e., not the sequential alternating signs above. In most of them, the fact that the hands alternate and follow each seems to actually increase the articulatory ease compared to signs in which the two hands would move in circles in the same phase. This may be related to offsetting the “reactive effort” needed by the torso in response to the force created by the hands moving in space away from the core of the body (Sanders & Napoli 2016). Indeed, there only four simultaneous/in-phase two-handed circling signs in the database, and all appear to compensate in some way: (i) small paths (e.g., GUILT), (ii) paths whose force cancels each other out by moving in opposite symmetrical directions (e.g., WITCHCRAFT-2); (iii) paths produced close to the body (e.g., SIN), and (iv) circle paths with large, slowly articulated circles (e.g., HERD).

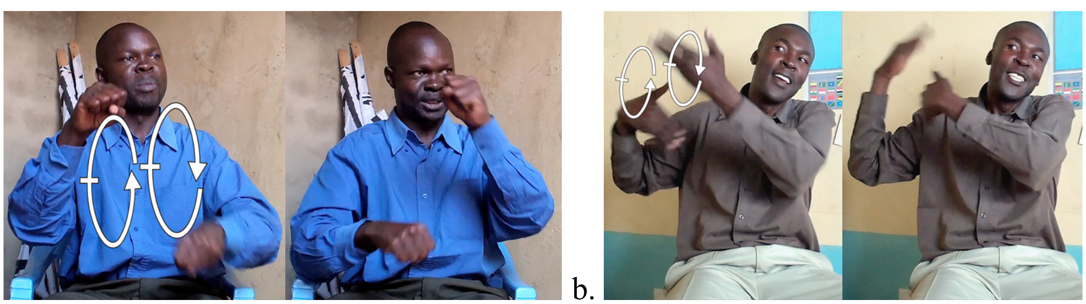
a.  b.

Figure 246. Alternating circular signs: a. BICYLE, b. HISTORY

Considered altogether, these signs show how an abstract feature like [alternating] is subject to prosodic and phonetic constraints in the sign modality.

7.8 Switch dominance

Another type of sign found in KSL has been classified as [alternating] by some researchers, but seen as distinctly different by others. These are disyllabic signs in which the dominant hand acts upon a body location, and then the non-dominant hand performs the same action in a mirrored reversal; e.g., JESUS and SWEATER in Figure 247. I refer to these as "switch dominance" signs.

a. 

b. 

Figure 247. Switch dominance signs: a. JESUS, b. SWEATER

There are 26 signs in the KSL database that were coded as 'switch dominance' signs, and I have identified two minimal pairs that appear to contrast the switch dominance operation with a normal [repeated] sign: STANDARD (switch dominance) vs. MATHEMATICS-1 (repeated) (Fig. 248) and FACE-TO-FACE (switch dominance) vs. DAY-3 (repeated).

a. 

Figure 248. Minimal pair for switch dominance?: a. STANDARD (switch dominance), b. MATHEMATICS-1 (repeated)

b. 

Figure 248 (continued). Minimal pair for switch dominance?: a. STANDARD (switch dominance), b. MATHEMATICS-1 (repeated)

It turns out that these signs have been described in several other sign languages. For example, in her description of Hausa Sign Language, Schmaling refers to them as a special type of unbalanced sign in which "the roles of the hands are reversed," and notes that they differ from alternating signs because "the articulating hand uses the other hand as a place of articulation, something which does not occur in [+altern.] signs" (2000: 121). Here, Schmaling relies on Padden & Perlmutter's description of alternating: "(i)n alternating signs, the moving hand never makes contact with a stationary hand; if the hands make contact at all, both are moving" (1987: 342).

Napoli et al. (2011) also mention such signs in their analysis of path movements in multiple sign languages, calling them 'ChSi 2HIB' (Changing Sides 2-handed Immobile Base) signs and reporting a small number in all six sign languages analyzed: ASL, British SL, Italian SL (LIS), French SL (LSF), Australian SL (Auslan), and Nicaraguan SL (ISN) (2011: 175). Thus, they are widely attested cross-linguistically, even though relatively infrequent within each lexicon.

However, these signs are barely addressed in phonological models. Brentari provides contradictory comments, saying that the sign JESUS (very similar in KSL [Fig. 247a] and ASL) is [alternating] (1998: 251), but also that "a type 3 sign is never specified for [alternating]" (267) while JESUS is a type 3 sign (from Battison's typology), with one hand acting on the other when they have different handshapes. Van der Kooij does not mention these signs, and neither does Sandler (as far as I know).

Thus, ‘switch dominance’ signs are descriptively distinct and occur in several languages, but the question is whether they require a dedicated feature other than [alternating]? Or would a clarification that alternating signs apply to ‘Type 3’ signs on the non-dominant hand suffice? Because based on the data provided so far, these signs could in principle be accounted for by [alternating]. However, two other KSL signs, EVERYTHING and MANY-DIFFERENT-2 in Figure 249, argue for a separate [switch dominance] feature. These signs both have two unidirectional path movements in which the hands move horizontally past each other, crossing in neutral space with the dominant hand on the top, and then repeat the movement, but switching their vertical order so that the dominant hand is now on the bottom. Without this change in the vertical order, both signs would be poorly formed versions of themselves (though not ill-formed in general).

a. b.

Figure 249. Switch dominance with simultaneous movement: a. EVERYTHING, a. MANY-DIFFERENT-2

The reason why [alternating] is not sufficient for these signs is that the movement of the hands is already ‘out of phase’ with each other, which is one of the characteristics of alternating movements described in the previous section. Therefore, some other feature is needed to account for the reversal in vertical order in the second syllable, especially since this reversal is necessary to be well-formed. Therefore, a [switch dominance] feature could fully account for these two signs, as well as the others described above.

Thus, a full description of the [switch dominance] feature is that it produces a disyllabic sign in which the first syllable is made with h1 in an asymmetrical position of dominance—either moving while h2 is stationary, or positioned over h2—and then the second syllable is articulated with the roles of h1 and h2 inverted. Note the signs LESO and BURIAL above look similar, but are actually symmetrical signs that are articulated one after the other.[216]

7.9 Dispersed ('double contact' signs)

In this section, I discuss disyllabic signs whose movements are repeated in two locations. The literature has usually referred to "**double contact**" signs, in which the hand(s) touches the body in two locations within the same major body area (head, torso, arm, hand). Examples of such signs in KSL are shown in Figure 250: HOME-2, PRETEND-1, POLICE-BOSS, and NYANGWESO-PRIMARY.[217] I will argue in this section that double contact signs are actually a subset of a larger category of a prosodic sign type that I call *dispersed signs*,[218] which can be accounted for by a manner of movement feature, **[dispersed]** instead of special setting features (Brentari 1998) or the same path features in a straight path sign (van der Kooij 2002). This

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[216] There are also 'switch orientation' signs in which the orientation in a two syllable sign is changed in the first and second syllable; e.g., COOK in ASL, PARTY in KSL. These are not discussed in this thesis because the Orientation parameter is not described, but are probably similar to 'switch dominance' in being infrequent in a lexicon, but found in most sign languages.

[217] The graphic representations of movement in this section will be done with arrows such that the first syllable is represented by dashed arrows and the second syllable by solid arrows.

[218] I entertained the name 'distributed', but it could be confused with other uses of the term in linguistics, including morphology and phonology (e.g., the distinctive feature [+/-distributed] describes the extension of the tongue in spoken languages). In particular, a distributed action (e.g., give out a pencil to every person) can be expressed with this 'dispersed' phonological feature.

section is more elaborated than other sections for several reasons: (i) these signs have been discussed at several points in the literature, (ii) there is a lot of data to account for, and (iii) I am proposing a relatively new approach to these signs compared to previous theoretical approaches.

Figure 250. 'Double contact' or distributed location signs: a. HOME-2, b. PRETEND-1, c. POLICE-BOSS, d. NYANGWESO-PRIMARY

For this discussion, I first review how these signs have been viewed and represented in the literature in §7.9.1. Then in §7.9.2, I propose the new [dispersed] manner feature and explain how it accounts for signs with two locations in the same phonological area. In §7.9.3, I evaluate whether this manner feature is enough to account for the totality of data, and then in §7.9.4 I expand the operation of dispersed to license additional axis features. Finally, in §7.9.5 I discuss how this new analysis fits with other data and linguistic phenomena in sign languages, concluding in §7.9.6.

7.9.1 'Double contact' signs in the literature

'Double contact' signs are mentioned in one of the first publications in sign linguistics, Stokoe's *Dictionary of American Sign Language* (1965). Stokoe referred to the movement as "double touch" and in effect treated them as sequential contacts in the same location. For example, one variant of the ASL sign HOME (the variant that is reduced/reanalyzed from a compound), which is an identical cognate with HOME-2 in Fig. 250a[219] is written in Stokoe Notation as ƷO$^{\times\top\times}$, meaning it is on the cheek (Ʒ) with an 'O' handshape (O) and touches ($^{\times}$) the cheek, then approaches ($^{\top}$) and touches it again ($^{\times}$). Stokoe's notation captures several aspects of the sign: it is made in one overall phonological location, the movement involves contact and a movement toward the location (at least in the second syllable), and it is disyllabic with some kind of sequential structure. However, the exact locations or order in which they are touched is not captured; indeed the notation alone is indistinguishable from a repeated touch in exactly the same location on the check.

Battison assesses the distribution of signs with two locations in ASL and determines that "(f)or signs whose articulation involves contacting the body twice rather than just once, the observed tendency is to make both contacts within the same major area" (Friedman & Battison 1973: 8), and those signs that do make contact outside the major area (e.g., WOMAN in ASL) were originally compounds or blends of two different lexical signs. Battison's observation was later formulated as a morpheme structure constraint by Sandler, who states that *there is only one major location per monomorphemic sign* (1989: 27). This is widely adopted in sign phonology, and is used to justify the Place node in Sandler's model. Thus, double contact signs have played a small but significant role in theories of sign phonology.

Friedman expanded Stokoe's movement category, TOUCH or ×, into five separate values: CONTINUOUS, HOLDING, END, BEGINNING, and DOUBLE (1979: 54), thereby formalizing double contact signs as a phonological movement type in ASL. She also appears to have coined the term 'double contact'; and considers signs that cross major body areas (i.e.,

[219] The KSL sign HOME-2 is borrowed from ASL, but is used in what appears to be free variation with an indigenous KSL sign that has a very different form, HOME-1.

head, trunk, arm, hand) as also being double contact signs, despite their complex morphological origins (1979: 138).

Klima and Bellugi (1979) only briefly mention double contact signs, referring to them as "two touch" signs and observe that their surface phonetic form has three parts, with the middle movement being a transition between locations: "touch—move over—touch" (1979: 131). The view that the second movement is transitional and perhaps not encoded in the phonology has varied in different analyses, as will be discussed in the next section.

Liddell and Johnson (L&J 1989) refer to these signs in ASL in an extended discussion on metathesis of location in lexical signs and provide a sample representation of the structure of the double contact sign DEAF—which is nearly identical in location and syllable structure to HOME-2 (1989: 244)—in their Move-Hold Model. Their model posits that these two signs have the segmental structure MH**M**MH, with each segment associating to a bundle of features, except for the transitional movement (bolded added), which associates to both its adjacent segments (underline added). Because of the rich detail contained in each feature bundle, this model can capture nearly all aspects of double contact signs: disyllabicity, approach movement to a location, contact, transitional movement from one sub-location to another, the exact sub-locations contacted, and their order. L&J also list nineteen such signs in ASL "with the same underlying segmental structure" (248); these are revisited in the next section.

Uyechi (1996: 122-125) argues that double contact signs are best analyzed as two repeated end-contact signs articulated at two sides of the 'Local Signing Space' and that the movement between each location is transitional and shouldn't be encoded in the phonology. That is, the arc movement between locations is the inevitable articulatory output of the transitional movement required for the hand to move from the contact point of the first location (on the body) to the starting point of the second movement (directly above the body). She argues that if these signs were specified as arc movements, then the first approach-to-location movement could be deleted, but this is not permissible in ASL, even in a phrase with two adjacent signs of the same type (e.g., DEAF RESTAURANT).

Sandler's segmental Hand Tier model with its canonical LML syllable captures double contact signs using two key structural properties (in addition to LML segmental structure). First, her model has two types of location specifications that have a dominance relation: a Place node (specifying the overall body location: head, trunk, h2, arm) that dominates a Setting node, which contains features for sub-locations within a Place (i.e., ipsi, contra, distal, proximal, hi, lo). Each segment has its own Place and dependent Setting node.[220] Second, the model uses a [+/-contact] feature that associates to each segment's Setting node (1989: 139). This accounts for the pattern of contact in double contact signs; i.e., the features [+contact][-contact][+contact] associate to the corresponding LML segments so that there is no contact during movement to the second location. This model captures the exact sub-locations and their order, as well as the movement (M) between them. It also provides a means of distinguishing continuous contact signs from double contact signs, by use of [+/-contact] features. However, the disyllabic prosodic structure of double contact signs is not captured by either the featural specifications or the underlying structure of these signs in this model. That is, a disyllabic double contact sign (e.g., HOME) and monosyllabic sign (e.g., IDEA) both have an identical LML phonological structure (Sandler & Lillo-Martin 2006: 176-177).

[220] This is the implementation worked out in Sandler's foundational analysis (1989: 139). A more recently published representation of these signs, in Sandler & Lillo-Martin (2006: 176-177, 203), appears to have a slightly different relationship between Setting features and segments, but because the actual implementation is not explained, I stick here with the initial Hand Tier model.

In contrast, Brentari's Prosodic Model explicitly accommodates double contact signs by reserving setting features almost exclusively[221] for double contact signs (using similar setting feature labels as Sandler, but with a very different purpose) and by creating a dedicated tier in the Prosodic Features branch to account for them (1998: 151-155). Thus, a sign like POLICE-BOSS in Figure 250c has the phonological location [upper-arm] and the setting features [top], [bottom]. In this way, this model captures both of the sub-locations where the hand makes contact, and can also distinguish double contact from continuous contact signs because the latter would have a [tracing] feature. Disyllabicity in double contact signs is captured through a rule that inserts a direction feature for approach-to-location, [>|] (which licenses one syllable), for each of the two settings. She also introduces the idea that there can be defaults in the order of settings in double contact signs: "(w)hen no setting order is indicated in the input, the following default settings are used: [contra] will occur before [ipsi], and [top] will occur before [bottom]" (1989: 153).

Van der Kooij takes yet another approach to double contact signs. While she adopts Uyechi's view of these signs as "repeated end contact signs at two sides of the Local Signing Space" (van der Kooij 1997: 117), her interpretation is that double contact signs and continuous contact signs have the same underlying structure—i.e., the same 'melodic' structure—and only differ in their 'prosodic' structure or "the way the end node specifications are lined up with the temporal skeleton" (van der Kooij 2002: 208). As evidence of the underlying uniformity of these sign types, she documents instances in NGT in which disyllabic double contact signs are articulated as monosyllabic continuous contact signs, as well as the reverse (1997). A schematic of these alternations (where each syllable is represented by a set of two X-slots) is provided in Figure 251 (from van der Kooij [1997: 200]). Also, like Brentari, van der Kooij lists some of the

[221] The setting features [ipsi] and [contra] are also used as lateral symmetry features (1998: 123).

default directions in NGT, which are the same as in ASL: [contra]>[ipsi] (for both continuous and double contact signs on the chest) and [high]>[low] (2002: 208).

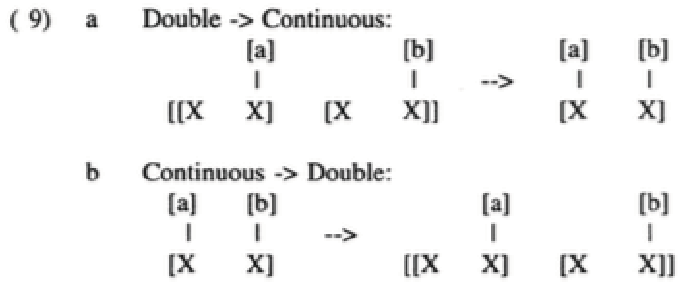


Figure 251. Van der Kooij's schematic of attested alternations between *double contact* and *continuous contact* signs in Sign Language of the Netherlands
([X X] is a syllable; [a], [b] are sub-locations)

To summarize, sign phonologists have all recognized double contact signs as being a distinct sign type that must be accounted for in one way or another, and most have acknowledged the disyllabic structure of these signs; however, the phonological representations of them vary considerably between researchers. Some track the details of every position of the hands (Liddell & Johnson), while others provide only minimal detail (Stokoe). In those phonological theories with more structure posited underlyingly, there is little similarity between models. Brentari provides much accommodation for these signs by using dedicated setting features and a special tier in the Prosodic Feature branch, while an approach at the other end of the spectrum is that of van der Kooij, who proposes that double contact are not distinguished as different from other continuous path movements in their featural representation, but have a different representation in their prosodic structure. And Sandler uses a third approach: nodes that attach to each LML segment and the distribution of [+/-contact] features as follows: L[+contact] M[-contact] L[+contact].

Each of these models has some gaps, especially when taking into account additional repeat-in-two-location signs that have not been addressed in these three models. In the next section, I describe such data in KSL and propose a new approach.

7.9.2 Proposal for new manner feature: [dispersed]

In the process of coding formational features in the KSL Lexical Database, 48 *double contact* signs were found. However, I also encountered many additional signs that were prosodically similar to double contacts, yet with some key phonological differences. In this section, I present observations about this data and the generalizations that emerge from them, and explain how a new analysis can account for this larger set of data.

The first observation is that double contact signs appear to differ minimally with signs that have a continuous contact in the same location. For example, the pair BREAD-1 and SIAYA (town in western Kenya) in Figure 252 both have the same handshape and orientation, occur in the same phonemic location ([*cheek +ipsi*]), and are disyllabic. They differ only by their movement: BREAD-1 is a continuous contact sign that moves parallel to the surface of the cheek, while each syllable in SIAYA moves perpendicular to the cheek, but its sub-locations are positioned along the same horizontal line as BREAD-1.[222]

a.


Figure 252. Minimal pair contrasting continuous contact and double contact: a. BREAD-1, b. SIAYA

[222] Representations on video with the same signer were not available, but the articulations shown here are standard ones for each sign.

b. 

Figure 252 (continued). Minimal pair contrasting continuous contact and double contact: a. BREAD-1, b. SIAYA

There is also a near-minimal pair, MOTHER-2 and FATHER-2 in Figure 253, in which the same perpendicular movement is either repeated identically on the ipsilateral cheek (MOTHER-2) or is repeated once on the ipsilateral and once on the contralateral cheek (FATHER-2). These are not true minimal pairs because in addition to the difference of the repetition in one or two sub-locations, the overall (inherent) phonemic locations differ by lateral symmetry features. That is, MOTHER-2 has the location features [cheek], [+ipsi] while FATHER-2 is [cheek], [+ipsi], [+cross]. However, the fact that MOTHER-2 and FATHER-2 are also a morpho-semantic minimal pair is not irrelevant. Frishberg & Gough (2003 [1973]) document many morphophonemic pairs and clusters of semantic opposites and semantically related signs in ASL that differ on the basis of minimal phonological characteristics; and KSL likewise has many similar pairs and clusters of this sort. Thus, the signs MOTHER-2 and FATHER-2 have been brought into a discrete formational contrast, (even if not perfectly minimal): repeat twice on one cheek vs. repeat once on one cheek and once on the other.

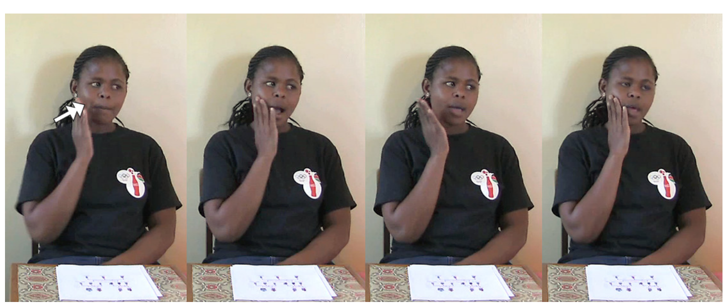
a. 

Figure 253. Morpho-phonological minimal pair: a. MOTHER-2, b. FATHER-2

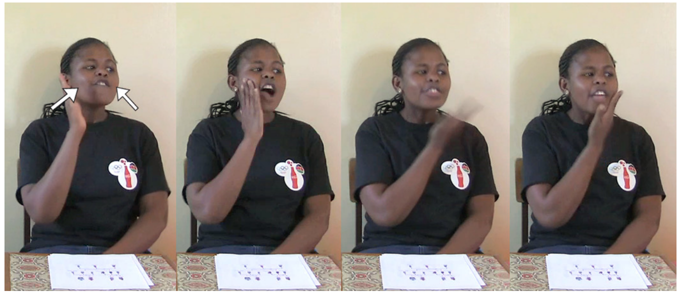
b. 

Figure 253 (continued). Morpho-phonological minimal pair: a. MOTHER-2, b. FATHER-2

I propose that pairs like BREAD-1 vs. SIAYA and MOTHER-2 vs. FATHER-2 justify a new manner of movement feature, **[dispersed]**, that has the following unique operation: *repeat the exact syllable in two sub-locations within the same distinctive location*. By definition, manner features take the core articulatory features specified in a sign—i.e., handshape, orientation, and/or path movement—and dictate how those articulatory movements are realized in the prosodic output. Other manner features affect whether the movement is performed singly or is repeated, whether a path is unidirectional or bidirectional, or whether the hands' movement is simultaneous or alternating—all without changing the core path, handshape, and/or orientation movements. In the same way, the [dispersed] feature dictates that the core articulatory movements, no matter which ones they are, are repeated at two points within the same location.

The two **sub-locations** implicated in dispersed signs are fully predictable given the phonological location and all the movement features specified in the sign (discussed momentarily). In this way, [dispersed] is consistent with the following cross-modality description of manner features: "manner specifies how the active articulator acts with respect to the place of articulation" (van der Hulst 1995: 13). Because monomorphemic signs are constrained to the same phonemic location (van der Kooij 2002: 161),[223] these two sub-locations

[223] This morpheme structure constraint was modified by van der Kooij, based on Battison's original observation (1978) that signs to not move outside the same 'major area'; e.g., head, torso, non-dominant

appear in "phonologically equivalent, but physically distinct, locations" (Uyechi 1996: 162); that is, they are articulated at two sub-locations evenly dispersed throughout the phonological area. And the number of sub-locations in [dispersed] is limited to two because of the length of the prosodic word: "(t)wo syllables is the maximum for well-formed core lexical signs" (Wilbur 2011: 1317). This predicts that the number of syllables/repetitions could potentially increase based on prosody and/or phonotactics, such as if sonority of the movement is low (e.g., a handshape change), or if the repetition is off the body, or in phrase-final lengthening, emphasis, etc. This needs to be investigated further, but preliminary evidence suggests multi-syllabic forms of [dispersed] signs do occur.

The second observation is that there are many signs that fit the operation "repeat the exact syllable in another location" in the KSL Lexical Database that have syllable types other than those in double contact signs (i.e., with a straight path that approaches and then ends on the body). Some examples are as follows. DIRTY-1 in Figure 254a has downward path movement parallel to the body,[224] or continuous contact, which is produced first on the ipsilateral cheek and then the contralateral cheek. ENUMERATE-POINTS[225] (Fig. 254b) has ulnar rotation that is repeated at a higher, then lower point on the palm. And TEACHER-2 and STRUCTURE (Fig. 254c, 254d) both have handshape contours ([close]>[open] and [open]>[close], respectively) that are repeated at different sub-locations in neutral space. Therefore, we can more accurately classify "double contact" signs as a sub-type of dispersed manner signs. Double contact signs are simply those

hand, etc. With the exception of a few 'two sequential location' signs, the KSL data is consistent with van der Kooij's modification; i.e., that "(m)ovement stays within a distinctive location," not just a major area.

[224] Thus, DIRTY-1 in KSL is similar in form to a common variant of the ASL sign RESTAURANT; e.g., *https://www.handspeak.com/word/r/restaurant.mp4*

[225] This gloss was assigned by the author and requires further investigation and consultation with KSL signers.

whose articulatory type happens to be a single, straight, midsagittal path (distal>proximal) ending on the body.

Figure 254. Distributed location signs with syllable types other than 'end-contact': a. DIRTY-1 (continuous contact), b. ENUMERATE-POINTS (ulnar rotation), c. TEACHER-1 (handshape contour) c. STRUCTURE (handshape contour)

Altogether, using the definition of [dispersed] above, there are around 135 signs in the KSL Lexical Database with a [dispersed] manner feature—or around 7% of the database—and the largest single group is of the double contact type (48 signs). Crucially, nearly all basic articulatory types are attested in dispersed signs; i.e., path only, HS change only, orientation only, path + HS change, path + orientation change. Also, dispersed signs occur in all the major body areas and neutral space, in 15 phonemic locations. Thus, [dispersed] is a generalized manner feature, independent of articulatory type and phonemic location and therefore similar to a manner feature like [repeated] that can apply to any articulatory type in any location.[226]

It is not completely clear why, but previous models have largely overlooked repeat-in-two-location signs other than those with double contact. While it could be the case that KSL has more than usual, we know that ASL, at least, does have several of these signs. Also, sign languages have been shown to be surprisingly similar in exploiting the same types of contrastive possibilities cross-linguistically (Crasborn, et al. 2000: 12). Therefore, it is assumed that they do exist in other languages, but have not been investigated before as a whole class. Another reason may be that out of all [dispersed] signs, double contact signs are simply the most noticeable because they are particularly common, especially on the body—and there is also a paucity of description of neutral space signs in the literature in general, as discussed in §5.11. In KSL, around 75% of dispersed signs *on the body* are double contact, and if this were typical across languages, the ones on the body might simply be more noticeable.

That said, Liddell & Johnson do list a few ASL that aren't double contact, including four with continuous contact (very similar to DIRTY-1 but with different handshapes)—RESTAURANT, HONEYMOON, TWINS, BACHELOR—and one sign that can be made with a handshape contour, NAVY, though it is unclear if this is the variant intended (1989: 247-248). Notably, L&J describe these signs as having "a movement to a hold at one location followed by a movement to a hold at another location" (248; underline added), without specifying the exact type of movement or the exact type of variation permitted. The structure of L&J's Move-Hold model can account for any

[226] There is one possible gap in the KSL data, though it may be accidental: there are no confirmed [dispersed] signs with only a change in handshape on the body.

kind of articulatory type in the repeated syllable because their model encodes the details of every sequential step in a sign, including details of the transitional movement.

Yet among the three models that I refer to most in this thesis—Hand Tier, Prosodic, and Dependency—none has developed an implementation for repeat-in-two-location signs with an articulatory type other than end-contact. Brentari does mention the sign BACHELOR as an ASL sign that can undergo metathesis, but does not say how these repeat-in-two-locations continuous contact signs would be represented by her model (Brentari 1998: 154). Sandler does not mention them in her ASL-based model, and I can also find no mention of such signs that aren't double contact in van der Kooij's analysis of NGT—though this may be a language-specific aspect of NGT.[227]

Therefore, in §7.9.5, I will offer a possible implementation for dispersed signs using the architecture of the Dependency Model, but first it is necessary in the following sub-section to explore which parts of these signs are predictable, and which parts must be lexically specified.

7.9.3 Working out what must be encoded in the phonology

What then is the minimal information that needs to be phonologically specified? In the previous section, I showed that the individual syllables in signs with a [dispersed] manner feature can be any articulatory type, meaning that the phonological information in the syllable is not predictable and must be represented in the phonology. In this section, I investigate whether specifying any aspect of the sub-locations is necessary given the newly proposed manner feature, [dispersed].

In principle, it is not clear why sub-locations would need to be specified under the [dispersed] manner strategy because the sub-locations are "phonologically equivalent" and

227 Els van der Kooij (personal communication) says that there are not many of these signs in NGT, and perhaps none that are other than the typical 'double contact' variety.

evenly dispersed throughout the phonological location. That is, each location has default points that should be predictable and therefore unnecessary to explicitly specify in the phonology. Like one-handed signs that have a default contact point at the geometric center of a phonological location (see §5.4), the sub-locations in dispersed signs are likewise located at idealized default points in the middle of evenly halved contiguous locations (e.g., torso, forehead, +ipsilateral cheek)—and these are typically matched to the beginning and end points of a continuous contact sign (e.g., as in BREAD-1 and SIAYA in Fig. 252). Also, recall Uyechi's view that the movement from one sub-location to another is simply transitional, and therefore not required to be specified. Additionally, some sub-locations in double contact signs can be metathesized in ASL and NGT without posing a problem for interpretability or well-formedness (though this has not been investigated in KSL).

However, there are several reasons why we may not be able to treat these sub-locations as wholly predictable. Sub-locations might require phonological specifications (i.e., [ipsi], [contra], [high], [low], [proximal], [distal]) if the orders are lexically-specified or are subject to a markedness hierarchy. Yet recall that double contact signs can have default orders in the directionality of sub-locations, meaning that the order would be predictable and unnecessary to encode phonologically. What is currently known about default sub-location orders for ASL, NGT, and KSL are shown in Table 27. Based on the literature, these defaults are the most widely attested orders, not absolute attestation. I have expanded this typology somewhat from Brentari and van der Kooij; however, it is clear that a more thorough study is needed to understand the true generalizations for different locations and different sign types cross-linguistically.

Table 27. *Default order of sub-locations in [dispersed] signs in ASL, NGT, KSL*

		ASL (Brentari)	**NGT** (v.d.Kooij)	**KSL**
body	**Head**, *horizontal*	*ipsi>contra**	*?*	*ipsi>contra*
	Head, *vertical*	*high>low*	*high>low*	*high>low*
	Torso, *horizontal*	*contra>ipsi*	*contra>ipsi*	*ipsi>contra*
	Torso, *vertical*	*high>low*	*high>low*	*high>low*
neutral space	**NS**, *horizontal*	*?*	*?*	*contra>ipsi*
	NS, *midsagittal*	*?*	*?*	*prox>dist†*
	NS, *vertical*	*?*	*?*	*lexically specified*

**Brentari did not list this, but it seems to be the default order in ASL;*
† the lack of dist>prox *here is likely an accidental lexical gap, rather than a default of* prox>dist

Despite having default orders, even the partial typology in Table 27 raises problems for the idea that sub-locations don't need to be specified in the phonology. First, the vertical axis in neutral space in KSL has lexically-specified orders that can't be predicted by the default; e.g., HAY is low>high, PETROL-2 is high>low, and they would likely be ill-formed if produced in the opposite direction. Second, within the same language there appear to be different default settings in the horizontal dimension. In ASL, for example, dispersed signs on the cheeks appear to have a default of [ipsi]>[contra], while on the torso they are [contra]>[ipsi]. In KSL, *all* horizontal dispersed signs on the body are [ipsi]>[contra], but in neutral space, the default is [contra]>[ipsi]. And finally, looking across languages, the default order for horizontal KSL signs on the torso does not match ASL and NGT. This last distinction, especially, suggests that even though there are default orders, they are not necessarily universal defaults, but may be part of a sign language's unique phonological patterning, and therefore must be referred to in order to assign rules that dictate the correct language-specific output. To summarize, it is necessary to specify the order of sub-locations at some point in the phonology of sign languages, but whether the specification must occur at the level of individual signs or classes of signs based on properties like location remains to be seen.

Even stronger evidence, however, that aspects of sub-locations might need to be phonologically specified comes from pairs of signs with [dispersed] manner in the same phonological location, but whose sub-locations are neither predictable on the basis of [dispersed], nor are they predictable by default orders. There are only a few of these signs in KSL, but their categorical nature asserts that they be accommodated in the phonology. Figures 225a and 225b show two signs in the phonological location, *nose*, with dispersed sub-locations that are ordered horizontally ([ipsi]>[contra]) in RENDILLE, and vertically ([high]>[low]) in AGA-KHAN. And Figures 225c and 225d show two dispersed signs on *upper-trunk* with sub-locations that are ordered horizontally ([ipsi]>[contra]) in BOARD-OF-GOVERNORS, and vertically ([high]>[low]) in BODY. Note that all four of these signs follow the defaults in Table 27; yet without knowing the relationship of the sub-locations to each other, it would be impossible to know how to correctly articulate these signs.[228] That is, having only the features [nose] and [dispersed] or [upper-trunk] and [dispersed] is insufficient.[229] Brentari referred to these ambiguities when she observed, "each type of plane has two possible sets of setting features" (1998: 151-152). For example, a horizontal plane parallel to the ground can equally refer to either of two setting features: [distal] and [proximal] on the horizontal plane are positioned closer and further from the body, like a road leading away from the signer, while [ipsilateral] and

[228] The two pairs in Figure 225 are not true minimal pairs, but do have very closely overlapping phonology. Crucially, each sign would be incorrect if the overall direction of the sub-locations was changed.

[229] It should be noted that the difference between signs like HOME-2 and FATHER-2 (or DIRTY-1) are accounted for by additional 'symmetry features', which are explained in §5.4. Thus, HOME-2 has an [ipsilateral] feature that FATHER-2 lacks.

[contralateral] are also on the horizontal plane and positioned on either side of signer's body, like road that extends to the left and right of the signer.

a. b. c. d.

Figure 255. [dispersed] signs whose sub-locations would be ambiguous without more features: a. RENDILLE is *ipsi>contra*, b. AGA-KHAN is *high>low*, c. BOARD-OF-GOVERNORS is *ipsi>contra*, d. BODY is *high>low*

There is also one set of signs in neutral space that would be ambiguous for the order of sub-locations without additional features: POSTPONE and CHILDREN (Fig. 256). The repeated syllable in both signs is a downward path movement in front of the body, but the sub-locations in POSTPONE are ordered midsagittally ([proximal]>[distal]),[230] while the sub-locations in CHILDREN are ordered horizontally ([contra]>[ipsi]).

[230] This image for POSTPONE is not ideal, but I didn't capture another one on camera. The ending position of the hands shown here appears higher than the starting position, but this is not a phonological specification of the sign. The height difference is partly an artifact of the camera angle and partly due to the articulatory situation in which the elbows remain bent for ease of articulation, resulting in a slightly higher position away from the body.

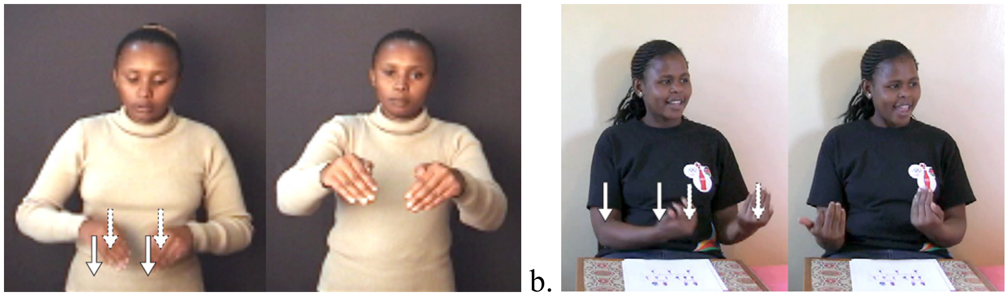
a. b.


Figure 256. Potentially ambiguous sub-locations in [dispersed] signs in neutral space: a. POSTPONE is *[proximal]>[distal]*, b. CHILDREN is *[contra]>[ipsi]*

Taken altogether, it appears that the movement properties of both individual syllables *and* some aspect of the sub-locations need to be specified in the phonology. However, doing so would require positing more underlying structure than the three main models have yet provided. Does the evidence just presented fully justify creating such additional structure? To prevent the over-generation of possible outputs, care should of course be taken when proposing brand new structures.

Fortunately, a solution for incorporating these generalizations of [dispersed] signs into the phonology dovetails with an analysis of signs in neutral space that was presented in Chapter 5. As I detail in §5.10.1, *plane* proved to be of limited use as a means of encoding discrete phonological distinctions, while *axis* is transparent, reliable, and phonologically contrastive for straight and arc path movements in neutral space. **Axis** refers to a line connecting any two points in space (or on the body) and has one of the following three values: (i) *vertical axis* moves upwards/downwards with the features *high* and *low*; (ii) *horizontal axis* moves from side-to-side with the features *ipsilateral* and *contralateral*; and (iii) *midsagittal axis* moves towards and/or away from the body with the features *proximal* and *distal*.

Once axis features are applied to dispersed signs, an important generalization emerges; there can be two distinct axes, occurring at two different levels in lexical signs: a **syllable-level**

axis and a **word-** or **morpheme-level axis**.[231] Thus, as shown in Table 28, in the sign CHILDREN, the syllable level axis is *vertical*, with *[high]>[low]* features, and the word level axis is *horizontal*, with the features *[contra]>[ipsi]*. In POSTPONE, the syllable level axis is the same as CHILDREN, *vertical [high]>[low]*, but the word level axis is *midsagittal*, with the features *[proximal]>[distal]*. Other than differences in relative orientation (and/or absolute palm orientation) for CHILDREN and POSTPONE, the axis of the sub-locations is the only difference between these near-minimal pairs. Two levels of axis features also account for the differences at the syllable level between FATHER-2 and DIRTY-1; they both have the same word-level axis, *horizontal [ipsi]>[contra]*, but at the syllable level, they differ: the core syllable in FATHER-2 is *midsagittal [proximal]>[distal]*, and in DIRTY-1 it is *vertical [high]>[low]*.

Table 28. *Pairs of dispersed signs that share path features at the syllable-level (CHILDREN, POSTPONE) and at the word-level (*FATHER-2, DIRTY-1*)*

	Axis #1 (syllable)	**Axis #2 (word)**
CHILDREN	*vertical [high]>[low]*	*horizontal [contra]>[ipsi]*
POSTPONE	*vertical [high]>[low]*	*midsagittal [proximal]>[distal]*
FATHER-2	*midsagittal [proximal]>[distal]*	*horizontal [ipsi]>[contra]*
DIRTY-1	*vertical [high]>[low]*	*horizontal [ipsi]>[contra]*

Evidence that axis specifications operate independently at both levels is found in the typology of [dispersed] signs in KSL. That is, nearly all combinations of syllable- and word-level axes were found. Table 29 shows the number of signs in the KSL Lexical Database with different combinations of axes (vertical, horizontal, midsagittal) for the syllable (Axis #1) and word (Axis #2) with an example of each shown in Figure 257 (movement of the first syllable is

[231] The only [dispersed] signs that don't have two axes are about a dozen signs in which the syllable is secondary movement (changes in handshape or orientation).

show with a dashed arrow). The only combination not found in the database is a sign with a horizontal axis path that is repeated on the midsagittal axis, although this could be an accidental lexical gap and may be found in a larger set of KSL signs and/or in other sign languages. And this combination would probably occur in morpho-syntactic constructions, such as 'I ran across two lines of rope laying parallel on the ground, crossing my path.'

Table 29. *Counts of 'dispersed' manner signs in KSL, by syllable- and word-level directional axes (vertical, horizontal, midsagittal)*

	Axis #2 (word) ▼		
Axis #1 (syllable) ▼	*vertical*	*horizontal*	*midsagittal*
vertical	6	23	8
horizontal	4	5	0
midsagittal	35	32	5

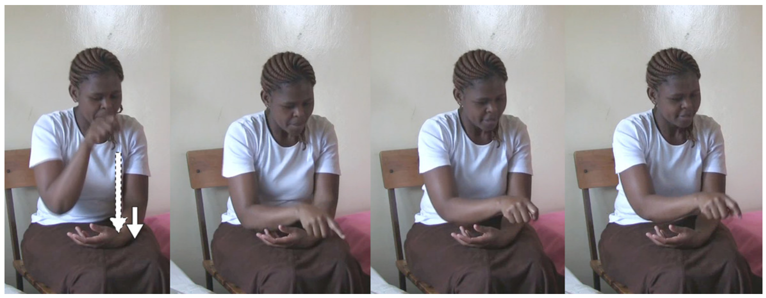
The most common combinations (67 of 118 signs or 56%) are those with a midsagittal path in the syllable and vertical or horizontal path at the word level, and most of these (48 signs) are on the body, meaning that they are the familiar 'double contact' type.

a.

Figure 257. [dispersed] signs with different combinations of axes at the syllable and word levels: a. HAY (*vertical, vertical*), b. MILLION (*vertical, horizontal*), c. TO-PLANT (*vertical, midsagittal*), d. ADDRESS (*horizontal, vertical*), e. COMMUNITY-2 (*horizontal, horizontal*), f. IMPORTANT (*midsagittal, vertical*), g. VOLLEYBALL-1[232] (*midsagittal, horizontal*), h. TO-MEASURE (*midsagittal, midsagittal*)

[232] Interestingly, all three tokens of VOLLEYBALL-1 from three different signers in the KSL Lexical Database have sub-locations that are ordered [ipsi]>[contra], following the default order on the body rather in neutral space, while the same signers producing a VOLLEYBALL-2, with the hands fully extended out in neutral space are [contra]>[ipsi]. This is seen as evidence that signs produced next to the head but not touching it should be classified with body locations.

b. 

c. 

d. 

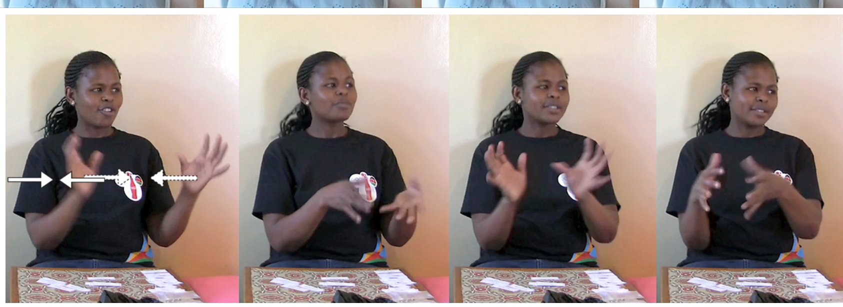
e. 

Figure 257 (continued). [dispersed] signs with different combinations of axes at the syllable and word levels: a. HAY (*vertical, vertical*), b. MILLION (*vertical, horizontal*), c. TO-PLANT (*vertical, midsagittal*), d. ADDRESS (*horizontal, vertical*), e. COMMUNITY-2 (*horizontal, horizontal*), f. IMPORTANT (*midsagittal, vertical*), g. VOLLEYBALL-1[233] (*midsagittal, horizontal*), h. TO-MEASURE (*midsagittal, midsagittal*)

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[233] Interestingly, all three tokens of VOLLEYBALL-1 from three different signers in the KSL Lexical Database have sub-locations that are ordered [ipsi]>[contra], following the default order on the body rather in neutral space, while the same signers producing a VOLLEYBALL-2, with the hands fully extended out in neutral space are [contra]>[ipsi]. This is seen as evidence that signs produced next to the head but not touching it should be classified with body locations.

f. 

g. 

h. 

Figure 257 (continued). [dispersed] signs with different combinations of axes at the syllable and word levels: a. HAY (*vertical, vertical*), b. MILLION (*vertical, horizontal*), c. TO-PLANT (*vertical, midsagittal*), d. ADDRESS (*horizontal, vertical*), e. COMMUNITY-2 (*horizontal, horizontal*), f. IMPORTANT (*midsagittal, vertical*), g. VOLLEYBALL-1[234] (*midsagittal, horizontal*), h. TO-MEASURE (*midsagittal, midsagittal*)

To summarize thus far, [dispersed] is a manner of movement feature that produces signs with a repeated syllable in two sub-locations within the same phonemic location. While this includes the previously documented type *double contact* signs, it also includes many signs that have not yet been fully described in the literature; in particular, signs with repeated syllables other than those having end-contact on the body. It was further discovered that these dispersed

[234] Interestingly, all three tokens of VOLLEYBALL-1 from three different signers in the KSL Lexical Database have sub-locations that are ordered [ipsi]>[contra], following the default order on the body rather in neutral space, while the same signers producing a VOLLEYBALL-2, with the hands fully extended out in neutral space are [contra]>[ipsi]. This is seen as evidence that signs produced next to the head but not touching it should be classified with body locations.

signs, by creating two ordered points in the signing space (on the body or in NS), license an axis that is independent of the axis in the syllable, and distributional evidence from the lexicon demonstrates that both the *syllable axis* and the *word-level axis* must be specified in the phonology for these dispersed signs.

In the next section, I show how this approach fits with additional linguistic phenomena.

7.9.4 Applying *dispersed* and *axis* features to other phenomena

In this section, I look at the consequences of having the [dispersed] manner feature and positing two levels or domains for features (i.e., syllable, word) in two different phenomena: (i) reported alternations between *double contact* and *continuous contact* signs, and (ii) phonological representations of some morphological processes using [distributed] and multiple axes.

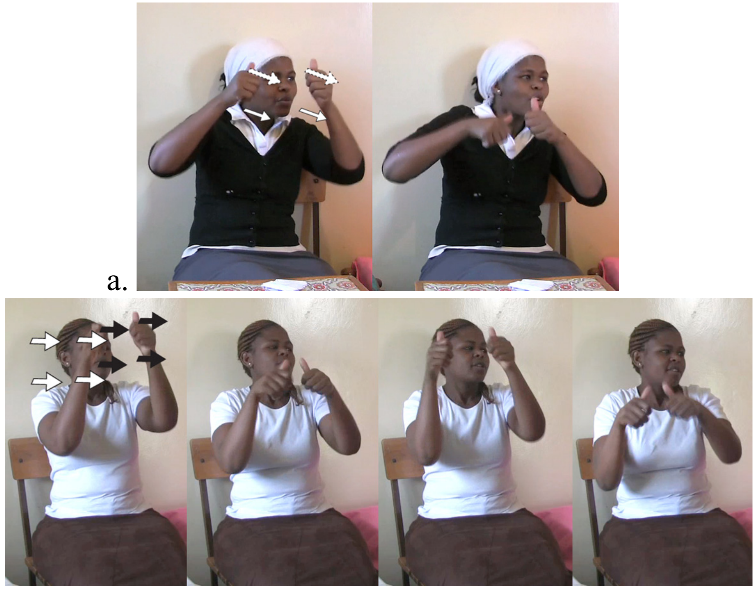
First, I revisit van der Kooij's view that *double contact* signs have the same underlying featural content as *continuous contact* signs (2002: 254). Her conclusion is based in part upon documented cases in which NGT signers produced a double contact sign with continuous contact, as well as the reverse. Considering the analysis I have presented here, an alternate explanation of this phenomenon is that in the first case, signers are deleting the syllable level path movement and in the reverse case, they are adding an epenthetic path movement at the syllable level. What might make such alternations likely to occur in NGT is that the default direction of both continuous and double contact signs on the body is [contra]>[ipsi].[235] By contrast, continuous contact and double contact signs in KSL have opposite default directions: continuous contact signs on the torso and head are consistently [contra]>[ipsi], while double contact signs in the same areas are consistently [ipsi]>[contra]. I have not found an alternation of double and continuous signs in the KSL data, and the minimal pair of BREAD-1 (continuous

[235] However, it is unclear if this same pattern holds for NGT signs on the head.

contact) and SIAYA (dispersed movement) (Fig. 252) suggests that the phonology of KSL may be different from NGT in this respect. This whole area of investigation presents further intriguing questions. Why does KSL have defaults in different directions for continuous versus dispersed signs? What are the patterns in other sign languages? And why are there default directions at all? These are all questions for future investigation.

A second consequence of the analysis of [dispersed] manner and axis features is that it may provide a way of accounting for some morphological processes in sign languages using phonological specifications. This can be observed in a construction found in the KSL elicitation data derived from the base sign, POSTER (Fig. 258a) that reduplicates along a horizontal axis in neutral space (Fig. 258b). The exact meaning of the construction isn't clear; it could either be a nominal pluralizing form (e.g., 'posters') or a reduplicate predicate form (e.g., 'to post around', 'posted all over the place'). In any case, the base sign, POSTER, is a dispersed sign with a midsagittal axis path ([proximal]>[distal]) at the syllable level, which is repeated on a vertical axis ([high]>[low]) at the word-level. In the modified construction (Fig. 258b), the whole word is reduplicated on the horizontal axis, moving [contra]>[ipsi]. The same [contra]>[ipsi] axis in front of the body is used for morphological means in KSL in ways that have not been fully analyzed yet, but the importance for this thesis is that any morphological structure should presumably have phonological exponence.[236] And using axis features that are 'stacked' or hierarchical or distributed may explain more than only lexical phenomena; it may allow phonology to more accurately represent morphological structures—an under-developed area of sign linguistics.

[236] *Exponence* is the mapping of morphosyntactic structure to phonological representations.



a.
b.

Figure 258. Dispersed sign with morphological reduplication: a. POSTER, b. 'TO-POST-AROUND' or 'POSTERS' (black arrows show the first morpheme)

Several such morphological constructions are described in ASL in Klima & Bellugi in their chapter, *The Structured Use of Space and Movement: Morphological Processes* (K&B 1979). An implementation for such morphological forms is not attempted here, but it is clear that the same phonological structure that can account for *double contact* signs and their larger class, *dispersed* signs, can be recruited to represent the phonology of many of the morphological modifications shown in K&B. Take the example of the augmentative inflection in ASL in Figure 259. The core articulatory movement is an orientation change (and/or path movement) involving pronation. The base sign is monosyllabic, while in the augmentative form ('to increase more and more') the base sign is repeated along a vertical axis, moving [low]>[high]. K&B report that a similar modification occurs with 'to understand more and more', repeating up the vertical axis. Therefore, using the analysis in this thesis, the augmentative in ASL manifests through (i) a [dispersed] manner feature employing (ii) the vertical axis and (iii) the feature values [low]>[high].

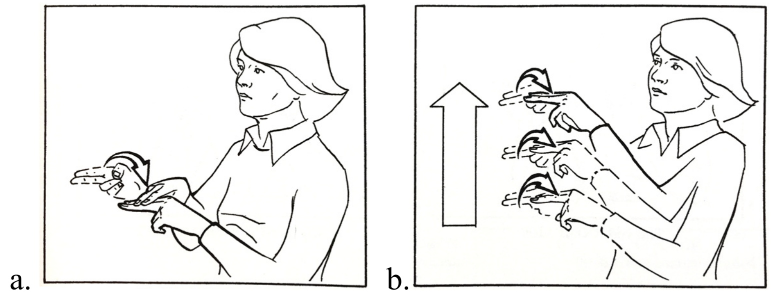


Figure 259. Augmentative inflection in ASL: a. INCREASE, b. INCREASE[M:augmentative] (reprinted from Klima & Bellugi 1979)

7.9.5 Proposal for representation of dispersed signs

This section has shown that dispersed signs have specific qualities that must be encoded in the phonology, but for which no adequate phonological representation is found in the major models considered in this thesis. Therefore, I offer a brief sketch of one possibility for how the Dependency Model (DPM) could accommodate dispersed signs in its representation.

Recall that what needs to be accounted for is any type of core articulatory movements (repeated in two locations) along an axis that must be specified in the phonology, but whose exact directionality is usually predictable on the basis of location. Consider the two signs MILLION-1 and BOARD-OF-GOVERNORS in Figure 260. The repeated syllable in MILLION-1 is an ulnar rotation, [prone]>[supine], in neutral space, while the repeated syllable in BOARD-OF-GOVERNORS is a path movement, [distal]>[proximal], on the upper torso. The sub-locations of both signs are on the horizontal axis, but MILLION-1 moves [contra]>[ipsi],[237] while BOARD-OF-GOVERNORS moves [ipsi]>[contra], reflecting the pattern for all signs on the body and neutral space, respectively.

[237] Crucially, the first sub-location is categorically contralateral to the second sub-location. As discussed in §5.10.2, a one-handed sign articulated in neutral space, like MILLION-1 in Figure 260a, is phonetically shifted to the ipsilateral side of the body for ease of production.

a. 

b. 

Figure 260. Dispersed sign with handshape change in two sub-locations: a. MILLION-1, b. BOARD-OF-GOVERNORS

Proposed representations for each sign are shown in Figure 261, with the dynamic features of the core articulatory movements (in blue) associating to adjacent X-positions in each {X X} syllable on the timing tier. Both signs have a [dispersed: —,—] feature in the Manner node at the top, which licenses two syllable positions on the timing tier (a modification to the Dependency Model discussed in §7.2). With regard to the directionality of the word-level axis (in orange), only the axis itself, {horizontal}, is specified because the exact directionality is predictable by location. However, it is currently unclear how to associate the contra/ipsi sub-locations to each syllable, rather than to a specific X-position. This is left for future implementation.

When it comes to representing the two path directions in BOARD-OF-GOVERNORS, I propose to split the dynamic features branch off of the setting node into two axes in order to accommodate both directions. Axis 1 is the head because its features apply at a higher level of organization—i.e., associating to whole syllables (sub-locations) rather than X-positions—while

Axis 2 is the dependent, with features in the end nodes that associate to X-positions on the skeletal tier and represent the local movement within each syllable.

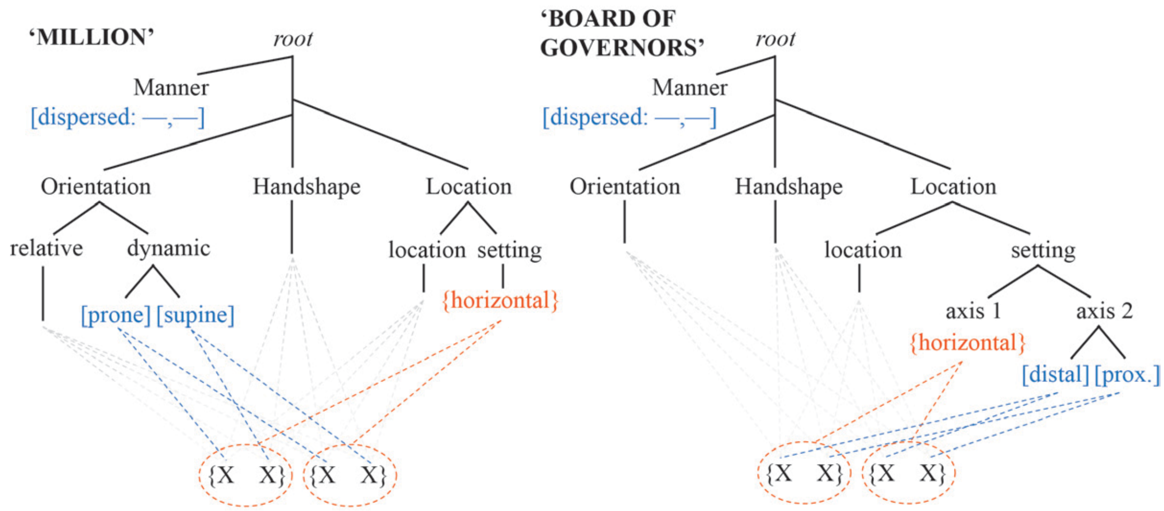


Figure 261. Implementation of two dispersed signs using the DPM: a. MILLION, b. BOARD OF GOVERNORS (blue = segmental level; orange = syllable level)

Note that the branching of the dynamic location (setting) features could presumably be extended one additional level to accommodate the type of morphological modifications just discussed in the previous sub-section (e.g., 'TO-POST-AROUND').

7.9.6 Dispersed signs conclusion

To conclude, this section has introduced a new manner of movement feature, *dispersed*, and described generalizations about the distribution of discrete phonological information in these signs from the KSL data. This has dovetailed with a new analysis of path movements in neutral space using axis features rather than phonological planes. While the data comes primarily from KSL, with some from ASL and NGT, it is hypothesized that these signs will be found in all sign languages, and a full accounting of these types may elucidate interactions between movement and location in sign phonology. It would also help to address many unanswered questions: (i) what are the default orders for different sub-locations cross-linguistically?; (ii) what motivates these defaults?; (iii) are the defaults for dispersed and continuous signs the same or different?;

(iv) which axes have default directions, and which are lexically-specified (is this consistent cross-linguistically)?; (v) why are there defaults at the word level *at all*—is it due to limits on complexity, or to some phonotactic constraint?; (vi) what are the morphological patterns in the use of axis features above the world level?; and (vii) how can these be represented in a model of phonology/morpho-phonology?

7.10 Other movement types

The core articulatory and manner features described in this chapter account for the majority of signs in the KSL Lexical Database. However, there are some exceptional signs that require further explanation. This section considers those that form four sub-groups: (i) signs with a "bounce" movement, (ii) disyllabic signs with a path movement followed by only local/secondary movement, (iii) highly complex disyllabic signs with primary and secondary movement in both syllables, and (iv) disyllabic paths in two directions that are neither parallel nor orthogonal.

There are around a dozen signs in which the hand seems to bounce off a body location, an effect that is produced by having unequal velocity in the first and second path directions and gives each path (approach and recoil) the impression of being a distinctly separate syllable. Thus, these were coded as disyllabic. Interestingly, this prosodic type seems to be present in several signs that are phonologically reduced from numeral incorporation. For example, CLASS-ONE in Figure 262a is reduced from SCHOOL^ONE, YESTERDAY in Figure 262b from PAST^ONE, and SHILLING and FIFTY-CENTS are also reduced from earlier signs, according to signers, but their original components are no longer transparent (they originate from coins used several decades ago). One hypothesis is that once the morpho-phonological pattern from numeral incorporation was developed, it was taken up by other signs without numeral incorporation roots; e.g., signs like EFFECT-2 in Figure 262c, TEST, and EMBU. It remains to be seen if these sign types are unique to KSL, or have simply gone unreported in other sign languages.

a.  b. 

c. 

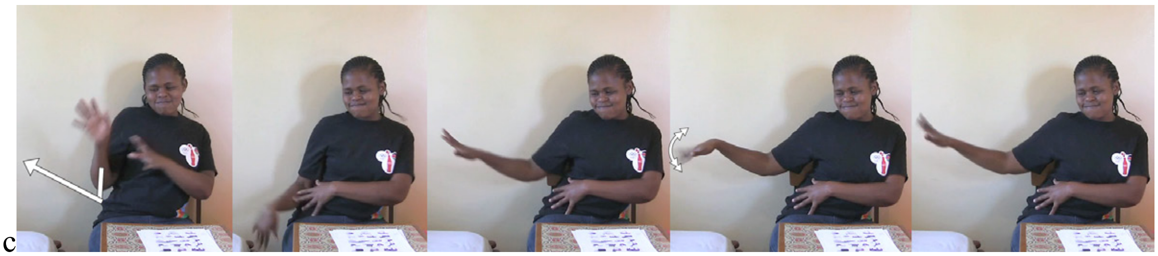
Figure 262. ‘Bounce’ signs: a. CLASS-ONE, b. YESTERDAY, c. EFFECT-2

The second type of signs with exception movement patterns are a group of at least eight signs that have a path movement followed by a repeated local movement (or trilled movement). For example, NAIROBI-1, PIPE-4, and MONGOOSE in Figure 263. Note that the handshape change in PIPE-4 is a repeated [closed]>[open] trilled movement, and the two syllables, path and HS change, are distinctly different syllables.

a. 

Figure 263. Complex disyllabic signs: a. NAIROBI-1, b. PIPE-4, c. MONGOOSE

b.



c

Figure 263 (continued). Complex disyllabic signs: a. NAIROBI-1, b. PIPE-4, c. MONGOOSE

Among these signs, three have repeated *pivoting* wrist movement (e.g., NAIROBI-1, EXPENSIVE, GAZELLE), three have repeated *nodding* movement (MONGOOSE, REFEREE-3, BARCLAYS-BANK), one has repeated ulnar *twisting/rotation* (PEPPER-HOT-2), and one has repeated handshape change (PIPE-4). In all cases except PIPE-4, the repeated local movement can be interpreted as a trill of the path movement, isolated in the wrist. Also, at the beginning of the sign, all of these cases (including PIPE-4) have a little 'bounce' in the first path movement that is similar to the signs just described.

Interestingly, path + local movement signs have also been reported in Hausa Sign Language. Schmaling discusses five HSL signs with a path movement (with or without secondary movement during the path) followed by only a local/secondary movement (2000: 112). The local movements in these signs are mostly different than the ones described here for KSL. They include: wiggling (2 signs), rubbing, pivoting, and single handshape contour.[238]

[238] The Hausa SL signs have the following English translations: 'lightning', 'guinea-corn', 'earth, soil', 'mad person, idiot', and 'fall' (Schmaling 2000: 112)

What is particularly noteworthy about all these signs is that the absence of such syllable types in ASL has been used as crucial evidence in one theory about phonological structure of the sign by Perlmutter (1992). Perlmutter essentially says that a secondary movement without a simultaneous path movement cannot precede or follow a path movement.[239] Recall that van der Kooij proposes that wrist pivots and nods should be interpreted as path movements, not local movements, but that ulnar rotations are distinctly orientation changes (§6.4.4). If this were the case, then only two of the eight signs would then offer counter-evidence to Perlmutter's generalization based on ASL (i.e., PEPPER-HOT-2 and PIPE-4). However, the other two signs and several HSL signs involve other local movements that are not considered paths; e.g., twisting, wiggling, rubbing, handshape contour. These signs require more study, but their existence demonstrates the importance of considering data from multiple sign languages when constructing theories about the structure of signs.

It remains to be seen if other sign languages exhibit similar prosodic types, but it bears mentioning that both of these sign languages are African. Is that coincidental or could there be a broadly shared gestural base from which these prosodic types have arisen? It is impossible to say at this point because the typological picture is so patchy, but it is an intriguing area for future study.

The third group of signs is comprised of six highly complex disyllabic signs in which both syllables have handshape contours and path movement (syllable complexity discussed in §6.10). In five signs, the contour is [open]>[closed]>[open]: MOVIE, EXPOSE-1, and SUBTRACT-1 (Figure 264), AUSTRALIA, BEAUTIFUL. And one sign, the contour is [closed]>[open]>closed]:

[239] "An M can always have secondary movement, regardless of its environment. A P, on the other hand, cannot have secondary movement if it is adjacent to an M" (Perlmutter 1992: 414). (P is a non-path "position"; and M is a path movement)

NETWORK-7 (Figure 238). In MOVIE and BEAUTIFUL, the first path movement is a circle and the second is a straight path. In the other four signs, the path movements in both syllables are straight.

Figure 264. Complex disyllabic signs: a. MOVIE, b. SUBTRACT-1, c. EXPOSE-1

Despite the fact that these signs don't appear to be particularly difficult to articulate and conform to prosodic word length constraints (two syllables), they are uncommon cross-linguistically, and small in number in the KSL lexicon. Presumably, this reflects their greater phonological complexity and the Zipfian principle that more complex forms are less common.

These signs are also notable because, like dispersed signs above and signs like DREAM and TO-MUSE (in §7.5), they show how the phonology has to apply manner features in specific prosodic domains. For the handshape movement, [bidirectional] ('return') has to apply to the level of the whole word, distributed across two syllables. For the path movement in NETWORK-7

(Fig. 238), [bidirectional] also applies to the whole word as the path returns back to the *h2 palm* location. This is similar to the often-cited case of DESTROY in ASL, also with a bidirectional path and simultaneous handshape change (Brentari 1998: 186-190).

However, the path movements in the other five complex signs here do not return to the initial location, but move away from it, at an angle (crucially, not at a 90º angle as in the sign TABLE [§6.5.1]). In this way, they are similar to a fourth cluster of disyllabic signs that were hard to classify for movement: TO-CURSE-1 (Fig. 265a),[240] FUNNY (Fig. 265b), SELFISH, AIRPORT-1, EMPLOY, ARREST-2, REFUGEE-2 and ADOPT. All other signs with two sequential paths can be classified as repeating the same exact path, returning along the same path (i.e., bidirectional), moving at 90º angle to the first path, or being an unusual tracing shape (e.g. TWINS-1 and POT-1, above). MOVIE and BEAUTIFUL can be classified as a circle+path movement type, but it is not clear yet how to classify the other dozen or so signs with this type of angular disyllabic movement.

a.
b.


Figure 265. Disyllabic two-path signs in two distinct directions: a. TO-CURSE-1, b. FUNNY

[240] 'Curse' here refers to 'putting a curse on' or 'hexing,' not using swear words. Its directionality can be modified to agree with a referent.

7.11 Conclusion

Considering how few descriptions of the Movement parameter there have been in the literature, Chapters 6 and 7 have sought to provide a relatively comprehensive classification of phonological movement in Kenyan Sign Language. The description was organized around the two main types of movement features: core articulatory movements (Ch. 6) and manner features (Ch. 7). Descriptions of all features and their co-occurrences were provided, as well as discussion about how different phonological models account for them.

In this chapter, I have shown how manner features can be applied to different articulatory movements to create new form-meaning mappings and can be combined with each other for the same purpose. Twenty-one manner features were presented, in five categories: *shape*, *size*, *repetition*, *return*, *dispersed,* and *hand configuration*. This chapter has also highlighted notable data in KSL: (i) path size as a typologically unusual contrastive movement feature; (ii) switch dominance as a distinct manner feature; and (iii) a new analysis of 'double contact' signs resulting in the identification of larger class of similar signs and a proposal for a new manner feature, [dispersed].

Finally, this chapter made several suggestions for ways that the Dependency Model could better represent the relationship between manner features and the prosodic output of signs be clarifying how articulatory features associate to the timing tier in specific manner types. More work is needed to further explicate how various signs are implemented in this model—especially more complex morpho-phonological types, like numeral incorporation or blends from compound signs—but its basic structural representation of Movement is nonetheless viewed as the best way to represent the dynamic aspects of the sign when compared to other models.

Chapter 8:
Conclusion and future directions

This phonological grammar of Kenyan Sign Language from southwestern Kenya[241] helps to establish this language as one of the many dynamic and complex sign languages of the world. In this concluding chapter, I first provide an overview of how the phonology of KSL compares with other sign languages (§8.1). Next, I briefly describe some of the distinctive features other than those related to Handshape, Location, and Movement (§8.2) that have been identified in minimal pairs. In the third section, I return to the three goals of the thesis and discuss how they were addressed (§8.3). And finally, I summarize the possibilities for future research that were brought up in the thesis and explain how this current project can contribute to new directions of study (§8.4).

8.1 KSL in context: cross-linguistic overview

In many respects, the phonology of KSL is very similar to other sign languages. For example, its inventories of handshapes, locations, and movements largely overlap with other sign languages, and more complex structures are less frequent in the lexicon overall. In addition, KSL signers—just like signers of older and more established sign languages—can be highly sensitive to constraints on prosodic wordhood and well-formedness, as demonstrated not only in their explicit metalinguistic judgments reported during elicitation sessions, but also as revealed in patterns of lexical contrast that are profiled in previous chapters.

At the same time, KSL has phonological characteristics not shared by all sign languages. These are listed in (15) below for the three major parameters described in this thesis: Handshape,

[241] This dialect is referred to as (SoNy)KSL for South Nyanza KSL at some points in the thesis because of its location in the former Nyanza Province.

Location, and Movement. Due to the limited total number of sign languages around the world that have been described, it is not possible to develop firm typological generalizations about the less common structures. Many questions remain: do the forms below simply appear in some languages and not others, or are they conditioned by common cultural/geographical histories (e.g., via contact between deaf people in the region and/or shared gestural practices)? It could also be the case that some properties are due to common developmental histories (e.g., younger sign languages or those with a majority of signers in rural areas). In one example, there is a snapping gesture that is common among hearing people around the world (Victoria Nyst, p.c.), but not in all American and European contexts. Is the presence of this snapping gesture in three African sign languages (in Ghana [Nyst 2008], Nigeria [Schmaling 2000], and Kenya [§6.8]) an areal linguistic feature, or can we expect it to be found in most sign languages around the world? Altogether, much more cross-linguistic data is necessary to understand such typological patterns.

(15) *Phonological structures in KSL not observed in all sign languages*:
- a. Handshape prime: the *'4'* handshape
- b. Location primes: *armpit*, *tongue*, *teeth*, *upper lip*, *hip*
- c. Location feature: *+/-connected*
- d. Location: possibly larger signing space
- e. Movement: *hold signs*
- f. Movement, handshape: *hinging*, *rubbing* ('snapping')
- g. Movement, complexity: several 'supercomplex' signs
- h. Movement, manner: *path size*, possibly *switch dominance*

8.2 Other distinctive features

The phonological analysis in this thesis relied upon the KSL Lexical Database that was richly coded for multiple phonetic details in the sign. However, it was not possible to include all of the phonemic characteristics of the sign for which minimal pairs exist. In this section, I will briefly describe these elements, but leave a full accounting of them for future work. They include

(i) orientation features, (ii) handedness (the number of hands in the sign), (iii) non-manual movements, and (iv) a few other miscellaneous distinctions.

The first of these, Orientation, refers to the direction that the hands face during the sign, which can be contrastive in KSL. For example, the signs BUNGOMA (town name) and BEER in Figure 266 differ only by the position of the hand during the repeated path movement onto the center of the forehead. In BUNGOMA, the palm faces to the contralateral side of the body, and in BEER the palm faces downward. Overall, there were 18 minimal pairs found in the lexical database that contrast for orientation.

a.  b. 

Figure 266. Signs that differ only by absolute orientation: a. BUNGOMA (facing contralateral), b. BEER (facing down)

This difference between BUNGOMA and BEER highlights one type of orientation called **absolute orientation** because it refers to the facing of the palm given the unchanging orientation of the body (similar to planes or directional axes). Absolute orientation has six values: *down*, *up*, *in* (toward the body), *out* (away from the body), *contralateral*, and *ipsilateral*. There are 7 minimal pairs in the KSL Lexical Database solely on the basis of absolute orientation (e.g., BICYCLE vs. FIFTY-FIVE, POSSIBLE vs. AGREE, OBAMA-2 vs. BUTERE, etc.)

Another way of encoding orientation is via **relative orientation** (Greftegreff 1992, Crasborn & van der Kooij 1997, Crasborn 2001), aspects of which have been called *focus*, *facing*, and *point of contact* in the literature. For Crasborn and van der Kooij, relative orientation refers to the more abstract relationship between one side/face of the hand and its placement in space or on the body. This is especially evident in indexical signs in which parts of the hand retain their orientation/facing toward a referent while the rest of the hand (its shape and the orientation of its non-facing side) may vary considerably in phonetic tokens. In signs with path movements (most signs in the lexicon), relative orientation refers to that part of the hand that is the leading edge of the movement. For example, in the pair in Figure 267, the relative orientation in RONGO (town name) is *palm*, while it is *back* in MANDAZI-2 (type of donut).[242] And BUNGOMA and BEER in Figure 266 both have the relative orientation *radial*.

a.  b. 

Figure 267. Signs that differ by both relative and absolute orientation: a. RONGO (absolute orientation = down; relative orientation = palm), b. MANDAZI-2 (absolute orientation = up; relative orientation = back)

Relative orientation was coded in the database and found to be a useful way of describing signs; it seems likely to be a categorical part of the phonology. However, there are no minimal pairs solely on the basis of relative orientation if absolute orientation features are also part of the phonology (which they must be based on the pairs just mentioned). This can be seen in RONGO and MANDAZI, which also differ by absolute orientation: *down* in RONGO and *up* in MANDAZI. There are 11 pairs found in the database differing by both absolute and relative orientation. For the time being, it will be assumed that these are all minimal pairs on the basis of absolute orientation, but further research on lexical contrast in Orientation in KSL is called for. Note that van der Kooij's Dependency Model uses only relative orientation, but in principle could use

[242] The six values for relative orientation refer to sides of the hand: *palm*, *back*, *tips* (fingertips), *root* (base of hand), *ulnar* (pinky-side), and *radial* (thumb-side) (Crasborn 2001).

absolute orientation without any consequences for the basic structure and assumptions of the model.

The distribution of all 18 minimal pairs for Orientation is shown in Table 30 below, with orientation values listed in order (top to bottom, left to right) of frequency in the database, based on one-handed signs as follows: *in>contra>down>out>up>ipsi*.[243] Interestingly, unlike handshape and location primes, frequency in the database does not fully predict contrastiveness in absolute orientation. That is, *down* is the value found in most minimal pairs, but is only 12.4% of the orientations in all one-handed signs.

Table 30. *Minimal pairs for absolute orientation in KSL*

contra	3					
down	3	4				
out	0	1	2			
up	0	0	5	0		
ipsi	0	0	0	0	0	
	in	contra	down	out	up	ipsi
total:	*6*	*8*	*14*	*3*	*5*	*0*

The next type of distinctive difference found in KSL signs is the number of hands in a sign, or **handedness**. For example, the signs ISIOLO (town and deaf school in Kenya) and WARTHOG-3 in Figure 268 differ by whether the sign is one-handed (ISOLIO) or two-handed (WARTHOG-3). In addition to this pair, there are four other minimal pairs in the database that contrast in this way (one-handed signs listed first): gold-1 vs. opulent, factory vs. witchcraft, orange-2 vs. photograph-2, and mandazi-1 vs. easy-1. Therefore, the two features [1H] and [2H] are proposed as distinctive in KSL. Van der Kooij does not mention how to integrate handedness features in the Dependency Model, but one solution is to place them in the Manner node because

[243] Distribution of absolute orientation in 638 one-handed signs without any orientation movement: *in* (31.5%), *contra* (27.9%), *down* (12.4%), diagonal & unsure (11.6%), *out* (10.2%), *up* (5.3%), *ipsi* (1.1%).

these features affects the entire operation of the sign. Alternatively, they could be inserted into the Manual Articulation node (see Dependency Model in Appendix 2), though this would subvert one assumption of this model—that all features are located in terminal nodes.

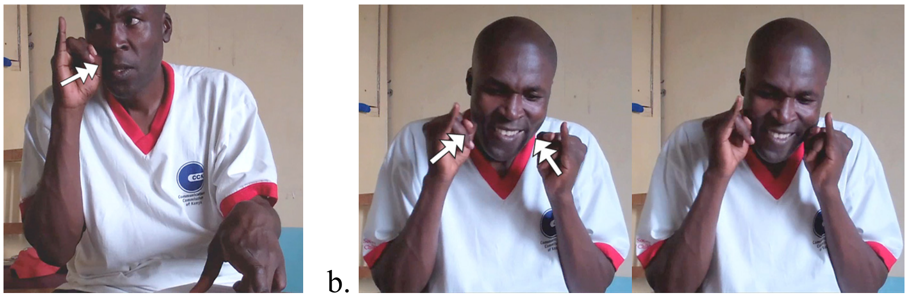


Figure 268. Signs that differ by the number of hands: a. ISIOLO (1H), b. WARTHOG-3 (2H)

The number of hands in the sign has also been shown to be contrastive in other sign languages (van der Hulst 1996), though never for very many pairs. Also, two-handed signs can become one-handed in a process called 'Weak Drop' (Padden & Perlmutter 1987). These facts prompted van der Kooij to speculate that "the distinctive load of one-vs. two-handedness cannot be very high" (2002: 260). Yet Weak Drop has not been evaluated yet in KSL, and five pairs is relatively high compared to other featural contrasts, so the distinctive load of handedness may be somewhat greater in KSL than in NGT (Sign Language of the Netherlands).

The third type of contrast are those with non-manual markers (NMMs). For example, there are two signs that appear to differ by whether there is blowing through the mouth or not: INFORM vs. EMPTY (Fig. 269) and MONEY-1 vs. GROUNDNUT-2 (Fig. 270). The first pair also differs by a more emphatic movement in EMPTY-4, and the second pair also differs somewhat by how long the rubbing path is between thumb and fingers, but in both cases the blowing appears to be lexically-specified. In addition, there is a pair that may differ by whether the signer frowns (PROUD-1) or not (HOLIDAY-2), but it needs to be verified.

a. b.

Figure 269. Signs that differ by mouthing: a. INFORM (no blowing), b. EMPTY-4 (blowing)

a. b.

Figure 270. Signs that may differ by mouthing: a. MONEY-1 (no blowing), b. GROUNDNUT-2 (blowing)

Finally, there are around seven pairs that are uncertain for which characteristics—if any—that they may contrast by. This includes two signs that could differ only by the part of the hand that makes contact with the location (DATE-1 vs. DOCTOR-3 and FUNERAL-1 vs. PIG-1) and two pairs that may differ by whether the torso bends forward or not (honor vs. me/my/mine and Monday vs. honest-3). There are also two pairs that are simply uncertain for whether they differ at all and require follow-up: OGWATA (gourd cup) vs. WINNOWING BASKET and SPREAD-1 vs. IFNLUENCE. And lastly, there is one pair, FLAG vs. FISH shown in Figure 271, that may differ by the position of the forearm; i.e., pointed upward versus pointed outward. If contrastive on this basis, this distinction would apply to very few signs, demonstrating how broad and potentially open-ended lexical contrast in sign languages—or at least KSL—may be.

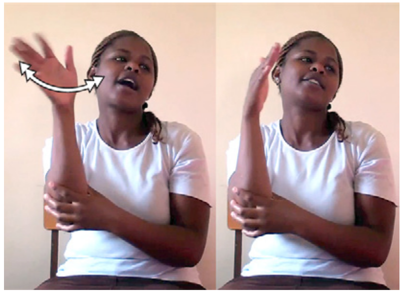
a.  b. 

Figure 271. Signs that may differ by the position of the forearm: a. FLAG, b. FISH

8.3 Contributions of the thesis

Three main goals for this project presented in Chapter 1 involved (i) description, (ii) methodology, and (iii) analysis. First and foremost, the thesis has provided a description of phonological structures in the southwestern dialect of Kenyan Sign Language, focusing on the three main parameters: Handshape, Location, and Movement. Altogether, the data and analysis has yielded inventories of 44 distinctive handshapes, 37 distinctive locations, 38 types of movement (21 manner features, 3 split coordinate values for path, 3 for orientation, and 11 types of handshape movement), and at least 12 other features: [+/-connected], the lateral symmetry features [ipsi] and [cross], 6 absolute orientation values, 2 handedness features ([1H], [2H]), and one non-manual feature [+/-blowing].

The second goal has been to make methodological advancements in the description of sign language phonology in order to address the "shortage of standard methods and tools" for reference grammars of sign languages (Nyst 2015: 110). In general, this goal has been addressed by being as transparent as possible in the analysis, but specifically involves the following: (i) a methodical treatment of minimal pairs in KSL that included the creation of a unique dataset of 'true' minimal pairs (see Chapter 3), (ii) the development of a set of diagnostics for determining phonological locations (§5.4), and (iii) making sure the description was complete by mentioning difficult, ambiguous, or complex cases in addition to the most frequent and typical data.

The third goal emerged during the analysis: contribute to a theoretical framework that can best represent the distribution of forms within the sign. This project started from a neutral position with regard to different theories of sign phonology, but moved toward the Dependency Model (van der Hulst 1993, 1996; van der Kooij 2002) over time. One way this thesis has contributed to the theoretical discussion is by explaining how different types of KSL data is represented in different models, and by evaluating the relative fitness of models for handling the KSL data. For the Movement parameter specifically, in Chapters 6 and 7, I have offered some suggestions for how this model could be clarified and/or modified to better represent the alignment of movement features and the distribution of articulatory information in the prosodic structure as represented on the skeletal/timing tier.

8.4 Future directions

There are many ways that the research and findings in this project can be applied to future research, which have been addressed at different points in the text and are summarized together here.

First, in addition to the work needed to address parts of the phonology that were not described in this thesis (see §8.1) and doing follow-up elicitation (e.g., using substitutability tests for handshape and location primes whose phonemic status was unclear, eliciting new words), one proximal step for future research would be to compare the phonological properties of the basic lexicon of monomorphemic signs described in this grammar with additional types of KSL signs. These include (i) a larger dataset of personal sign names in KSL,[244] (ii) forms with numeral incorporation (Morgan 2013), and (iii) blended forms of compound signs that are reduced to fit

[244] The lexicon used in this thesis already includes 132 place names (towns, cities, provinces, mountains, water bodies, countries, etc.) and 14 personal sign names (all politicians), but a larger set of personal name signs would make it possible to evaluate potential phonological differences between names and the rest of the lexicon.

the prosodic constraints of a single signed word. Each of these types has the potential to either conform to the patterns established in the basic lexicon, or to deviate from them in interesting ways, presumably by having more infrequent and/or more complex forms.

Second, an intriguing direction for future research arises out of the minimal pair findings in this thesis. In some places in the phonology an unequal distribution of minimal pairs were found from among similar featural types. A key example is the disparity in pairs that contrast on the basis of a single handshape feature. There are many pairs that contrast on the basis of *selected fingers*, as well as whole handshapes (i.e., handshapes that differ by more than one handshape feature), but very few or no contrasts on the basis of the other four types of handshape features. Another example is the high number of contrasts between the manner features [repeated] vs. [single] compared to other manner features. The explanations for these disparities may originate from a pressure for signs to be perceptually and/or articulatorily distinct enough from each other within a single person's mental lexicon. This hypothesis could be tested experimentally with KSL signers using various psycholinguistic performance tasks, such as recall and/or response time under conditions that tax working memory. At the same time, if these patterns are grounded in general perception and production, the same phenomena may be present in other sign languages as well, presenting the opportunity to test these hypotheses in other sign languages.

Third, another direction for future research is comparative and typological. Now that a lexicon of this dialect has been gathered and its phonological forms digitally encoded, it is possible to make measurable comparisons with the lexicons of other potential dialects in Kenya—or to evaluate the degree to which there are different dialects at all. It also opens the possibility of comparing the lexicons of other sign languages in East Africa. Having examined existing sign language dictionaries of Ugandan Sign Language (Wallin et al. 2006), Tanzanian Sign Language (Muzale & Languages of Tanzania Project 2004), and Rwandan Sign Language (Rwanda National Association of the Deaf 2009), as well as video of signs from these countries, it is possible that there is an overall Sprachbund (linguistic area) of sign languages in East Africa, to which Kenyan Sign Language belongs.

Fourth, a potential extension of this project is to develop a way to automatically find minimal pairs in a lexicon coded for phonological features. Having collected a dataset of minimal pairs for this grammar and coded the phonological features, the opportunity presents itself to create a computer script that can automatically pick out just the set of minimal pairs—no more, no less—from the coded data. This can be facilitated by having the set of minimal pairs as the target output for such a script (discussed in §3.5). While any computer script can output potential minimal pairs when all (or even most of) the formational aspects of the sign are encoded, finding just those pairs that are contrastive has not yet been accomplished in any sign language lexicon to my knowledge. Of course, one caveat is that sign languages will differ in ways that may require modifications to capture.

Fifth, another important step in describing this language overall is to connect the forms of individual signs described here with meanings, at all levels. This includes determining the lexical semantics of different signs and variants in a way that could make this lexical database applicable for dictionaries of KSL or pedagogical materials. In addition, further linguistic description the lexical level should address the morphology of KSL. This includes studying how (or whether) the language encodes grammatical categories (e.g., verbs, nouns, adjectives) as well as the characteristics of morphosyntactic forms (e.g., plurality, perfectives, indexicals, emphatics), constructions (e.g., compound signs, verb agreement), and word origins (e.g., calques, polysemy). One might call this 'grammatical morphology', in contrast to a recent and still-emerging focus in sign linguistics on what might be called 'iconic morphology'—or how individual features (van der Kooij & Zwitserlood 2015) and/or clusters of features situated in linguistic constructions (Lepic 2015, Occhino 2016) convey meaning with the smallest levels of form in sign languages. Having a lexical database coded at this fine formational level can allow these properties and their linguistic patterning to be studied in a more systematic way than would be otherwise possible.

And finally, a long term goal for KSL is to understand its patterns of usage around Kenya, especially in a way that supports needed research into applied linguistics of KSL for training for teachers in deaf schools, for use in interpreter training programs and certification, and for teaching KSL to the general population. In many European countries over the last decade or so, corpus projects of the national sign language have been used to address some of these goals, and a corpus of KSL—based in Kenya and with the leadership and participation of the Kenyan deaf community—could likewise serve this function. The lexical database created for this project would be able to contribute to a KSL corpus project in at least two ways: (i) by representing the lexicon in the southwestern part of Kenya, and by (ii) forming the initial input (with further research on lexical semantics) for a database of unique ID-glosses of KSL signs, which is necessary in order to properly annotate a sign language corpus (see §2.8).

In sum, there is much to do in order to better understand, document, and promote the use of this rich, living sign language in East Africa. It is hoped that this phonological description of (SoNy)KSL will be one of many studies in a long record of research on Kenyan Sign Language.

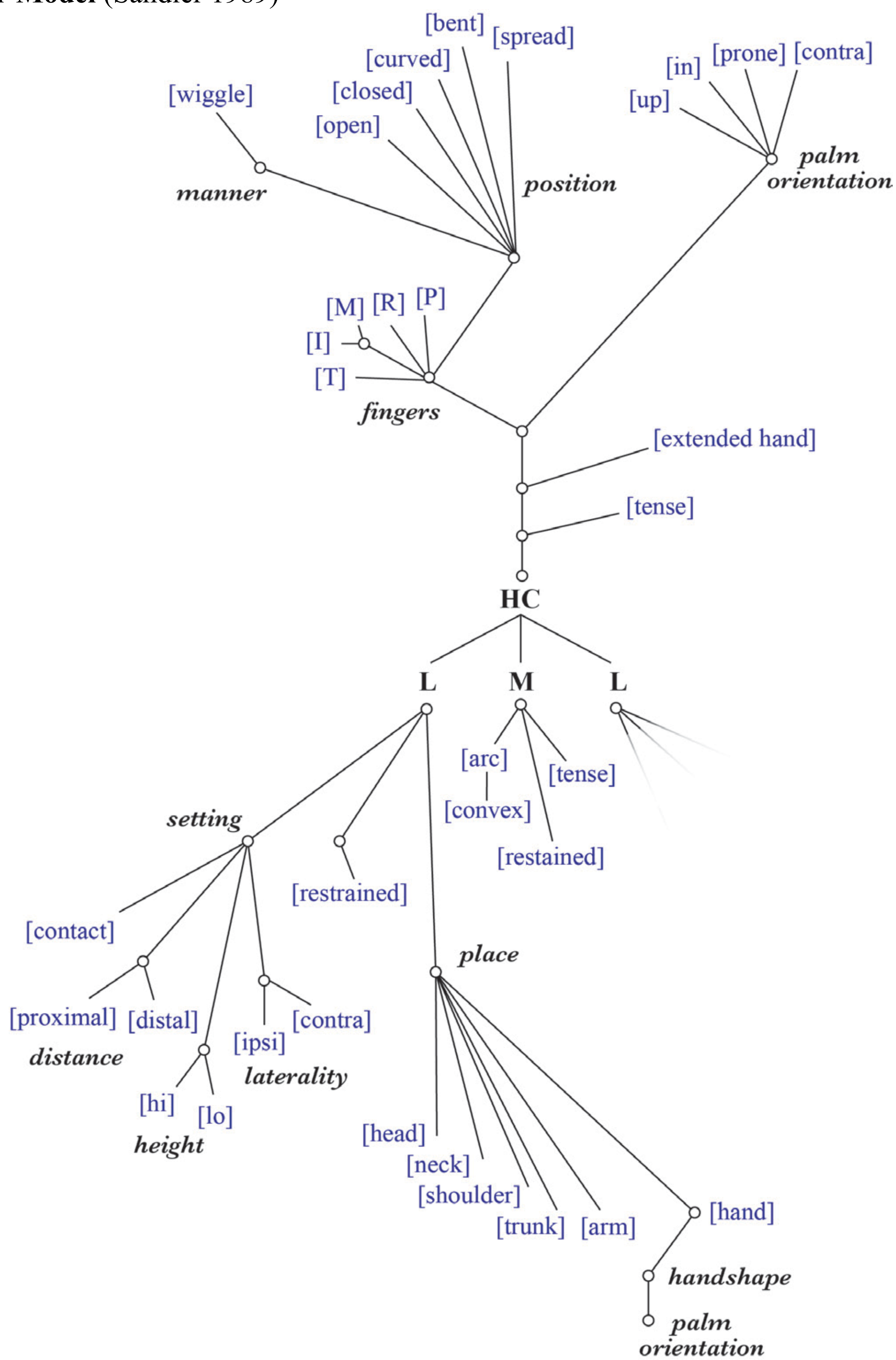
Appendix 1: *Fields in the KSL Lexical Database*

	Type:	Field Name:
1	organizational	Index
2	organizational	Creation Timestamp
3	organizational	Modification Timestamp
4	organizational	Phono Analysis Flag
5	organizational	ImagePath 1
6	organizational	ImagePath 2
7	organizational	ImagePath 3
8	organizational	Marked for exclusion
9	organizational	Problematic sections
10	organizational	Comments
11	organizational	Temporary Field
12	lexical	Gloss 1
13	lexical	Gloss 2plus
14	lexical	SingleOCompound
15	lexical	COMPOUND Components
16	lexical	Compounds Flag
17	lexical	Word Class - Major
18	lexical	Word Class - Minor
19	lexical	Word Class - Classifier
20	lexical	Minimal Pair
21	lexical	Homophone
22	lexical	Initialized Sign
23	lexical	Etymological Sources in Kenya
24	lexical	Word formation origins
25	lexical	Variant flag
26	semantics	Semantic Class 1
27	semantics	Semantic Class 1 SubClass
28	semantics	Iconic Origin 1
29	semantics	Iconic Origin 2
30	prosodic	SignType
31	prosodic	Syllable Complexity
32	prosodic	MOVEMENT: number sequential PHONETIC
33	prosodic	MOVEMENT: number sequential PHONEMIC
34	articulator	Articulator
35	articulator	Articulator Secondary
36	articulator	OneTwoHandedSign
37	articulator	TwoHandedSign Type
38	articulator	TwoHands Geometry
39	articulator	h2 Role
40	articulator	Mouthing this record
41	articulator	Mouthing detail
42	articulator	Facial Expression
43	handshape	Sign1: H1

44	handshape	Sign1: H2
45	handshape	Sign2: H1
46	handshape	Sign2: H2
47	handshape	H1 HamNoSys
48	handshape	H2 HamNoSys
49	contact	CONTACT handpart
50	contact	CONTACT type
51	location	LOCATION: MAJOR AREA 1
52	location	LOCATION: MAJOR AREA 2
53	location	LOCATION: MINOR AREA 1a
54	location	LOCATION: MINOR AREA 1b
55	location	LOCATION: MINOR AREA 2
56	location	LOCATION: SETTING
57	location	LOCATION: AXIS 1 (syllable)
58	location	LOCATION: AXIS 2 (word)
59	location	LOCATION: proximity
60	location	LOCATION: plane relativity
61	location	LOCATION: plane relativity body part
62	location	LOCATION: Symmetry 1
63	location	LOCATION: Symmetry 2
64	location	LOCATION two sequential
65	location	LOCATION PHONEMIC
66	movement	MOVEMENT TYPE: 1st syllable/morpheme
67	movement	MOVEMENT TYPE: 2nd syllable/morpheme
68	movement	MOVEMENT: manner 1
69	movement	MOVEMENT: manner 2
70	movement	MOVEMENT: manner 3
71	movement	MOVEMENT Path
72	movement	MOVEMENT Orientation
73	movement	MOVEMENT Handshape
74	movement	MOVEMENT: path shape
75	movement	MOVEMENT: tense
76	movement	HS: joint change
77	movement	Sign1: trill
78	movement	Sign1: 2hand movement
79	movement	MOVEMENT: dispersed
80	orientation	ORIENTATION: relative orientation
81	orientation	ORIENTATION: dynamic relative
82	orientation	ORIENTATION: h1 absolute palm ori
83	orientation	ORIENTATION: absolute finger ori
84	orientation	ORIENTATION: h2 absolute
85	orientation	ORIENTATION: h1 dynamic absolute
86	orientation	ORIENTATION: move based on source

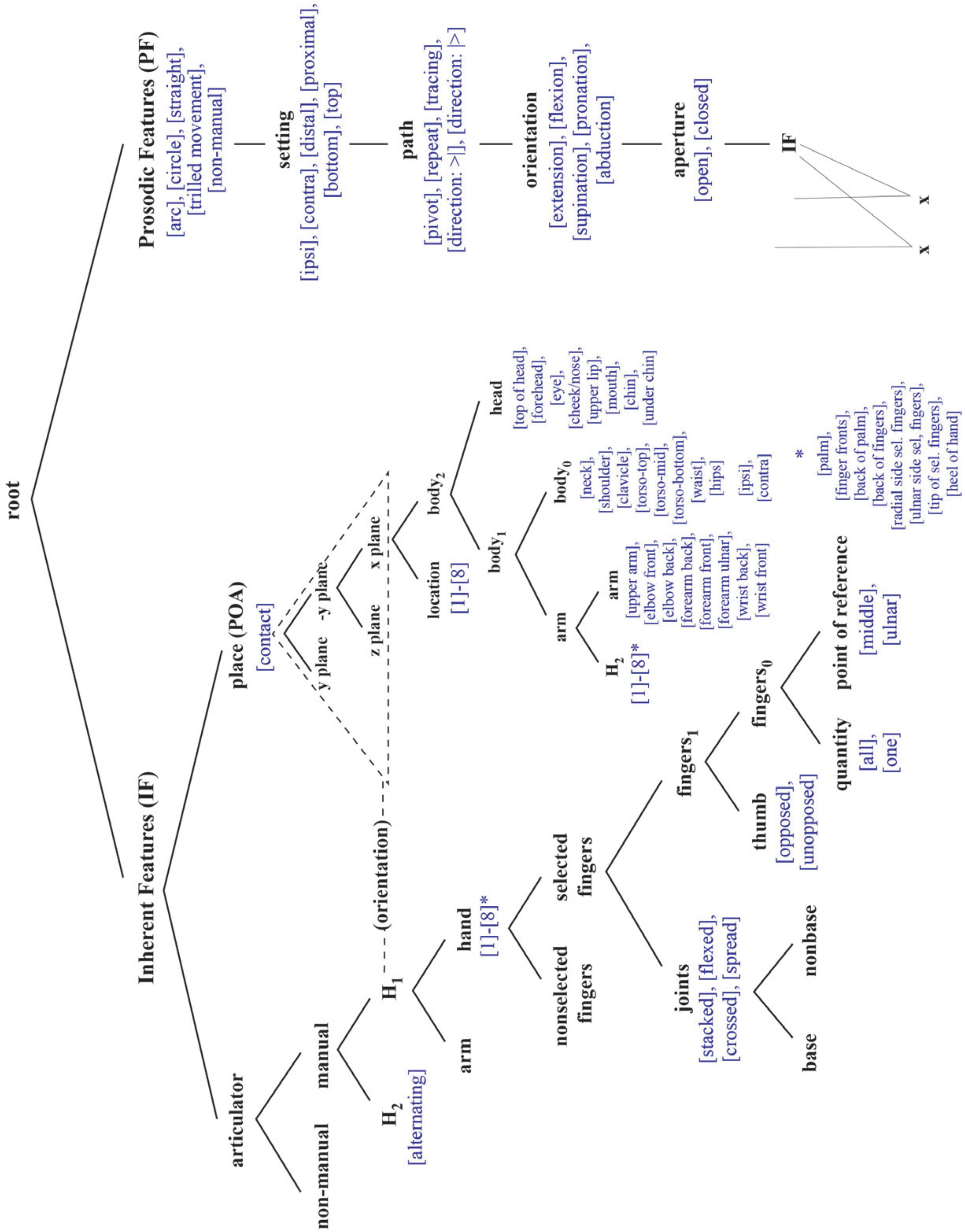
Appendix 2: *Representation of phonological structure in three models*

Hand Tier Model (Sandler 1989)*

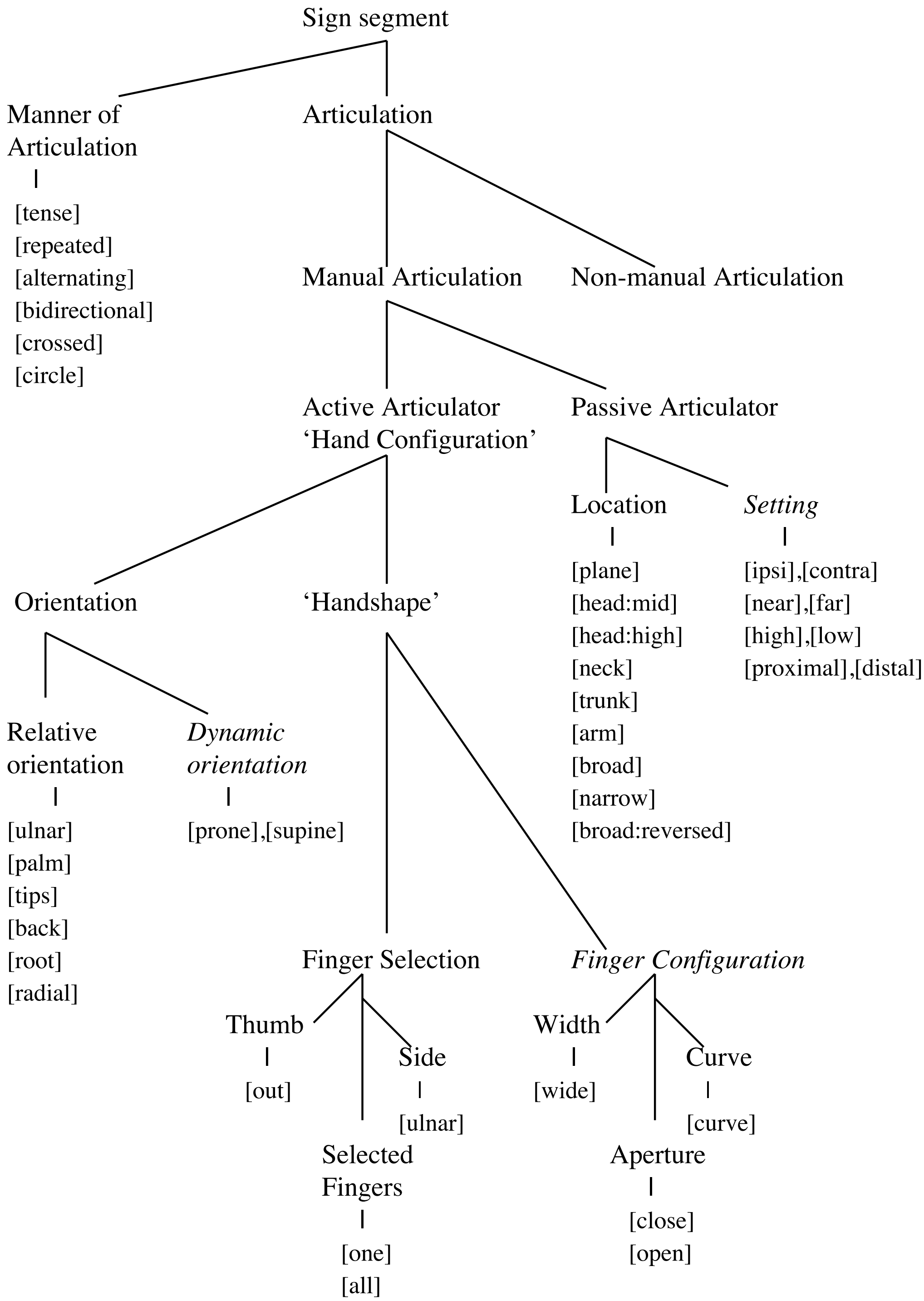


*NB: model was updated in Sandler & Lillo-Martin (2006)

Prosodic Model (Brentari 1989)



Dependency Model (van der Kooij 2002)



Appendix 3:
Inventory of KSL Handshapes

This appendix contains an annotated registry of 44 handshapes in the KSL Lexical Database of 1,880 signs collected in southwestern Kenya. This is a partially-phonemic inventory, meaning that allophonic variants have been located for most of the 70+ phonetic handshapes coded in the database. However, the difference between some handshapes could not be conclusively determined (e.g., *1* and *D; T* and *fist-stacked*); this is indicated in each respective entry.

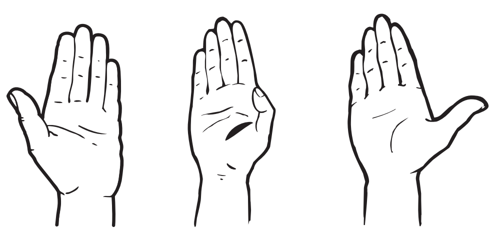
For each handshape entry, the following information is provided:

- **Index number** of handshape, listed in order of greatest to least frequency in the lexical database (#1-44)
- The **name** of the handshape used in this dissertation
- **Hamburg Notation System symbol** of handshape
- **Number of signs** in which this handshape is found on the dominant hand (in non-dynamic handshapes; see below for dynamic handshapes)
- **Drawing(s)** of the main handshape followed by phonetic variants
- **Photographs** of KSL signs with the handshape taken from video elicitation
- Number and examples of the **minimal pairs** in which this handshape is found; the first sign listed in a pair contains the handshape of that entry; see Chapter 3 for methodology of determining minimal pairs and Appendix 4 for a chart of all handshape contrasts
- Description of the allophones and other **phonetic variation** of this handshape
- Motivated origins for handshapes, which can include those handshapes that participate in (i) **manual numbering** and (ii) **alphabetic letters**, as well as various iconic mapping strategies, including (iii) object **size and shape** representation (e.g., a long, thin CARROT-1 depicted by the extended index finger in the *1* handshape, ⊴), (iv) depictions of object **handling** (e.g., BELL represented by gripping the handle of the bell while ringing it with *T* handshape, ◁▯), and handshapes that arise from **embodied actions** or gestures not involving objects (e.g., TO-WARN indicated by the shaking of an index finger, ⊴)
- Non-Kenyan sources for handshapes; e.g., evidence of **borrowing** handshapes from other sign languages, which were determined by comparisons with multiple print and online dictionaries
- Whether a given handshape occurs in signs with **dynamic handshape** changes; i.e., the handshape is found in a sign with changes in the flexion and/or aperture of the fingers (e.g., repeated hooking of index finger in VIRUS, or closed > open aperture in NOTHING) or in a change from one distinct handshape—with different selected fingers—to another shape (e.g., *O* to *K* in OKAY); note that the dynamic handshapes described herein are phonetic

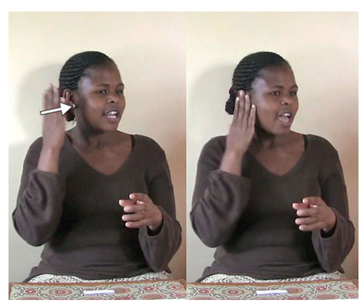
1. *flat*	12. *A-thumb*	23. *small-C*	34. *O*
2. *1*	13. *V*	24. *Y*	35. *wood*
3. *fist*	14. *L*	25. *lax*	36. *bent-L*
4. *open*	15. *H*	26. *G*	37. *4*
5. *claw*	16. *T*	27. *open-spray*	38. *mid-bend*
6. *X*	17. *open-curved*	28. *W*	39. *N*
7. *bent*	18. *i*	29. *fist-stacked*	40. *flat-o-curved*
8. *curved*	19. *K*	30. *closed-G*	41. *H-thumb*
9. *C*	20. *B*	31. *D*	42. *H-thumb-closed*
10. *F*	21. *E*	32. *R*	43. *thumb-in-fist*
11. *flat-o*	22. *bent-V*	33. *uganda*	44. *V-L*

List of 44 KSL handshapes (ordered by greatest-to-least frequent in the KSL Lexical Database based on only static/non-dynamic handshapes on the dominant hand)

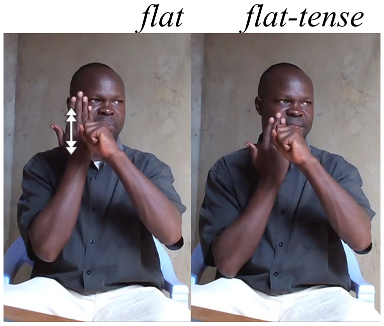
1.	***flat*** ▢	337 signs



flat *flat-tense* *flat-thumb*



DEAF-1



MEAT-1

TO-RETURN

Minimal pairs: 32 pairs. *flat* contrasts with *1* in four signs (see #2), with *fist* in four pairs (see #3), with *claw* in six pairs (see #5), *X* in one pair (see #6), *flat-o* in one pair (see #11), *A-thumb* in one pair (see #12), *V* in one pair (see #13), L in one pair (see #14), *H* in one pair (see #15), *i* in one pair (see #18), *K* in one pair (see #19), *bent-V* in one pair (see #22), *lax* in one pair (see #25), *W* in two pairs (see # 28), *uganda* in one sign (see #33), *thumb-in-fist* in one pair (see #43)

Variation: *flat* is found in phonetic variants in which the thumb can be extended outward in *flat-thumb* (e.g., in KNIFE, TO-TRAVEL, RIVER-1), held tightly against the side of the hand in *flat-tense* (e.g., in BUILDING, WATCHMAN, MATERIAL/CLOTH); the fingers can also be partly spread in many signs without resulting in an ill-formed sign; see more detailed analysis of *flat* in §4.6 of Chapter 4

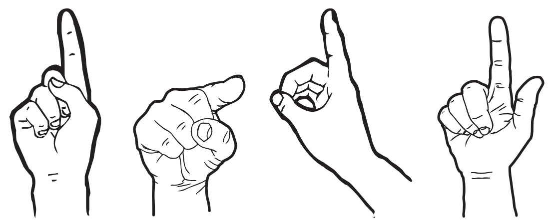
Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: at least 62 signs (18%) with this handshape map to the shape of flat objects, such as a blade (e.g., KNIFE, PAPAYA-1, MEAT-1, PANGA-1), animal ears (e.g., DONKEY-1, HARE-2, ELEPHANT-3), sheet(s) of paper (e.g., PAPER, TO-READ, FILE, BOOK-1, PASSPORT-3), or another object (goatee in RAILA-ODINGA; sheaves of dried grass in HAY; flat hat in UNIVERSITY)
- **Handling**: very few signs with this handshape are motivated by handling or holding an object; only three could be unambiguously discerned to represent handling: TO-PRESENT, TO-VISIT, and MAGIC
- **Embodied action**: at least 41 signs with this handshape are motivated by some embodied action, such as flipping the pages in a book in BOOK-2, covering the mouth while ululating in FUNERAL-1, fanning away a smell in WEBUYE (town with a former paper mill), wiping off ones' hands in TO-FORGIVE, rubbing ones' hands together in CURIOUS, etc.
- **Note**: Motivation is hard to discern in 39% of signs (130 signs) with a *flat* handshape. In some cases this is because there could be multiple motivations for the handshape, such as PLATE-2 in which *flat* hands, palm-up, move in a midsagittal arc (distal>proximal) and may be seen as: (i) tracing the three-dimensional surface of the plate, (ii) representing the flat object of the plate itself, and/or (iii) depicting holding a plate. In addition, the *flat* hand may sometimes be a kind of default handshape, used when a sign's motivation originates from the relationship between the hands and not specifically their shape (e.g., OVER, UNDER, ON, DECREASE-2, TO-LEAD, etc.).

Borrowing: The majority of signs with a *flat* handshape are indigenous to Kenya (201 signs or 59%); of those that are likely borrowed, at least a couple dozen are of ASL or Signed English origin (e.g., GENERAL, SERVICE, PLEASE, LATE, MUSIC); at least one, GAY-MALE-1, originates from a Nordic sign language (i.e., Danish or Swedish SL), at least one, TO-HIDE, has a BSL origin; and one is identical to a sign used in India, with the same articulation, same mouthing and same meaning: BASI, meaning "only"

Dynamic handshapes: there are 19 dynamic handshapes with *flat*; 17 involve the bending of the fingers, either as bending of all fingers into the palm as in *flat>A* (5 signs; see #3) and *flat>A-thumb* (2 signs; see #12), or as only some of the fingers into the palm, as in *flat>L* (1 sign; see #14) and *flat>Y* (1 sign; see #24), or as only partial bending of the base joints in *flat>bent* (6 signs; see #7); there is also un-bending or straightening of the joints in two signs (*bent>flat*; see #7); signs that don't involve bending include one sign, TO-SPREAD-1, in which the fingers spread apart (*flat>open*), and one sign with a change in thumb contact, TO-GIVE-1 (*flat-o>flat*)

2. *1* 230 signs



1 *bent-1* *D* *1-thumb*

TO-COOK-1

HOME

HARSH

TO-TRAVEL (SAFARI)

Minimal pairs: 32 pairs. *1* contrasts with *flat* in four pairs (e.g., YOURSELVES and THEMSELVES, KISII-1 and GAY-MALE-1), with *fist* in four pairs (see #3), with *open* in three pairs (see #4), with *claw* in one pair (see #5), with *C* in one pair (see #9), with *F* in two pairs (see #10), with *V* in one pair (see #13), with *H* in one pair (see #15), with *T* in one pair (see #16), with *K* in two pairs (see #19), with *B* in one pair (see #20), with *E* in one pair (see #21), with *bent-V* in one pair (see #22), with *small-C* in one pair (see #23), with *lax* in one pair (see #25), with *G* in one pair (see #26), with *W* in one pair (see #28), with *R* in one pair (see #32), with *bent-L* in one pair (see #34), with *mid-bend* in one pair (see #38), with *N* in one pair (see #39), and with *thumb-in-fist* in one pair (see #43),

Variation: *1* is found in the following three phonetic variants that cause no change in meaning: *bent-1* in which the finger bends at the base joint (e.g., TO-COOK-1); *D* in phonetic variants in which the thumb makes contact closer to the fingertips than the exterior of the fingers (e.g., HARSH, DATE-3); and in *1-thumb* in which the thumb is not opposed, but held loosely parallel against the index finger (e.g., WHO, CRAZY)

Motivated forms:

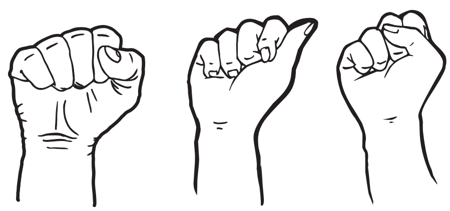
- **Letters**: *1* may represent the letter 'D' in at least four signs, though it is not clear if signers actually interpret these as initialized or not: DATE-3, DISCIPLE-1, DEAF-2, DEBATE-1 (see separate entry #31 for signs with an unambiguous *D* handshape)
- **Numbers**: this handshape represents the number one in at least a dozen signs (e.g., SIX, JUNE, FIRST, CLASS-ONE, EACH, RARE) and several others that may be numbers or not, which is still an unresolved issue in theories of numeral incorporation (e.g., in signs such as WEEK-1, TOMORROW, YESTERDAY-1)
- **Size/Shape**: the index finger maps to shape of a symbol (most are cross/X) in POSITIVE, NEGATIVE, MULTIPLICATION, DIE-4 and SLEEP-6; it maps to an object in around 40 signs, which include parts of an animal's body (e.g., COCKROACH, PORCUPINE, MOSQUITO-1), a flame (e.g., TO-COOK-1, PARAFFIN, LAMP-4), bodily fluids (e.g., TO-URINATE, TO-VOMIT-4, DIARRHEA-2), and other objects (e.g., THORN, TOOTHPICK, HUT-1, CHIEF-1); and it maps to a two-dimensional traced shape at least 20 signs (e.g., MAP, TO-PASS-BY, MISTAKE-1, CORRECT, PILE/HEAP, WHO)
- **Handling**: none
- **Embodied action**: use of the *1* handshape indicates an action in at least ten signs; e.g., TO-WARN, TO-COUNT, NO-1, QUIET, CRITICIZE-1
- **Other**: one unique motivation of the *1* handshape is that it is used to index locations on the body or in specific directions, which themselves carry meaning; in at least 40 signs, a *1* handshape touches, rubs, or interacts with parts of the body that carry meaning (e.g., BLACK, BROWN-1, TEETH, TO-SEE-2, TO-TASTE, I/ME, MYSELF) or parts of the body that can be adorned with objects that carry meaning (e.g., TIME, INDIA, TURKANA, NUMBER-1); pointing at a location away from the body is also an index to create lexical meaning (e.g., GOD-2, BLUE, YOU, YOURSELF, HERE-2, TODAY-1)
- **Note**: a relatively large proportion—around 41% of signs with a *1* handshape (95 signs)—could not be evaluated for motivation with confidence; more investigation is needed

Borrowing: at least 13 signs with a *1* handshape are unambiguously borrowed from ASL or Signed English (WHAT-2, FOR-1, START-2, WEEK, SHOW, BORED-1, ESCAPE, etc.), while at least 20 more signs show a close phonological relationship with ASL forms, but a genetic relationship cannot be firmly established because of phonological changes and possible influence from other languages (e.g., VARIATION, DISCIPLE, TO-ORDER, TECHNICAL, ABOUT-1, etc.); at least two signs are likely borrowed or influenced by British Sign Language (i.e., TRAVEL, BUT [one-handed variant]), while two others could be borrowed from either ASL or BSL (ANNOUNCE, OPPOSITE-2); four signs also are identical or very similar to to several European languages (e.g., BSL, Italian SL, Danish SL, Russian SL) and could be borrowed from one of them or from International Sign (ALSO, SAME, TO-TELL, TO-TALK); there are also at least 15 signs which appear to be very similar cross-linguistically regardless of historical relationship (e.g., TIME, THINK, ME, DOWN, TO-TASTE, TO-CRY-1, etc.); there are 39 signs which are uncertain for origin, and 119 (52%) that are probably indigenous to Kenya or East Africa

Dynamic handshapes: there are 28 signs with dynamic handshapes; 17 of these are opening signs, including one *fist>1* sign (NOVEMBER) and 16 *baby-o-restrained>1* signs (e.g.,

MONTH, MINUTE-2, INVENT-2, MEDICINE, KERICHO); there are ten signs involving the flexion of the index finger at the non-base joints (or “hooking”) (*1>X*; see #6); and one sign with bending at the base joint (or “flattening”), RED-1

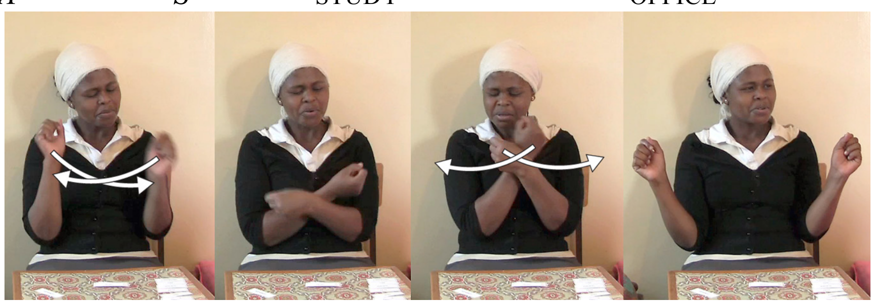
3.	***fist*** ⬭	116 signs



fist *A* *S*

STUDY

OFFICE



IMPOSSIBLE

Minimal pairs: 15 pairs. *fist* contrasts with *flat* in four pairs (e.g., OFFICE and TRUE, SORRY and SCIENCE-1), with *1* in four pairs (e.g., MUMIAS and ONLY-2, SHOES-2 and SAME), with *open* in one pair (see #4), with *X* in one pair (see #6), with *F* in one pair (see #10), with *flat-o* in one pair (see #11), with *L* in one pair (see #14), with *E* in one pair (see #21), with *W* in one pair (see #28)

Variation: *fist* is found in phonetic variation with the handshape *A* with the thumb upright and adjacent to fingers, and the handshape S, with the thumb opposed; described in greater detail in §4.4.2.1 of Chapter 4

Motivated forms:

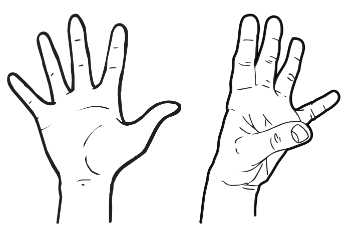
- **Letters**: at least four signs with a fist shape probably originate from a fingerspelled letter: letter S in SCHOOL-SUBJECT, SYLLABUS-1, SYLLABUS-2 and letter A in AUNT-2
- **Numbers**: *fist* indicates the number 5 in the following signs in the database: FIVE, TEN, MAY, OCTOBER; this handshape is derived from one of the manual counting systems used in east Africa (Zaslavsky 1999; Creider 1977)
- **Size/Shape**: in at least a dozen signs, *fist* maps to the shape of an object: a head in in TO-WAKE-UP-1, TO-ENTER-3, AGGRESSIVE, TO-WANDER-2, TO-AGREE-2, ERECTION-2; an egg in EGG-2; jaws in TO-CHEW-1; a breast in GIRL; feces in DEFECATE-1
- **Handling**: in around 35 signs, *fist* depicts gripping or holding; e.g., OFFICE, TO-WASH, HARVEST, REPORTER, CARPENTER, MAIZE-1, MAIZE-3, GROUNDNUT-1, etc.

- **Embodied action**: this handshape is used in the depiction of actions that don't involve gripping or handling in around two dozen signs, including TO-STUDY, TO-RUN-2, TO-FIGHT-1, COLD-1, ABUSE-1, HIT-1, SCHOOL, SOFA, etc.

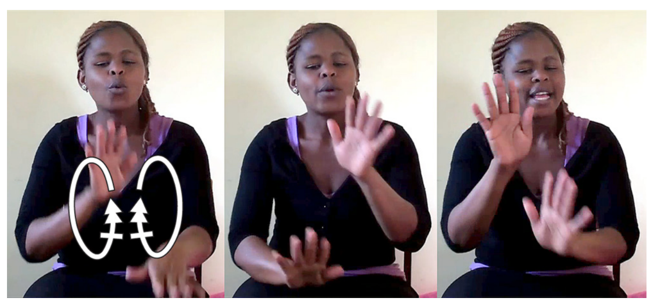
Borrowing: at least eight signs appear to borrowed from ASL or Signed English (e.g., SORRY, LOVE, SAFE, TO-PROTECT, TO-MAKE-1, SHOES-2), with around a dozen more showing a possible relationship to ASL but with altered forms (e.g., TO-DESTROY-3, SUPPORT, AUNT-2); around five are identical to signs in International Sign (e.g., POSSIBLE, IMPOSSIBLE, CAN, CHANGE-1) but may also originate from ASL or another European SL (Swedish SL, Italian SL, British SL, French SL, etc.); in addition, at least a dozen KSL signs have nearly identical forms as found in other sign languages, but appear to be motivated by similar ways of encoding iconic forms rather than a historical relationship between languages (e.g., WHEELBARROW, MOTORCYCLE, COLD, TO-BREAK, TO-STAB, TO-DRIVE)

Dynamic handshapes: there are 37 dynamic handshapes with a *fist*, *A*, or *S* handshape; the majority (30 signs) have an aperture change, with four opening from a fist as in *fist>open* (2 signs; see #4) and *fist>V* (2 signs; see #13), and 26 closing to a fist as in *spray>fist* (16 signs; see #27), *claw>fist* (7 signs; see #5), *V>fist* (1 sign; see #13), and an *A-thumb-lax>A* (2 signs; MAIZE-2, ORANGE-3); there are also seven signs in which the fingers flatten into an *A* in *flat>A* (5 signs; e.g., FROM-1, TO-CALL, WHY-1) and *L>A* (2 signs; see #14)

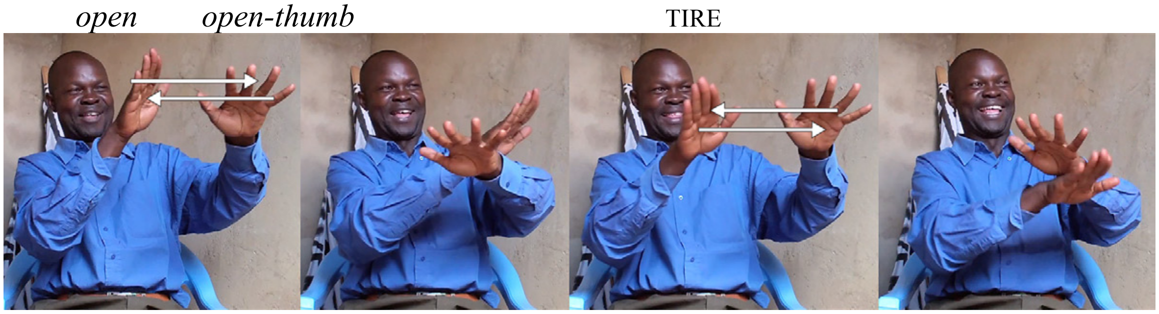
4. ***open*** 80 signs



open *open-thumb*



TIRE



EVERYTHING

Minimal pairs: 11 pairs. *open* contrasts with *1* in three pairs (EVERYTHING and MANY-DIFFERENT-2, PINEAPPLE-1 and HUT-1, DONKEY-2 and COCKROACH) with *fist* in one pair (TO-COPY and RABUON[SWEET-POTATO]), with *X* in one pair (see #6), with *C* in one pair (see #9), with *flat-o* in two-pairs (see #11), with *T* in one pair (see #16), with *B* in two pairs (see #20)

Variation: *open* in three cases can surface as *open-thumb* in order for the hands to make contact with the body (i.e., PROUD-1, PROUD-2, HOLIDAY-2); otherwise, *open* has known variants with the *flat* handshape, which is described in detail in §4.6 in Chapter 4

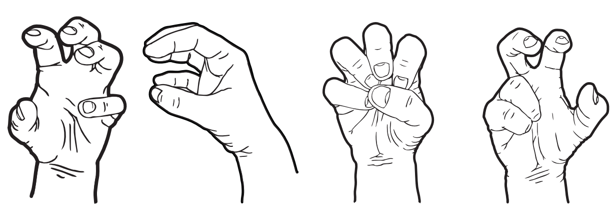
Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: the handshape *open* maps to the size or shape of objects in at least 17 signs; e.g., depiction of straight parallel lines in FENCE-1, NET, GATE, REFUGEE (ribs), SCHEDULE; depiction of a flag in RAKWARO; wings in BIRD-1; a comb in ROOSTER-4; vegetation in PINEAPPLE-1, TREE-1, FOREST-2
- **Handling**: A slight variant on *open* occurs with signs related to clothing in which the thumb and index (or middle) finger—slightly flexed at the based joint—make contact with the body: SKIRT, SWEATER, SOCKS, UNDERPANTS-2, TO-VISIT (derived from 'necktie')
- **Embodied action**: 13 signs; indicates slapping the side of a van in TOUT, covering the face in EMBARRASS and SHY; rolling a tire in TIRE; running in TO-FLEE
- **Note**: around 30 signs with *open* handshapes are unclear for motivation; e.g., EVERYTHING, CONFUSE/DECEIVE, HEALTH, ALWAYS, PEOPLE; though some of these can be explained by the phonetic tendencies, described in §4.6 in Chapter 4

Borrowing: at least 17 signs show evidence of borrowing; these include forms uniquely related to ASL/Signed English (e.g., THINGS, FINE, NEVER-1) as well signs that could have an origin in either ASL/Signed English or a European-related language like BSL, Swedish SL, French SL, or even International SL (e.g., SCHEDULE, ENCOURAGE, FOREST-2); also, several signs have similar forms in genetically unrelated sign languages, which are likely due to common iconic mapping strategies (e.g., BIG, BODY, WIND, FAT).

Dynamic handshapes: there are 38 dynamic handshapes with an *open* handshape; the majority of these—22 signs—feature wiggling/fluttering fingers (e.g., DOG, TO-LIE-1, RANK-2, TAILORING, HOUSEFLY); ten have opening handshape changes, with seven *O>open* (e.g., NOTHING, EXPENSIVE-1, TO-INFORM) and three *fist>open* (TO-INFLUENCE, TO-EXPOSE-2, OR-2); there are two signs with bending at the base joints (*open>bent*; see #7), two with straightening of the base joints (*bent>open*; see #7) one with grasping (*open>open-E*; see #21), and one solely with finger spreading, i.e., TO-SPREAD-1 (*flat>open*)

5.	***claw***	73 signs



claw *claw-narrow* *closed-claw* *V-claw*

BUTTERMILK-1

RICH

JERK

Minimal pairs: 23 pairs. *claw* contrasts with *flat* in six pairs (e.g., METAL-1 and WET, BUSINESS-2 and MAYBE, HOT-2 and SUGAR-1), with *1* in one pair (HAVE-2 and I/ME), with *X* in two pairs (see #6), with *F* in one pair (see #10), with *flat-o* in one pair (see #11), with *A-thumb* in one pair (see #12), with *H* in one pair (see #15), with *i* in one pair (see #18), with *B* in one pair (see #20), with *E* in one pair (see #21), with *Y* in one pair (see #24), with *open-spray* in one pair (see #27), with *W* in one pair (see #28), with *closed-G* in one pair (see #30), with *H-thumb-closed* in one pair (see #42)

Variation: *claw* can vary by the degree of aperture, which is related to the size of a location, as in *claw-narrow* which narrows to the size of the nose in WILLIAM-RUTO or expands to the size of the top of the head in LAMU (see discussion in §4.4.2.3 in Chapter 4); the variant *closed-claw* also does not seem to be different than *claw* because it varies in different tokens (e.g., MANDARIN-ORANGE, OBAMA-3); and another phonetic variant is *V-claw* in which the ring and pinky fingers are more flexed, but without causing a change in meaning (i.e., COMPUTER-MOUSE-1, GOLD-1)

Motivated forms:

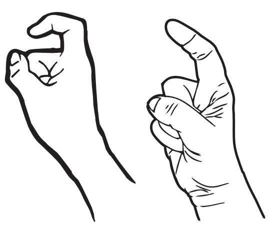
- **Letters**: none
- **Numbers**: none
- **Size/Shape**: mapping to shape of object in at least 15 signs, such as teeth/jaws in BITE-1 and LION; hoofs in ANIMAL-1 and UNGULATE(GRAZER); bubbles in TO-BOIL, headphones in AUDIOLOGY; tines (or blades) in PLOUGH-1, etc.
- **Handling**: at least 15 signs with the *claw* handshape depict handling; however, most of these also depict size and shape properties and/or embodied actions; e.g., SUPERMARKET-1, OBAMA-3, APPLE, BALL-1, PERSON'S-CHILD; i.e., this handshape has a higher proportion of multiple motivations than other handshapes
- **Embodied action**: indicates enactment of physical assault in ABUSE-3, act of holding out an upturned hand in BEG-4 and BEG-5; and rapping on a hard surface with knuckles in METAL and BONE
- **Note**: in addition to many signs with multiple motivations for handshape, there is a high proportion of signs with *claw*, around 30, in which the proximal iconic motivation of the handshape is unclear; e.g., COMPUTER, MATATU, POOR, RICH, COMPLEX; though a subset of these may form a morphological class involving internal states, i.e., UPSET-1(DISTRAUGHT), UPSET-2(ANGRY), UPSET-4(SAD), JEALOUS-2, JERK

Borrowing: only around three signs could be linked uniquely to ASL, though with some phonological changes (ANIMAL-2, LION, COMPLAIN-2), with at least five more having phonological overlap with ASL; three signs probably originate from a sign language in Europe or International Sign (RICH is the same in sign languages of Denmark, Sweden, and

Poland; POOR is highly similar in the languages of Great Britain, France, Italy, and Spain; and SITUATION is the same sign in one component of a compound in Swedish Sign Language); and two signs have the same forms in ASL as well as some sign languages in Europe (RADIO-1 is the same in ASL, BSL, French and Italian SLs; HOT-2 is the same in ASL and French SL and close overlap with BSL); finally, at least two have a high degree of cross-linguistic form-meaning mapping, and probably lack a genetic relationship to another sign language despite phonological similarity: COMPUTER-MOUSE-1, BALL-1

Dynamic handshapes: there are thirteen signs with dynamic handshapes; eleven involve an aperture change (i.e., change in contact with the thumb), from closed to open (*O>claw*; 3 signs; TRACTOR-1, SHOCK-1, PIPE-3) and open to closed (*claw>fist*; 7 signs; e.g., PATIENCE, UGALI-1, TO-MISS, STRUCTURE); and two involve only change in flexion: ORANGE-1 ("hooking") and TO-EXPLOIT (*spray>closed-claw*)

6.	***X***		53 signs



X *1-curved*

REFUSE

SHOP-1

Minimal pairs: 9 pairs. *X* contrasts with *flat* in one pair (NYANG'OMGA-TECHNICAL and MEAT-2), with *fist* in one pair (VANQUISHED and TO-WAKE-UP-1), with *open* in one pair (DRY and ADULT-2), with *claw* in two pairs (CHANGE-2 and COMPLEX, OYUGIS-1 and MBITA), with *bent-V* in one pair (see #22), with *closed-G* in one pair (see #30), with *D* in one pair (see #31), with *mid-bend* in one pair (see #38)

Variation: *X* can vary in the degree of finger flexion, with some sign tokens having a *1-curved* shape (e.g., POTATO, SUDAN-1); however, near-minimal pairs like SUDAN-1 versus HOME-1 suggest that the finger flexion still carries some distinctive weight

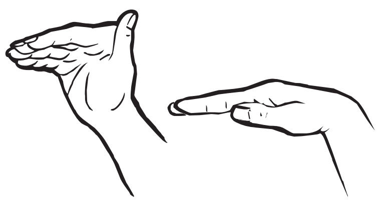
Motivated forms:

- **Letters**: the letter X in two signs: EXECUTIVE-1, EXECUTIVE-2
- **Numbers**: none
- **Size/Shape**: at least 11 signs map handshape to shape of various objects; e.g., beak in CHICKEN, BLACK-KITE-1, tusks in WARTHOG-1, horns in RAM, tools in POTATO-1 and TABAKA-2, and tail in VANQUISHED; one sign is used for three-dimensional tracing, JEALOUS-1, and used for two-dimensional tracing QUESTION, WHY-3, EXAM-2
- **Other**: *X* handshape with a swiping movement indicates "ensnarement" in several signs: RAPE-2, REFUGEE-2, ARREST-2, I.C.C.-2, I.C.C.-3

Borrowing: at least 12 signs have forms suggesting that they have been borrowed from ASL/Signed English or another European sign language like BSL, French SL, or International SL, though most have phonological differences that distinguish them; e.g., QUESTION, CONTROL, CHANGE; a more unambiguous connection to ASL/Signed English are in the signs DONATE, DRY-2, SIN

Dynamic handshapes: there are eleven signs with a dynamic handshape, all of which exhibit bending of the non-base joints (“hooking”) in *1>X*; examples include WHITE, SWAHILI-1, RICE-2, UHURU-KENYATTA, WORSE-2, etc.

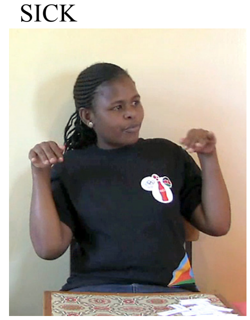
7.	***bent***	53 signs



bent *wrist-bent*

SICK

UNIVERSITY (phonetic variant)



TO-REST

Minimal pairs: 7 pairs. *bent* contrasts with *flat-o* in two pairs (see #11), with *i* in one pair (see #18), with *K* in one pair (see #19), with *G* in one pair (see #26), with *W* in one pair (see #28), with *N* in one pair (see #39)

Variation: the shape *bent* is a phonetic variant of the *flat* handshape at least 9 signs (e.g., UNIVERSITY, DECREASE-2, FLAT-1, FOREVER-1, PAPAYA-1, MORNING, MANGO-1, -1), but there is also evidence for its phonemic status in many other signs, such as TO-ASK, EXAM-4, LAZY-3, JEMBE-2, COBRA; the phonemic status could not be determined of all signs with this handshape (see discussion in §4.6.2 in Chapter 4)

Motivated forms:

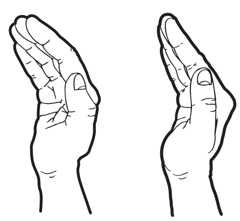
- **Letters**: none
- **Numbers**: none
- **Size/Shape**: mapping to shape of a flat object in at least six signs (e.g., VIDEO-1, SHEEP-2, UNIVERSITY, BLOOD-1); mapping to a bent object in two signs (COBRA, JEMBE-2); used to trace the three-dimensional shape of a curved surface in three signs (e.g., CAMEL-1, FUNDING, JUDGE)
- **Embodied action**: in at least seven signs, *bent* indicates embodied action (e.g., SICK, TO-TOUCH, TO-ASK, TO-BOTHER, LAZY-3)

- **Other:** at least nine signs with *bent* handshapes indicate some type of delineation; this is discussed in §4.6.3

Borrowing: at least 11 signs show unique relatedness to ASL/Signed English even though they may have some altered phonological properties (e.g., TIRED, WEAK-2, HAVE-1, LIMIT-1, MILLION-3); two other signs have a possible origin in British SL (JUDGE [N.], EFFECT-1) and a few share similar forms, but also have a high degree of similarity across unrelated sign languages, suggesting a common iconic but not genetic origin (e.g., SEPARATE, CAMEL-1, ADULT)

Dynamic handshapes: there are twelve signs with a dynamic handshape, all of which involve flexion of the base joints; eight signs have bending ("flattening") during the sign including six that are *flat>bent* (e.g., TO-WANT, TO-COME-2) and two that are *open>bent* (CAT, LEOPARD-2); and six signs exhibit "straightening" during the sign including two that are *bent>flat* (TO-GROW-UP, TO-SEND-1) and two that are *bent>open* (LOST, EMPTY-4); note that handshape change in each of these signs can be interpreted as an underlying path shape, with bending at the base joints as a way to produce the sign with maximum articulatory ease (see van der Kooij 2002)

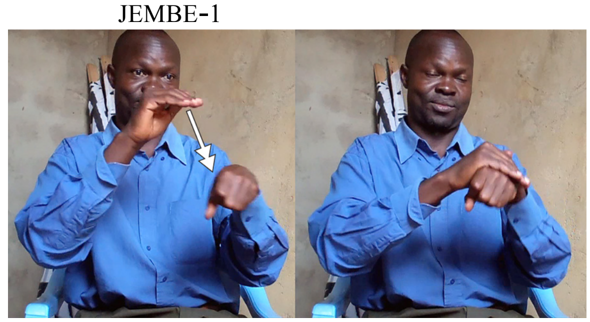
8.	***curved***		43 signs



curved *cupped*

JEMBE-1

BABY-3



GOOD

Minimal pairs: 0 pairs. One near-minimal pair, KEEP and BANK-2, is discussed in §4.2.4 in Chapter 4

Variation: *curved* is a phonetic form with all fingers flexed and the thumb upright and adducted to the radial side of the hand (e.g., JEMBE-1); *cupped* is similar but has flexion mainly in the base joints, similar to *bent* (e.g., GOOD); there are about seven signs with *cupped*/*curved* that may be considered phonetic instantiations of a flat hand and three of these have *flat* handshape variants (BAD-1, GOOD, MURANG'A [town name]); in one sign, BISCUIT-1, the *curved* handshape is a phonetic outcome of contacting the body with all fingertips in a row; future investigation into the distinctiveness of *curved* is warranted

Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: in nine signs, the handshape *curved/cupped* maps to the shape of an object (e.g., SHOVEL-1, JEMBE-1, TO-SHAVE-2, RAZOR-BLADE, THATCH, BISCUIT-1); in nine other signs, it is used to trace the three-dimensional shape of a curved surface (e.g., CAR-1, PREGNANT, TOWN, CITY, MOUNTAIN-3, POWER, POT/JUG-1)
- **Handling**: in at least ten signs, *curved* indicates holding or cupping an object (e.g., BATHE-1, KEEP, KIDNAP-2, COLLECT, SATURDAY-2)
- **Embodied action**: *curved* depicts an embodied action in one sign, TO-HEAR-1

Borrowing: nearly all signs with this handshape have a Kenyan origin; there only around three from ASL/Signed English: POWER, COLLECT, ENGLISH-1; FLOWER-3 shares the same movement and location, but the handshape has been altered from *flat-o* in ASL

Dynamic handshapes: none

9.	*C*		39 signs

DIPLOMA-2

GET-1

Minimal pairs: 11 pairs. *C* contrasts with *1* in one pair (CHRISTIAN-1 and SISTER-2), with *open* in one pair (CHEMISTRY and HIVI-HIVI [‘kinda-sorta’]), with *T* in one pair (see #16), with *open-curved* in one pair (see #17), with *i* in one pair (see #18), with *K* in one pair (see #19), with *B* in one pair (see #20), with *small-C* in one pair (see #23), with *G* in one pair (see #26), with *D* in one pair (see #31), with *N* in one pair (see #39)

Variation: *C* is found in 10 variants in which the curved *C* hand actually grips a body part (wrist, lower-arm, upper-arm, or neck); therefore, there is usually some non-distinctive minor change in joint flexion at the beginning and end of the sign (e.g., GET-1, BRACELET-2, CONDOM-3, SOCIAL-STUDIES-1, I.C.C.-2); in addition, there can also be some variation in spreading of the fingers

Motivated forms:

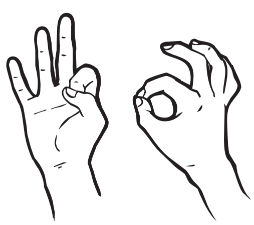
- **Letters**: this handshape represents the letter C in at least 12 signs, including CHURCH, CONSTITUTION, COMPOSITION, CONCEPT, CANADA, CLASS-2, COUSIN; the motivation in four signs is uncertain because there are other possible reasons for the shape of the *C* handshape (CUP-1, COACH-1, COUNCILLOR-2, COMMUNITY-2), though there is no reason to believe that handshapes could not have more than one motivation

- **Numbers**: none
- **Size/Shape**: the *C* handshape traces the rounded/cylindrical shape of an object in at least six signs (e.g., FLOUR-BAG-1, BOTTLE-1, FOX-1, HIPPOPOTAMUS-1); however at least a dozen other signs have multiple possible motivations, of which properties of size and shape is only one motivation (e.g., CONDOM-1, SOCKS-1, LAB, BINOCULARS)
- **Handling**: the *C* handshape is used in mappings that involve holding or gripping in at least 20 signs (51%); this sometimes involves actually gripping a body part (e.g., GET-1, BRACELET, SOCKS-1, COACH-2) and sometimes holding/gripping an imagined object (e.g., DIPLOMA, CUP-1, LAB, BINOCULORS)
- **Embodied action**: none

Borrowing: at least five signs are from ASL or Signed English: CHURCH-3, CHRISTIAN-1, PICTURE-1, CONCEPT, and probably CONSTITUTION; a few signs have shared forms with other sign languages, but high "universality"—i.e., unrelated sign languages also share the same or highly similar forms; e.g., DRINK, GIRAFFE, BOTTLE-1, BINOCULORS

Dynamic handshapes: five signs with this handshape involve gripping a body part, with a minor, phonetic change in flexion of the fingers; only one sign, COAST-2, has a distinct change from one shape to another that doesn't involve gripping: *C*>*O*

10.	***F***		38 signs



F *F-curved*

VEGETABLE

DEPENDS

Minimal pairs: 9 pairs. *F* contrasts with *1* in two pairs (IF-1 and RUN-1, EIGHT-1 and SIX-1), with *fist* in one pair (PUMKIN-LEAF and TO-HARVEST), with *claw* in one pair (FRESH and GOLD-1), with *A-thumb* in one pair (see #12), with *open-curved* in one pair (see #17), with *i* in one pair (see #18), with *B* in one pair (see #20), with *Y* in one pair (see #24)

Variation: *F* is found in lexical variants with the handshapes *F-curved* in OWNER, SURPRISE-2, FAMILY-2, TEA-1, TAITA (ethno-linguistic group)

Motivated forms:

- **Letters**: the *F* handshape represents the letter 'F' in at least seven signs, including FRUIT, FREE, FAMILY-2, FEEL-2, FOR-3, FUTURE-2, but it is unclear in six other signs whether the handshape is a letter, a handling classifier, is borrowed without reference to a letter, or is morphologically-derived from another sign; e.g., FRANCE, FRESH, FASHION, TO-FAST, IF-1, OFFICIAL
- **Numbers**: represents the number three in THREE, EIGHT, MARCH, and AUGUST
- **Gesture:** *F* occurs in a sign originating from the "okay" gesture: PERFECT-2 (it also occurs in a compound not included in the phonological analysis: HANDSOME (FACE^PERFECT)

- **Size/Shape**: mapping to shape of eye in SURPRISE-2; mapping to null/zero in ZERO
- **Handling**: in around 15 signs, the *F* indicates handling, with either a more proximal iconic mapping (VEGETABLE, TEA-1, BRAID-2, PUMPKIN-LEAF) or a more abstract or metaphorical mapping (DEPENDS, TO-JUDGE, TO-FAST, TO-DECIDE)
- **Embodied action**: the sign PERFECT-2 originates from a gesture meaning "okay"; also the sign TO-DANCE my depict an embodied action

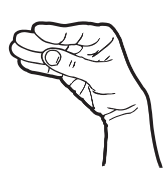
Borrowing: at least seven signs bear a resemblance to European sign languages like German SL, French SL, Italian SL, Polish SL, Russian SL, and/or ASL: TO-JUDGE, FREE, FRANCE, TO-ALLOW (TO-ALLOW in KSL is identical in the Russian language family)

Note: The evidence for which fingers are the "selected fingers" in KSL's *F* handshape is mixed because contact is allowed with either the open fingers (middle, ring, pinky) or the closed fingers (thumb, index). Some sign languages highly prefer (or require) contact with only one set of these fingers—those that are either open or closed (Klima & Bellugi 1979: 157). The possible reason for a lack of preference in KSL (which has been confirmed with KSL signers) is influence from both the KSL manual numbering system, in which extended fingers in the THREE handshape (i.e., *F*) makes contact on the non-dominant hand, in addition to borrowings from ASL/Signed English with thumb+index contact. Examples of signs with extended finger contact: EIGHT, AUGUST, SERIOUS-2, FOR-3, FAMILY-2, and individual signnames not in the KSL Lexical Database. Signs having contact with the closed fingers are both borrowed (e.g., TO-INTERPRET, TO-DECIDE) and indigenous to KSL (e.g., PUMPKIN-LEAF, TAITA, MWAI-KIBAKI, FEEL-2).

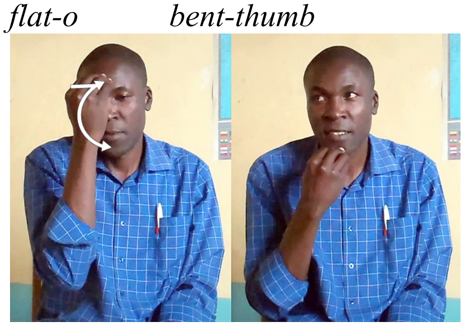
Dynamic handshapes: there are eight signs with dynamic handshapes; in six signs, the thumb and index are parted and then close during the sign (*open-F*>*F*; e.g., GRAMMAR, CONNECT, CHOOSE-1, OLYMPICS) and in one sign the index and thumb open up (*F*>*open-F*; ARROW); in addition, one sign changes from *O* to *F*: IF-2

11.	***flat-o***	37 signs


flat-o


bent-thumb


MEETING-2



PRETEND-1 RIOSIRI (market)

Minimal pairs: 15 pairs. *flat-o* contrasts with *flat* in one pair (FOOD and FUNERAL-1), with *fist* in one pair (TO-MEET and TEN), with *open* in two pairs (ECONOMY and TO-INTERACT, PLASTIC-2 and TO-SIGN), with *claw* in two pairs (FOOD and APPLE, RIOSIRI and OPULENT), with *bent* in two pairs (MEETING and EQUAL-1, HOME-2 and SIAYA), with *H* in one pair (FOOD and SPOON-1), with *i* in one pair (HOME-2 and NAKURU), with *bent-V* in one pair (PRETEND-1 and GOAT-1), with *Y* in one pair (RIOSIRI and PLAY-3), with *D* in one pair (MEETING and DATE-2), with *closed-G* in one pair (EAT-3 and CHIPS-2), with *N* in one pair (HOME-3 and NINA-DEAF-UNIT)

Variation: when a *flat-o* is inserted into a *C* handshape on the non-dominant hand, in the signs IN and VOTE, the fingers become flatter; i.e., the *bent-thumb* shape

Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: none
- **Handling**: *flat-o* almost exclusively depicts handling (31 out of 37 signs), whether with more proximal semantics (TO-PICK-UP, ELECTION, FOOD) or iconic mappings that are more removed/metaphorical (TO-TEACH, LONG, MEMORY, TO-EMBELLISH).
- **Embodied action**: none
- **Note**: only six signs are unclear for any motivation related to handshape: AGAIN, PERCENT, PRETEND, FIGURE-OUT, MEET, MEETING

Borrowing: the *flat-o* appears in signs borrowed from ASL or Signed English that also have a *flat-o*, such as HOME-2 and NUMBER-2 (both of these are in free variation with Kenyan synonyms) and PERCENT-2, but it also appears in signs possibly borrowed from ASL/Signed English without a *flat-o*: AGAIN, VOTE; there are at least six signs with phonological forms that are shared with ASL, but may not be borrowed because they are highly similar across genetically-unrelated languages; e.g., FOOD, EAT-1, MOVE, LEARN-1, BANANA, IN. Otherwise, the majority appear to be indigenous to Kenya (PRETEND-1, ECONOMY, TO-MEET, SCRATCHCARD, ELECTION, TICKET, CORRUPTION, etc.)

Dynamic handshapes: there are 44 signs with *flat-o* in handshape change; nearly all of these are aperture changes, with 33 open-to-closed aperture (*spray>flat-o*), 5 closed-to-open (flat-o>spray), and 5 "return" or "reflection" signs (*spray>flat-o>spray*) (see *open-spray* #27); the last dynamic handshape is *flat-o>flat* in TO-GIVE-1

12. ***A-thumb***	36 signs


A-thumb


A-thumb-lax


NICE


NOT-YET ("BADO")

Minimal pairs: 4 pairs. *A-thumb* contrasts with *flat* in one pair (PROUD-3 and TO-VISIT), with *claw* in one pair (PROUD-3 and UPSET-2), with *F* in one pair (NEVER-3 and VEGETABLE), with *L* in one pair (DANGER-2 and JEANS); an extended thumb also exhibits some contrastive potential in the near-minimal pairs TO-LIVE-1 (*A-thumb*) and BOSS-1 (*S* handshape)

Variation: *A-thumb* sometimes appears with barely-flexed fingers in *A-thumb-lax*, as in PROUD/PRIDE-3) and in phonetic variants of BRITAIN and NICE; it can also vary with a *Y* handshape in some signs, such as INTERVIEW and DIRTY

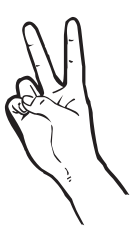
Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: object depictions are few and are idiosyncratic: shape of stalk in MUSHROOM-2, shape of rod in UMBRELLA-3, shape of knife in CIRCUMCISION(MALE)-2
- **Handling**: *A-thumb* indicates handling via gripping in two signs MILK-2 and PROSTITUTE, and handling via pressing with the thumbs in at least four signs: STAMP, LETTER-2, POSTER, TO-REMEMBER
- **Embodied action**: one sign, WELL/ SAWA, derives from a 'thumbs-up' gesture
- **Note**: a high proportion of signs with *A-thumb*, 52% or 19 signs, are unclear for motivation in handshape

Borrowing: unlike other handshapes, only a minority of signs with *A-thumb* handshape have a likely Kenyan origin (i.e., 11 signs or 30%), while the others are either borrowed or show similarities to foreign signs; of those that are likely borrowed, eight are uniquely from ASL or Signed English (e.g., OTHER, DANGER-2, PROUD/PRIDE-3, REMEMBER-2, CONTINUE-2), one sign is the same in BSL (PROBLEM), one is the same in both ASL and BSL (LETTER-2), two share properties of European sign languages (SPORTS is the same in not only ASL, but also German, Italian, Swedish, and many other sign languages; PRIVATE/SECRET, is the same or very similar in Russian, Polish, Estonian, Latvian, and Lithuanian SLs), and at least seven more have a degree of phonological overlap that may or may not be the result of some kind of borrowing: e.g., POSTER, INTERVIEW-1, SYSTEM-1, SCIENCE-2

Dynamic handshapes: there are six signs with handshape changes; three involve the closing of the fingers into the palm: *flat*>*A-thumb* in TO-FORGET and BEST, and *open-curved*>*A-thumb* in TO-KIDNAP; in the other three, the thumb alone bends: i.e., SMS, SWEETHEART-2, TORTOISE

13.	***V***		31 signs



ATTITUDE

HOTELLI (RESTAURANT)

Minimal pairs: 3 pairs. *V* contrasts with *flat* in one pair (VAGINA-2 and CAR-2), with *1* in one pair (VERB and TOMORROW), with *B* in one pair (VERB and TO-GOSSIP)

Variation: *V* can be found with some slight variation in joint flexion, though never when the relative orientation is [fingertips] (e.g., MEANING, PROJECT); when representing the number two, *H* can be "stacked"—i.e., the fingers can be offset, as in *K*.

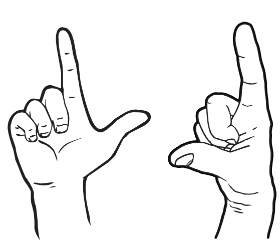
Motivated forms:

- **Letters**: the letter 'V' in at least four signs VERY-1, VOCATIONAL, VERB, VOICE; it may also represent a letter in three variants of VAGINA and in VISION, but there are also potential iconic motivations for those signs
- **Numbers**: number two in TWO, SEVEN, FEBRUARY, JULY, DEPUTY-HEADMASTER-2, BOTH-1, BOTH-2
- **Size/Shape**: mapping to shape of legs in TO-STAND, TO-WALK-1, FALL; indicates eyes in ATTITUDE, SEEM, VISION, LEARN-3; a fork in HOTELLI (RESTAURANT); a bottle-opener in SODA-2; stripes in ZEBRA-1, POLICE-BOSS; AND outline of body part in VAGINA-2, -3, -4
- **Handling**: *V* depicts handling in at least six signs; e.g., TO-FIX, CIGARETTE, BHANG-2 (cannabis)
- **Embodied action**: none

Borrowing: at least seven signs are borrowed, with four from ASL (MEANING, VOICE, VERY-1, STUCK/TRAPPED), one from either ASL or BSL (BOTH-1), one from Danish SL or a related language (PROJECT), and one from a European origin, although the exact source is not known because of shared similarity with a few languages (RESTAURANT; identical to sign languages from Germany, Iceland, Turkey and similar to Italian Sign Language); there are also at least three signs that appear to be very close in articulation across multiple unrelated sign languages and therefore not necessarily borrowed, but likely innovated in Kenya: TO-STAND, TO-FALL, TO-WALK-1

Dynamic handshapes: there are eleven signs with dynamic handshapes; in four signs the fingers hook from *V* to *bent-V* (see #22); in one sign, TO-WALK-1, the fingers flutter/wiggle alternatingly; in one sign, PICKPOCKET, the fingers "un-spread" (*V*>*H*); in another sign, TO-STEAL-1, the fingers close from *V* to *fist*; and in three other signs the handshapes represent sequential letters or numbers: TWENTY (*V*>*O*), DECEMBER (*fist*>*V*), and TELEVISION (*T*>*V*)

14.	***L***	ꝺ	30 signs



L *open-G*

LORRY-2

TROUSERS-3

Minimal pairs: 4 pairs. *L* contrasts with *flat* in one pair (LAW and WATCHMAN), with *fist* in one pair (LESSON-4 and SCHOOL-SUBJECT), with *A-thumb* in one pair (JEANS and DANGER-2), with *B* in one pair (LANCE-DEAF-ORPHANS and BOARD-OF-GOVERNORS)

Variation: the thumb in *L* can move into a more opposed position—an *open-G* handshape—for purposes of ease-of-articulation during contact with the body; this happens either predictably in certain signs, such as in SAMOSA-1, SAMOSA-3, VAGINA-1, or in occasional tokens, such as in COW and TO-LIVE-2 (note that when *open-G* occurs in a dynamic sign, it is not an allophone of *L* but of *closed-G*)

Motivated forms:

- **Letters**: the letter 'L' in at least 16 signs: LAW, LUCK, LODGE-1, LORRY/TRUCK, LUNCH-2, LANGUAGE, LAMBWE, LIBYA
- **Numbers**: none
- **Size/Shape**: depicts the shape of horns in COW-1, to shape of nozzle in PETROL-1, shape of plough or blades in PLOUGH-2; mapping to an outlined shape in SAMOSA-1, SAMOSA-3, VAGINA-1, CERTIFICATE
- **Handling**: none
- **Embodied action**: none

Borrowing: at least four are borrowed; LIFE-2, TO-LIVE, and LUNCH originate specifically from Signed English, while LANGUAGE may originate from either ASL/Signed English or BSL; about five other signs show some overlap with signs from ASL or Signed English; e.g., SLOW-3, CERTIFICATE-3, LESSON-4

Dynamic handshapes: there are five signs with dynamic handshapes; in two signs the index finger in *L* closes into the palm (*L*>*A* in BECAUSE-1, BOSS-3); in another sign, a *flat* handshape changes into an *L* (*flat*>*L* in SELFISH-2); in the sign CAMERA, the index finger of *open-G* "hooks" repeatedly, while the thumb remains straight; and finally, the sign BLOOD-TEST-3 changes from *L* to *bent-L* (see #34)

15.	***H***	☝	29 signs

H

bent-H

NORMAL

YOGHURT-2

KURIA (ethno-linguistic group)

Minimal pairs: 7 pairs. *H* contrasts with *flat* in one pair (FUNERAL-1 and SPOON-1), with *1* in one pair (TUESDAY and TURKANA), with *claw* in one pair (SPOON-1 and APPLE), with *flat-o* in one pair (SPOON-1 and FOOD), with *bent-V* in one pair (TUESDAY and TO-LAUGH), with *small-C* in one pair (TUESDAY and LUO-1), and with *Y* in one pair (POLICE and IGNORANT)

Variation: *H* is found in one sign, CHIAR, with the handshape *bent-H*, in which the base joints are bent, with no change in meaning; also, the position of the thumb can vary in some tokens—it doesn't always have to be in a restraining position across the closed fingers (e.g., USE, YOGHURT-2)

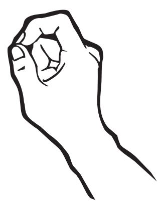
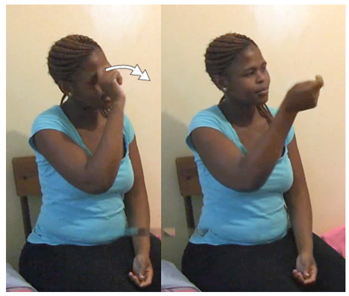
Motivated forms:

- **Letters**: the letter 'H' in HIGH-2, HOLY, QUALITY-2; the letter 'U' in USE, US-2, UNCLE-2. Other signs may be borrowed initialized signs, but with simplified joint specifications: from *R* in RESPONSIBLE; from *N* in NIGERIA-2; from K in CARE-2
- **Numbers**: none
- **Size/Shape**: depicts the size and/or shape of an object in at least eight signs; e.g., shape of spoon in SPOON-1, SPOON-2, YOGHURT-2; depicts legs in in TO-SIT, CHAIR; to small card (SIM card) in PHONELINE-3; and adornment/jewelry in KURIA and SAMBURU
- **Handling**: none
- **Embodied action**: represents a gesture made by police in the sign POLICE; also, the sign TUESDAY may reference an activity in oralist pedagogy whereby aspirated [t^h] is detected by putting the fingers to the lips during pronunciation (a similar type of origin as MONDAY; see §1.3.1 in Chapter 1)

Borrowing: two signs with this handshape are borrowed from ASL, though they are used alongside well-established, indigenous KSL synonyms: NAME-2, EGG-3. Other borrowings from ASL/Signed English or other European sign languages include: SOON, UNCLE-2, HOLY, USE, US-2, HOSPITAL.

Dynamic handshapes: this handshape participates in three signs with dynamic handshapes; two involve the alternating fluttering of the fingers, in EAT-2 and SNAKE-1, and one involves the "un-spreading" of the fingers, *V>H*, in PICKPOCKET

16.	***T***		28 signs


T *baby-o* RESPECT TANZANIA-2

Minimal pairs: 5 pairs. *T* contrasts with *1* in one pair (KENYA-1 and FIRST), with *open* in one pair (SIGNED-EXACT-ENGLISH and TO-RECORD), *C* in one pair (TRIBE and COMMUNITY-1), *G* in one pair (TRIBE and GROUP-2), *uganda* in one pair (TO-RECORD and AIRPORT-3)

Variation: *T* is found in different lexical variants with the handshapes *baby-o*, which varies by whether the thumb contacts the pad of the index finger (*baby-o*) or contacts the second joint from the tip (*T*); *T* can also vary with *fist-stacked* if the thumb contacts the radial side of the index finger more than the front/palm side, but more information is needed to know whether *T* and *fist-stacked* could be allophones of each other

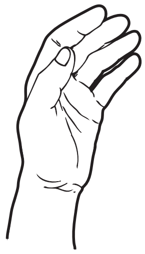
Motivated forms:

- **Letters**: 'T' in three signs: TANZANIA-2, TRIBE-1, TELEVISION
- **Numbers**: none
- **Size/Shape**: none
- **Handling**: *T/baby-o* indicates handling in the overwhelming majority of signs—in 24 out of 28 signs; these include more semantically direct mappings such as BELL, SHOES-1, WRITE-1, MEAT-3, TO-LOCK-1, as well as more abstract semantics, such as RESPECT, HARAMBEE (a kind of cooperative/collective enterprise/fundraising), LIMURU (a town), and WITCHCRAFT-2
- **Embodied action**: none

Borrowing: only one sign is clearly borrowed from ASL: EXACT; there is also a similar sign for RESPECT in some European sign languages (e.g., sign languages of Italy, Austria, Romania, Bulgaria) but it's not clear whether it is borrowed or originated independently in Kenya

Dynamic handshapes: there are eleven signs with dynamic handshapes related to *T*; this includes eight signs in which the index finger is slightly extended and then closes to a *T* (e.g., MILK-1, TUMU-TUMU, RECENT-1, SMS-1), two signs with *bent-L>T* (see #34), and one sign involving two distinct handshapes, *T>V* in TELEVISION

17.	***open-curved***		26 signs



HAWKER-1

FORCE

Minimal pairs: 2 pairs. *open-curved* contrasts with *C* in one pair (WORLD-1 and COMMUNITY) and with *F* in one pair (COMPOUND and FAMILY)

Variation: *open-curved* differs from *open-spray* by only the flexion of the non-base joints and some phonetic variation is found between these shapes; *open-curved* is also similar to *claw*, with some phonetic variation acceptable between them; however, there are also many signs with either handshape that cannot replace one with the other

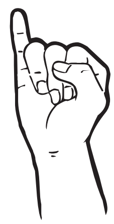
Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: *open-curved* depicts properties of object size and shape in least ten signs, including a curved hat in NURSE, objects with multiple prongs or sub-parts in five signs, i.e., those with 'teeth' (RAKE, TO-FARM, CROCODILE), a woven net (FISHING-NET-3), and raindrops (RAIN); *open-curved* also depicts the shape of round or curved objects (real or metaphorical) in four signs by a traced path; e.g., WORLD-1, HILL, COMPOUND, and ORGANIZATION-3
- **Handling**: the *open-curved* handshape represents holding or handling in at least eleven signs; e.g., CARRY, BRING, HAWKER-1, HAWKER-2, SUNEKA-1 (town), HEAVY, FORCE, COCONUT-1, KILIFI, (town), CATCH(BALL)
- **Embodied action**: represents embodied action in STONE, in which a person knocks their knuckles against a hard object

Borrowing: No signs with this handshape are conclusively borrowed. Several signs have identical phonological forms in other sign languages, but the striking similarities across multiple unrelated sign languages suggests that they are not genetically related, but rather independently utilize very similar form-meaning mappings; i.e., RAIN, HEAVY, WORLD-1, CARRY, BRING, HILL, COCONUT, CROCODILE (see https://spreadthesign.com)

Dynamic handshapes: none

18.	***i***	⅃5	25 signs



OMENA-2

INVOLVE

CLEAN/TO-CLEAN

Minimal pairs: 12 pairs. *i* contrasts with *flat* in 5 pairs (e.g., CLEAN and BASI/ONLY, ENJOY and BEHAVIOUR), with *claw* in x one pair (TO-INVOLVE and SITUATION), with *bent* in one pair (NAKURU and SIAYA), with *C* in one pair (INSHA and COMPOSITION), with *F* in one pair (TRY and FREE), with *flat-o* in one pair (NAKURU and HOME-2), with *W* in one pair (TO-INVOLVE and FORK-2), with *N* in one pair (NAKURU and NINA-DEAF-UNIT)

Variation: *i* is found in different lexical variants with the handshapes *bent-i* (in MARRY-1) and when the base fingers of the pinky are bent, as in NAKURU

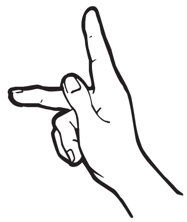
Motivated forms:

- **Letters**: the letter 'I' in at least six signs IDEA, INDIVIDUAL, INVOLVE, ISIOLO, ITEN-1, INSHA (Swahili composition class); the letter 'J' in JOB (and 'Z' in ZIWANI [deaf school], but only via a traced path movement, not handshape)
- **Numbers**: none
- **Size/Shape**: mapping to shape of small herring-like fish in OMENA-1, OMENA-2, SATURDAY-1; to tusks in WARTHOG-3, to hair in BRAID-1; to stream of liquid in URINATE-2, to thin body in THIN-3
- **Handling**: unsure; *bent-i* depicts a metaphor for linking in TO-MARRY with the pinky fingers gripping each other; however, it may also represent the (metaphorical) binding material itself
- **Embodied action**: none

Borrowing: at least three from ASL/Signed English: IDEA, INDIVIDUAL, END (likely a semantic shift from the sign FINAL in ASL)

Dynamic handshapes: none, although there is some phonetic change in flexion during the articulation of TO-MARRY as the pinkies grip each other

19.	***K***	2 \ 3	24 signs




KAREN (school/district)

COMPLAIN-3

Minimal pairs: 8 pairs. *K* contrasts with *flat* in one pair (PERFECT-1 and PROVINCE-1), with *1* in two pairs (TO-FEEL-1 and MYSELF, KING and SISTER-2), with *bent* in one pair (KAREN and HEADTEACHER-1), with *C* in one pair (KING and CHRISTIAN-1), with *G* in one pair (KAREN and GOVERNMENT-1), with *R* in one pair (PLACE-1 and ROOM-2), and with *N* in one pair (KING and NYANGWESO)

Variation: when the middle finger in *K* makes contact with the torso, the thumb can be slightly extended outward rather than maintaining contact at the base of the middle finger; e.g., in K.I.S.E. and in TO-FEEL-1

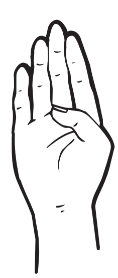
Motivated forms:

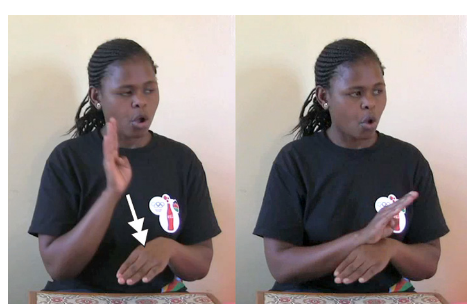
- **Letters**: most signs (at least 19) with the *K* handshape are initialized, including ten representing the letter 'K' (e.g., KING, KAREN, KILONZO-MUSYOKA, KISUMU-2, KISII-2, KOMOTOBO), and nine representing the letter 'P' (e.g., POISON, PROVINCE-1, PERFECT-1, PINK, PHYSICS, PILSNER-1)
- **Numbers**: none
- **Size/Shape**: the *K* handshape depicts an open beak in ROOSTER-3 and its derived sign COMPLAIN-3; no other motivations of this kind were identified
- **Embodied action**: none

Borrowing: only three are identical to ASL or Signed English: KING, PINK, PARENTS-3, while a few others likely have roots in ASL, but have been altered in some way: FEEL-1 (changed in KSL to *K* from *mid-bend* [a.k.a. "open-8"] in ASL), PERFECT-1, PLACE-1. The sign for K.I.S.E. (Kenyan Institute of Special Education) is said to originate from the name sign for Denmark, who funded the establishment of the institute, though the handshape has been changed from *V-L* to *K*.

Dynamic handshapes: none (but see note on '*snap*' handshape at the end of the Appendix)

20.	***B***	▢	22 signs





GOSSIP BONDO-2 (town name)

Minimal pairs: 10 pairs. *B* contrasts with *1* in one pair (GOSSIP and TOMORROW1), with *open* in two pairs (BUNGOMA and ROOSTER-4, BOTSWANA and CHARITY-NGILU), with *claw* in one pair (BLUE-2 and GOLD-1), with *C* in one pair (BIBLE-1 and CONSTITUTION), with *F* in one pair (BLUE-2 and FRESH), with *V* in one pair (GOSSIP and VERB), with *L* in one pair (BOARD-OF-GOVERNORS and LANCE-DEAF-ORPHANS), with *Y* in one pair (BLUE-2 and YELLOW-2), and with *H-thumb-closed* in one pair (BLUE-2 and KIKUYU-2)

Variation: *B* occurs in one sign in which the fingers curve to trace the curved path of a moustache in MUSALIA-MUDAVADI (Kenyan politician)

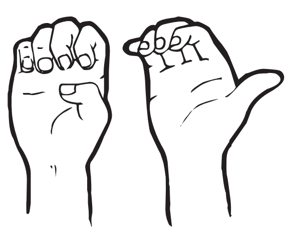
Motivated forms:

- **Letters**: the letter 'B' in at least four signs (BIBLE-1, BLUE-2, BOARD-OF-GOVERNORS, BONDO-2) and possibly two others (BUNGOMA [town], BUSY), though this must be verified with signers
- **Numbers**: none
- **Size/Shape**: at least five signs; depicts shape of ears in DONKEY-1 and OBAMA-1, to a card in REFEREE-3, to a foot in TO-SACK-2, and to flat doors in TO-CLOSE-1
- **Handling**: in one sign, *B* indicates handling a ball: GOALIE
- **Embodied action**: two signs: GOSSIP-1, AS-FAR-THE-EYE-CAN-SEE

Borrowing: four signs are conclusively borrowed from ASL/Signed English (BIBLE-1, BOARD-OF-GOVERNORS, BUSY, BLUE-2); a few others are uncertain for origin (ENOUGH, GOALKEEPER, TO-CLOSE-1) or are Kenyan in origin

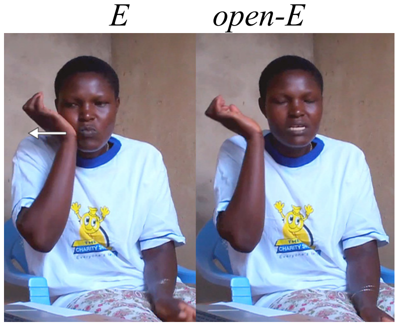
Dynamic handshapes: none

21.	***E***		21 signs

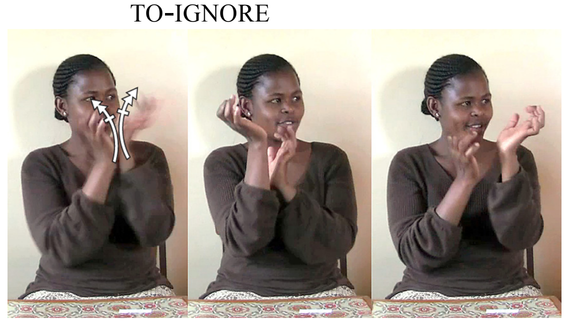


E *open-E*

TO-IGNORE



TART/BITTER



GEOGRAPHY/SOCIAL-STUDIES

Minimal pairs: 3 pairs. *E* contrasts with *1* in one pairs (BUBU [Swahili word for 'mute', used derogatorily] and DEAF-2), with *fist* in one pair (MACHAKOS [town, deaf school] and TO-FIGHT-3), with *claw* in one pair (BUBU and COLLEGE-1)

Variation: *E* varies with *open-E* with an outward thumb (in GEOGRAPHY/SOCIAL-STUDIES, NEED, ELDORET, etc.), both of which are found in environments where the heel of the hand makes contact with the body (in BONDO-1, TART/BITTER, LAZY-1, BUBU, PRISON, ELDORET, IGNORE)

Motivated forms:

- **Letters**: the letter 'E' in four signs: ETHIOPIA, EDUCATION-2, EAST, EVANGELICAL
- **Numbers**: none
- **Size/Shape**: depicts the shape of an adze in KAMBA (ethnolinguistic group) and MACHAKOS (town name), and the shape of bones poking through the skin in and THIN(ANIMAL) (and possibly AIDS-2)
- **Handling**: *E* or *open-E* indicates cupping/holding in PORRIDGE and probably BUSINESS-1 and NEED
- **Embodied action**: at least one sign with *E* indicates a gestural action: LAZY-1 depicts a posture in which a person rests their head on their hand

Borrowing: There are two three borrowed from ASL or Signed English, EAST, EVANGELICAL, EXAMPLE-1, with some phonological changes to EXAMPLE-1

Dynamic handshapes: *E/open-E* is found in one sign in which the handshape changes: TO-GREET changes from *open* to *open-E* as the hands clasp each other

22.	***bent-V***	18 signs

TO-LAUGH

TO-SEE-1

STONE-DEAF

Minimal pairs: 9 pairs. *bent-V* contrasts with *flat* in one sign (ORAL and OIL-1), with *1* in one sign (LAUGH and TURKANA), with *flat-o* in one sign (GOAT-1 and PRETEND-1), with *X* in one sign (CONTACT and PAIN-1), with *small-C* (LAUGH and LUO-1), with *H* (LAUGH and TUESDAY), with *W* (CHIPS-1 and FORK-1), with *D* (INVIGILATE and DUTY-TEACHER), and with *mid-bend* (CONTACT and EMAIL-1)

Variation: the degree of finger flexion can vary from loosely flexed (TO-LAUGH) to highly flexed (STONE-DEAF, TO-KNEEL), but with no difference in meaning

Motivated forms:

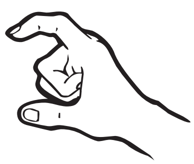
- **Letters**: none
- **Numbers**: none

- **Size/Shape**: mapping to legs in TO-ALIGHT(DISEMBARK), TO-BOARD(GET-INTO), TO-KNEEL; mapping to animal appendages in SCORPION, GOAT-2, GAZELLE-2; mapping to teeth in DIE-5
- **Other**: *bent-V* appears in several signs related to vision: TO-SEE-1, TO-LOOK-FOR, AWAKE, TO-CONTACT, TO-INVIGILATE/PROCTOR

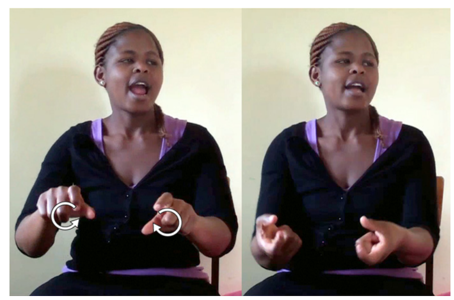
Borrowing: there are four signs that may be borrowed from abroad: TO-INVIGILATE/PROCTOR is identical in Swedish Sign Language, and probably borrowed because of its unique pairing of form and meaning; TO-LAUGH is identical in several SLs in eastern Europe (Russian, Ukranian, Lithuanian, Latvian, Estonian), though it is not clear if this has been borrowed or is simply the same by chance; ORAL is the same in ASL, BSL, and SLs in Sweden, Italy, and France; TOPIC is phonologically similar in ASL, BSL, and the sign languages of Spain and Latvia

Dynamic handshapes: *bent-V* is found in four signs with "hooking" flexion of *V>bent-V*: TO-SEARCH, TO-SUSPECT, HARE-3, SWAHILI-2

23.	***small-C*** 	17 signs



AIDS-1



GAS-STOVE

Minimal pairs: 5 pairs. *small-C* contrasts with *1* in one pair (LUO-1 and TURKANA), with *C* in one pair (JAMES-ORENGO and COAST-2), with *H* in one pair (LUO-1 and TUESDAY), with *bent-V* in one pair (LUO-1 and TO-LAUGH), and probably with *wood* in one pair, though verification needed (MOON and NARC)

Variation: the aperture of *small-C* can vary based on the size of the location or referent (see §4.4.2.3 in Chapter 4)

Motivated forms:

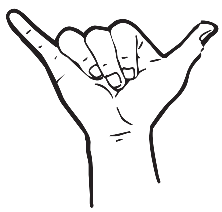
- **Letters**: none
- **Numbers**: none
- **Size/Shape**: mapping to object of tusks in TUSKER (brand of beer); glasses in JAMES-ORENGO (politician); shape/outline in MOON, PROVINCE, VEST
- **Handling**: *small-C* indicates handling in only one sign: GAS-STOVE
- **Other**: indicates an abstract measure of quantity in ADD-2, ADD-3, and EXPENSIVE-4

Borrowing: all signs with *small-C* appear to have a Kenyan origin, although the sign for SWITZERLAND, as an international place name, may be influenced from abroad

Dynamic handshapes: *small-C* is found in 8 signs with dynamic handshapes, in two different types of changes; two signs have an aperture change (NETWORK-7 is *baby-o>small-c>baby-*

o; STING is *small-C>baby-o*) and six involve "hooking" flexion of the distal finger joints (e.g., CAMERA, DEVIL, ORANGE-2, TO-DETECT)

24.	***Y***	17 signs



NEW-2

THAT

Minimal pairs: 8 pairs. *Y* contrasts with *claw* in two signs (YELLOW-2 and GOLD-1, PLAY-3 and OPULENT), with *F* in one sign (YELLOW-2 and FRESH), with *flat-o* in one sign (PLAY-3 and RIOSIRI), with *H* in one sign (IGNORANT-2 and POLICE), with *B* in one sign (YELLOW-2 and BLUE-2), with *H-thumb-closed* in one sign (YELLOW-2 and KIKUYU-2), and with *V-L* in one sign (THAT and APPROVE-2)

Variation: *Y* is found to vary with other handshapes in specific signs; it varies with *open* in DIRTY-1, with *uganda* in FOREVER-2, and with *i* in ENJOY and NEW-2

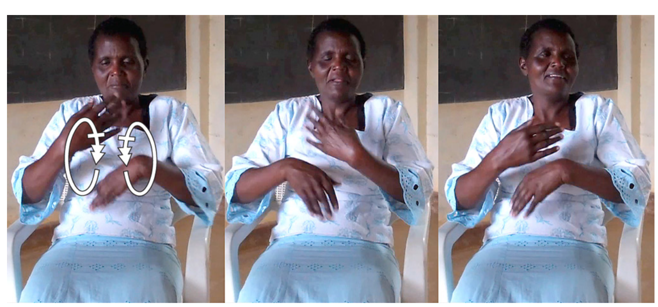
Motivated forms:

- **Letters**: Y in YELLOW-2, YESTERDAY-2
- **Numbers**: none
- **Size/Shape**: mapping to shape of airplane, phone receiver
- **Handling**: indicates handling of a collar in NEW-1 (according to B1)
- **Embodied Action**: none

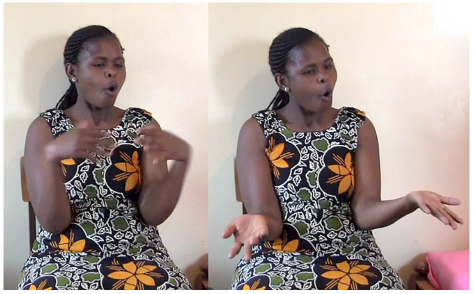
Borrowing: at least four signs with a *Y* handshape are borrowed from ASL or Signed English, including PLAY-3, WRONG-2, NOW-2, and THAT, and one sign THEY-2 is borrowed exclusively from Signed English; YELLOW-2 is also borrowed, but this handshape is used in several European sign languages in addition to ASL (e.g., French, German, Austrian, Polish, Russian, Czech) so the donor language is not certain

Dynamic handshapes: one sign is found with a handshape change: THEY-2 has a change in whole handshape, from *flat* to *Y*

25.	***lax***	16 signs



TO-PLAY-2



OR-1

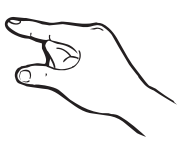
LAZY-2

Minimal pairs: 2 pairs. *lax* contrasts with *flat-tense* in one pair (PLAY-2 and CLOTH/FABRIC) and with *1* in one sign (PLAY-2 and CONTINUE-1)
Phonetic variation: despite being found in one minimal pair with an allophone of *flat*—*flat-tense*—*lax* can vary with *flat* in some signs with no change in meaning (e.g., DAY-3, BEFORE-1), but not all (e.g., LAZY-2, LIGHTWEIGHT, PLAY-2, WHATEVER, ANY)
Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: none
- **Embodied action**: depicts useless limbs in LAZY-2; this handshape also appears to have roots in the universal 'palms-up' gesture for inquiry in several signs: WHY-1, HOW, FOR-2, BECAUSE-2
- **Other**: relaxed hands can also be interpreted to have the lexical semantic property of indeterminacy in several signs: OR-1, ANY, WHATEVER, HOW, and FOR

Borrowing: at least one sign borrowed from ASL appears with a lax hand, THAN-1, though it is a phonetic variant of *flat*. The handshape itself does not seem to have been borrowed.
Dynamic handshapes: none

26.	***G***		15 signs



CARD-1

GOLDEN/OPULENT

Minimal pairs: 5 pairs. *G* contrasts with *1* in one pair (GIANCHERE and KISII-1, both towns), contrasts with *bent* in one pair (GOVERNMENT-3 and HEADTEACHER-1), contrasts with *C* in one pair (GROUP-2 and COMMUNITY-1), contrasts with *T* in one pair (GROUP-2 and TRIBE), contrasts with *K* in one pair (GOVERNMENT-3 and KAREN)
Variation: none

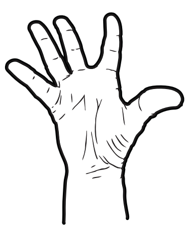
Motivated forms:

- **Letters**: 'G' in seven signs; e.g., GREEN-2, GOVERNMENT-1, GHANA, GROUP-1
- **Numbers**: none
- **Size/Shape**: the handshape *G* indicates the outline of eyeglasses in GLASSES-1, and the outline of a card in CARD-1; and an abstract measure of quantity in SMALL-2, BRIEF-2, and WORD-3
- **Handling**: two signs are motivated by handling: SPICE-1 depicts holding spice containers and VISITOR-2 depicts cinching a tie
- **Embodied action**: none

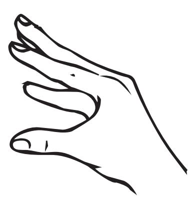
Borrowing: four signs show borrowing from ASL or Signed English: GREEN-2, GROUP-2, WORD-3, and GOVERNMENT-1, which appears to have undergone a change in movement; UGANDA-2 and GHANA are the borrowed eponymous signs from those countries; otherwise all signs are of Kenyan origin (e.g., SPICE-1, OPULENT-2, VISITOR-2)

Dynamic handshapes: none (but see *closed-G*, #30)

27. ***open-spray*** 14 signs



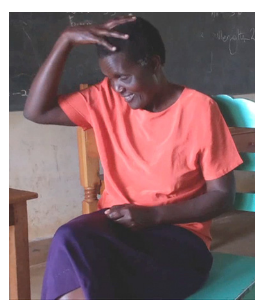
open-spray



spray

TO-SUFFER/STRUGGLE-2

HONEST-1



HAT

Minimal pairs: 1 pair. *Open-spray* contrasts with *claw* in one pair (BOWL-2 and MANDAZI-2)

Variation: *open-spray* can vary in the size of the aperture (the width of the opening created by the fingers and thumb), similar to other handshapes (see §4.4.2.3 in Chapter 4), from the more narrow handshape *spray* (in HONEST-1) to extremely spread fingers in TO-SUFFER/STRUGGLE-2; there is also an important difference in the distribution of each allophone: *spray* occurs almost exclusively in signs with dynamic handshapes—the only exception being HONEST-1—while *open-spray* occurs only in static handshapes

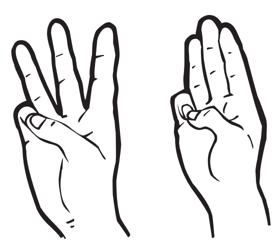
Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: in at least three signs, *open-spray* depicts the size or shape of objects: piles of goods displayed in the sign MARKET, the shape of a breast in BREAST, and feet or shoes in MUD-1
- **Handling**: *open-spray* may indicate handling in three signs, HAT, BOWL-2, and QUEEN; however, these signs can also be interpreted as depicted size and shape characteristics of objects
- **Embodied action**: in two signs the handshape is used to depict a gestural action: SHAME-1, HONEST-1

Borrowing: one sign is unambiguously borrowed from ASL or Signed English, CLOUD-1; another, CONFUSE, bears as much resemblance to ASL as to many other European sign languages (e.g., Italian, Ukranian, Czech, Lithuanian) and may be similar for reasons of shared iconic motivation; the remaining 12 signs are either of Kenyan origin or they have a high degree of similarity across genetically unrelated languages (e.g., MIX, BREAST, TO-RETIRE, SUFFER-1, -2, HONEST-1, etc.)

Dynamic handshapes: this handshape occurs in far more signs, 89 signs, with dynamic handshapes than with static handshapes; in which it only occurs as the *spray* allophone; the allophone *spray* appears as the first handshape in 50 signs with *open>closed* aperture (33 *spray>flat-o* [e.g., ACCEPT], 16 *spray>fist* [e.g., TAKE-OVER]; 1 *spray>O* [e.g., TAKE-1]), 33 signs with *closed>open* aperture (28 *O>spray* [e.g., SHINY], five *flat-o>spray* [e.g., CONTRIBUTE]), five signs with *open>closed>open* (*spray>flat-o>spray* [e.g., MOVIE, AUSTRALIA, EXPOSE-1]), and one sign with a change in flexion only (*spray>closed-claw* [e.g., EXPLOIT])

28.	***W***		13 signs



W *W-unspread*

ZEBRA-3

WATER-2

MIGORI (town)

Minimal pairs: 8 pairs. *W* contrasts with *flat* in two pairs (MIGORI and RECOMMEND, WAY-2 and ROAD), with *1* in one pair (WEDNESDAY-1 and ONLY-2), with *fist* in one pair (WEDNESDAY-1 and MUMIAS [town & deaf school]), with *claw* in one pair (FORK-2 and SITUATION), with *bent* in one pair (HOE-RAKE-1 and JEMBE-2), with *i* in one pairs (FORK-2 and TO-BE-INVOLVED), with *bent-V* in one pair (FORK-1 and CHIPS-1)

Variation: this handshape allows several phonetic variations, including degrees of base joint bending, of finger spreading, of thumb contact with the pinky, and the degree to which fingers are "stacked", none of which can cause a change in meaning; e.g., ZEBRA-3 has fingers that are both bent at the base joints and stacked, and in one sign, FORK-3, the fingers are unspread

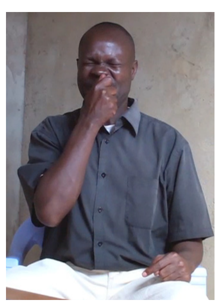
Motivated forms:

- **Letters**: this handshape references the letter 'W' from the KSL fingerspelling alphabet in eight signs (e.g., WORRY, INTERNET-3, WEST, WORLD-2, WEDNESDAY-1), and the letter 'M' from the BSL fingerspelling alphabet, in the sign MIGORI
- **Numbers**: none
- **Size/Shape**: mapping to shape of an object with tines in three lexical variants for 'fork' and a type of hoe with tines, HOE-RAKE-1; this shape also maps to the stripes on a zebra in ZEBRA-3
- **Handling**: none
- **Embodied action**: none

Borrowing: three signs originate from ASL (WATER-2, WORRY, WEDNESDAY-1) one from BSL (MIGORI), and the rest are either ambiguous (e.g., WEST, WORLD-2, INTERNET-3) or are Kenyan in origin (e.g., WHEAT-3, HOE-RAKE-1, FORK-3)

Dynamic handshapes: none

29. ***fist-stacked***	10 signs



HOT-4

JIKO [charcoal stove]

Minimal pairs: 0 pairs.

Variation: *fist-stacked* can vary with the *T* handshape (# 16) when the thumb is placed under rather than adjacent to the index finger; also, *fist-stacked* is descriptively very close to *fist*; it remains to be seen if *fist-stacked* is distinct from either of those shapes

Motivated forms:

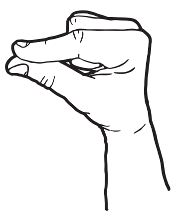
- **Letters**: none
- **Numbers**: none

- **Size/Shape**: none
- **Handling**: nine signs depict holding an object: a stick of sugarcane in SUGARCANE, a shovel in KENDU-BAY, handles in JIKO, a flywhisk in KENYA-1, etc.
- **Embodied action**: one sign originates with an embodied action: blowing warm air into the palm in HOT-4

Borrowing: none—only the sign, KEY, has a nearly identical form in other sign languages, but because it is so uniform across unrelated sign languages, it is impossible to know which foreign source it could be, if there was one; this also means it is highly likely to have a Kenyan origin

Dynamic handshapes: only one sign with a *fist-stacked* handshape, SEX-5, has dynamic movement—in this case, a pinching/closing movement in which an extended thumb closes onto the radial side of the hand

30. *closed-G*	8 signs



FULU-FISH-1

REFEREE-2

Minimal pairs: 3 pairs. *Closed-G* contrasts with *claw* in 1 pair (MOSQUITO-2 and MBITA), with *bent* in 1 pair (MOSQUITO-2 and OYUGIS-1), and with *flat-o* in 1 pair (EAT-3 and CHIPS-2)

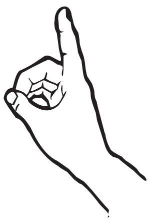
Variation: in some signs, such as VOLUNTEER-1 and CLOTHES-2, *closed-G* can vary with the handshape *F-curved*; that is, the middle, ring, and pinky fingers may not be fully closed into the palm, but loosely extended in a flexed position

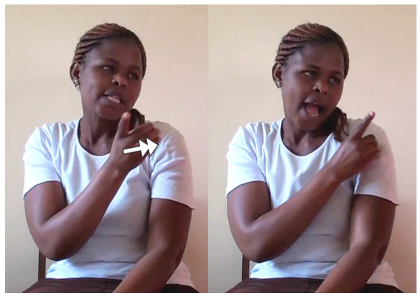
Motivated forms:
- **Letters**: none
- **Numbers**: none
- **Size/Shape**: none
- **Handling**: *closed-G* indicates holding, pinching, or plucking in at least six signs, including FULU-FISH-1, REFEREE-2, CLOTHES, and CHIPS-2
- **Embodied action**: none

Borrowing: only one sign shows a relationship to ASL or Signed English, VOLUNTEER; all other signs are of Kenyan origin, although the origin of MOSQUITO-2 is uncertain

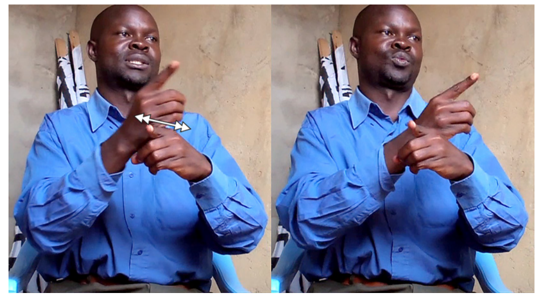
Dynamic handshapes: *closed-G* is found in many more signs with dynamic handshapes than in static handshapes, and occurs in two different types of dynamic signs: eight signs with a rubbing movement between the pads of the index finger and thumb (e.g., MONEY-1, TO-PAY-2, GROUNDNUT-2), and and 18 signs with a closing aperture (*open-G*>*closed-G*; e.g., WORD-1, TO-FINISH, CHEAP, JAPAN)

31.	***D***	3 4 5	8 signs





DOCTOR-2



DUTY-TEACHER

Minimal pairs: 4 pairs. *D* contrasts with *X* in one pair (DATE-1 and HOSPITAL-1), *C* in one pair (DATE-1 and CHURCH), *flat-o* in one pair (DATE-2 and MEETING), and *bent-V* in one pair (DUTY-TEACHER and TO-INVIGILATE/PROCTOR)

Variation: in some signs, *D* is an allophone of the handshape *1*, and these are included with *1* above (#2); in all eight signs here, however, the handshape cannot be changed to a *1* handshape and be well-formed

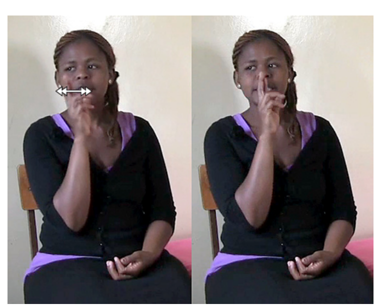
Motivated forms:

- **Letters**: this handshape represents the letter 'D' in seven signs, including DECIDE-2, DATE-1, DINNER-4
- **Numbers**: none
- **Size/Shape**: in the sign MOBILE-PHONE-4, the handshape appears to represent the shape of a cell phone with an extended antennae
- **Handling**: in the sign MOBILE-PHONE-4, the handshape may also represent the holding of a cell phone in the space created by the curved fingers (in addition to indicating its shape)
- **Embodied action**: none

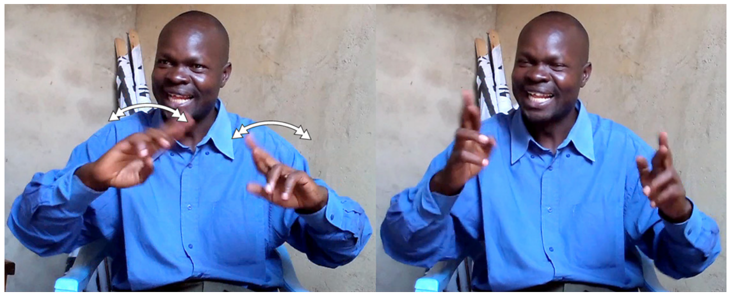
Borrowing: two signs appear to originate directly from an American version of Signed English—DINNER-4 and DATE-1—while four other signs have unclear origins and may be influenced by foreign sign languages, including ASL/Signed English (i.e., DOCTOR-3, DECIDE-2, DUTY-TEACHER, MOBILE-PHONE-4)

Dynamic handshapes: none

32.	***R***	2 3	8 signs



RISKY



READY

Minimal pairs: 2 pairs. *R* contrasts with *1* in one pair (RISKY and HARSH) and *K* in one pair (ROOM-2 and PLACE-1)

Variation: the degree to which the thumb is in an opposed position and contacts the closed fingers is variable, as seen in the examples above of RISKY and READY

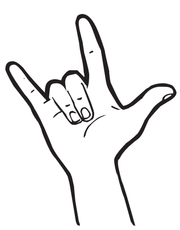
Motivated forms:

- **Letters**: represents letter 'R' in all eight signs in which it appears (e.g., ROOM-2, REASON, ROME, RIVER-2)
- **Numbers**: none
- **Size/Shape**: none
- **Handling**: none
- **Embodied action**: none

Borrowing: three signs can be conclusively traced to ASL/Signed English: READY, REASON, and REPORT; while a fourth sign, ROME, is also likely borrowed from ASL and modified in form; three signs are unique to Kenya (RISKY, ROOM-2, RED-2); and the origin of the last sign could not be determined (RIVER-2)

Dynamic handshapes: none

33.	***uganda*** 2 5	8 signs



UGANDA-1

LUO-2

Minimal pairs: 1 pair. *uganda* contrasts with *flat* in 1 pair, UGANDA-1 and RAILA-ODINGA

Variation: the closed fingers (middle and ring fingers) can vary in their degree of flexion without causing a change in meaning

Motivated forms:

- **Letters**: none
- **Numbers**: none

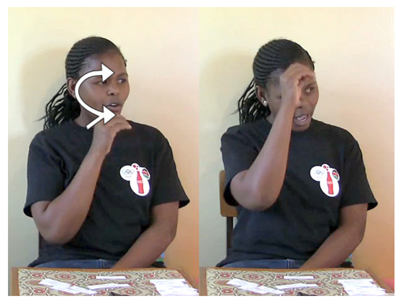
- **Size/Shape**: mapping to shape of missing teeth in LUO-2 and MISSING-TEETH (and a sign possibly derived from the latter meaning "shabby"), and it maps to the shape of an airplane in two signs: AIRPORT-3 and SUNEKA-2 (town name)
- **Handling**: none
- **Embodied action**: none

Borrowing: the use of this handshape to mean "I love you" in ASL is recruited in the sign SWEETHEART-5, but it is not clear if the sign itself is borrowed, or just the handshape; also, the sign MOSQUITO-NET may be a semantic shift from a borrowed sign, TENT, which is almost identical in several sign languages (e.g., ASL, BSL, French and Italian Sign Language)

Dynamic handshapes: none

34.	***O***		6 signs

SCRUTINIZE



ORPHAN-2

Minimal pairs: 0 pairs.

Variation: *O* may vary with *F* in some signs, such as ZERO and OWNER; more investigation needed

Motivated forms:

- **Letters**: may represent the letter O in one sign: ORPHAN-2
- **Numbers**: may represent the numeral zero in ZERO and NONE-1
- **Size/Shape**: mapping to shape of a cylinder in FOCUS-2, PIPE-4
- **Handling**: indicates holding a spyglass in SCRUTINIZE; gripping a wedding ring in DIVORCE
- **Embodied action**: none

Borrowing: the sign NONE-1 may have been borrowed from ASL or BSL

Dynamic handshapes: *O* handshape appears in many more dynamic handshapes than static ones; 43 signs with dynamic handshape changes; 38 have a *closed>open* aperture with *O* as the initial phonetic shape, opening to *spray* in 28 signs (e.g., TO-KNOW-2, TO-COMPLAIN-1, TO-EXPLAIN), to *open* in 7 signs (e.g., EXPENSIVE-1, SURPRISE-1, NOTHING), and to *claw* in 3 signs (TRACTOR-1, SHOCK, PIPE-3); two have a *open>closed* aperture: *C>O* (1 sign; COAST-2) and *spray>O* (1 sign; TO-TAKE-1); and three involve different sets of selected fingers: *O>F* (IF-2), *O>K* (OKAY), *V>O* (TWENTY)

35.	***wood***		6 signs

WOOD

NARC (National Rainbow Coalition, a political party)

Minimal pairs: *wood* likely contrasts with *small-C* in the pair NARC and MOON, although tokens with the same signer have not yet been obtained on video

Variation: with further investigation, *wood* may be found to be an allophone of the *C* handshape; descriptively, it differs from *C* in having no flexion at the base joints (note: finger spreading can vary in both handshapes without a change in meaning)

Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: used to trace a three-dimensional shape in WOOD, N.A.R.C. (for rainbow), and BRA; it also indicates an abstract size and shape in PARAGRAPH
- **Handling**: unsure
- **Embodied action**: none

Borrowing: one sign, PARAGRAPH, is probably borrowed from ASL/Signed English; another, BRA, has a high degree of similarity cross-linguistically; the remaining four are of Kenyan origin (WOOD, N.A.R.C., NILOTIC, CUSHITIC)

Dynamic handshapes: none

36.	***bent-L***	5 signs

EGG-1 WONDERFUL

Minimal pairs: 1 pair. *bent-L* contrasts with *1* in EGG-1 and MOBILE-PHONE-1

Variation: slight variation in the distance of the thumb from the radial side of the hand, which is conditioned by the size of the location

Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: none
- **Handling**: indicates holding an egg in EGG-1 and YELLOW-1; holding beans and maize in GITHERI, holding a gun in WAR
- **Embodied action**: WONDERFUL is derived from a regional gesture in which the chin is held in wonderment (Creider 1977)

Borrowing: none

Dynamic handshapes: the *bent-L* handshape appears in 3 signs with handshape changes; two of these involve the pinching closed of the thumb against the radial side of index finger (TO-WEED-1, EASY-2), and another, *L>bent-L*, the index finger bends repeatedly (BLOOD-TEST-3)

37.	***4***	1 2 3 4	4 signs

APRIL SEPTEMBER

Minimal pairs: the *4* handshape is found in morpho-phonological minimal pairs in numeral incorporation (e.g., SEPTEMBER and AUGUST), which are not considered in this thesis (see Morgan 2013); there are no solely phonological minimal pairs with this handshape

Variation: the thumb can be opposed or extended with no change in meaning

Motivated forms:

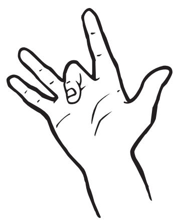
- **Letters**: none
- **Numbers**: this handshape only occurs as a number

- **Size/Shape**: none
- **Handling**: none
- **Embodied action**: none

Borrowing: none

Dynamic handshapes: none

38.	***mid-bend***		4 signs



EMAIL-1

ORIGINAL-2

Minimal pairs: 3 pairs. *mid-bend* contrasts with the handshape *1* in ORIGINAL-2 and BLACK-1); with *X* in EMAIL-1 and PAIN-1, and with *bent-V* in EMAIL-1 and TO-CONTACT

Variation: note that *mid-bend* is typically produced with unselected fingers that are more flexed than the drawing above; that is, as shown in the photographs

Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: unknown
- **Handling**: unknown
- **Embodied action**: none

Borrowing: three out of four KSL signs with this handshape originate from borrowings: JESUS, EMAIL-1, INTERNET-1

Dynamic handshapes: none

39.	***N***		3 signs

N

N-straight

NYANGWESO-SCHOOL-FOR-THE-DEAF

NAIROBI-2

NINA-DEAF-UNIT-2

Minimal pairs: 3 pairs. *N* in NYANGWESO contrasts with three other handshapes; with *1* in SISTER-2, with *C* in CHISTIAN-1, and with *K* in KING

Variation: *N* with curved fingers can also be found with straightened fingers in *N-straight* (in NINA-DEAF-UNIT-2)

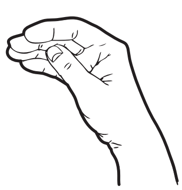
Motivated forms:

- **Letters**: 'N' in all three signs in which it appears (which are also proper names)
- **Numbers**: none
- **Size/Shape**: none
- **Handling**: none
- **Embodied action**: none

Borrowing: none

Dynamic handshapes: N occurs in one dynamic sign with the fingers repeatedly opening and closing, NTIMARU (deaf school)

40.	*flat-o-curved*	2 signs



SOUP-2

CHEMISTRY

Minimal pairs: 0 pairs.

Variation: none; it must still be evaluated if this handshape is a variant of the *flat-o* handshape, but it is unlikely that the sign SOUP-2 would be acceptable with *flat-o*

Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: none

- **Handling**: indicates scooping up soup with ugali in SOUP-1, and some type of handling in CHEMISTRY
- **Embodied action**: none

Borrowing: none known

Dynamic handshapes: none

40.	***H-thumb***	1 sign

PETROL-2

Minimal pairs: 0 pairs.

Variation: none; this *H-thumb* may prove to be a variant of the *L* handshape (#14)

Motivated forms:

- **Letters**: none
- **Numbers**: none
- **Size/Shape**: mapping to shape of a gas nozzle in PETROL-2
- **Handling**: none
- **Embodied action**: none

Borrowing: none known

Dynamic handshapes: this handshape is found in three signs with a "hooking" movement: EVIL, GHOST, and KANYAWANGA (hearing school)

42.	***H-thumb-closed***	1 sign

KIKUYU-2

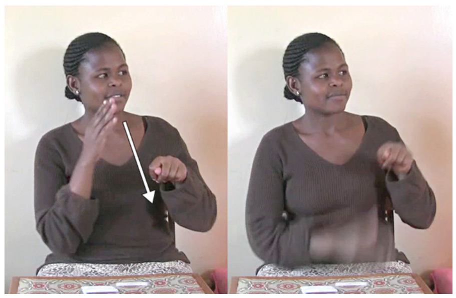
Minimal pairs: 3 pairs. *H-thumb-closed* contrasts with *claw* in 1 pairs (KIKUYU-2 and GOLD-1), with *Y* in one pair (KIKUYU-2 and YELLOW-2), and with *B* in one pair (KIKUYU-2 and BLUE-2)

Variation: none

Origin: according to signers in Nyanza, this handshape originates from the manual counting system of the Kikuyu people. However, this may be a folk etymology; other evidence suggests that it is found in the manual counting system of certain (Nilotic) linguistic communities in Kenya, such as the Kipsigis (Creider 1977) and the Masaai (Zaslavsky 1999)

Dynamic handshapes: this handshape occurs in one sign with a dynamic handshape: NO-3, which has an aperture change from open>closed, ending with the *H-thumb-closed* shape

43.	***thumb-in-fist*** ⬭ ²\³	1 sign / 5 signs*



FEMALE-CIRCUMCISION-2

LESBIAN-4

Minimal pairs: 2 pairs. *Thumb-in-fist* contrasts with *flat* in 1 pair (FEMALE-CIRCUMCISION-2 and STOP-1) and the handshape *1* in one pair (FEMALE-CIRCUMCISION-1 and MALE-CIRCUMCISION-1)

Variation: none

Motivated forms:

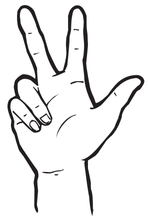
- **Letters**: none
- **Numbers**: none
- **Size/Shape**: corresponds to shape of female genitalia in all signs in which it appears
- **Handling**: none
- **Embodied action**: none

Borrowing: none known

Dynamic handshapes: movement can be added to the sign CLITORIS by emphasizing the bending of the index finger as it moves into the handshape position or by lighting flexing the index finger repeatedly

***Note**: This handshape only appears on the dominant hand in one sign, LESBIAN-4, and appears on the non-dominant hand in four other signs. This includes a typologically unusual one-handed sign on the non-dominant hand, CLITORIS.

44.	***V-L***	1 sign



APPROVE-2

Minimal pairs: 1 pair. *V-L* contrasts with the *Y* handshape in APPROVE-2 and THAT

Variation: none

Motivated forms: none

Borrowing: The *V-L* handshape appears in only one sign, APPROVE-2, which has a striking similarity to signs in the sign languages of disparate sign languages in Europe, including Italy, France, Portugal, and Lithuania, suggesting that it probably borrowed from Europe—perhaps via International Sign—and is not an “indigenous” handshape of KSL

Dynamic handshapes: none

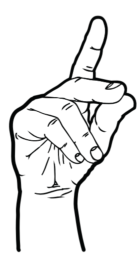
Other handshapes (in dynamic handshapes)

The six handshapes below are not listed as separate entries above because they are only found in signs with dynamic handshapes (i.e., handshape contours) and thus never appear as unchanging, static handshapes on their own. Three of these, *baby-o-restrained, H-thumb-open*, and *open-T*, are assumed to be phonetic variations on a static handshape, but which one is uncertain. The other three, *baby-D* and *middle+thumb* (and its open variant) have no counterpart as static shapes; they only occur as variations in a contour.

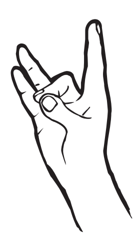
baby-o-restraining

H-thumb-open

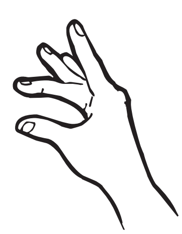
open-T



baby-D (snap)



middle+thumb

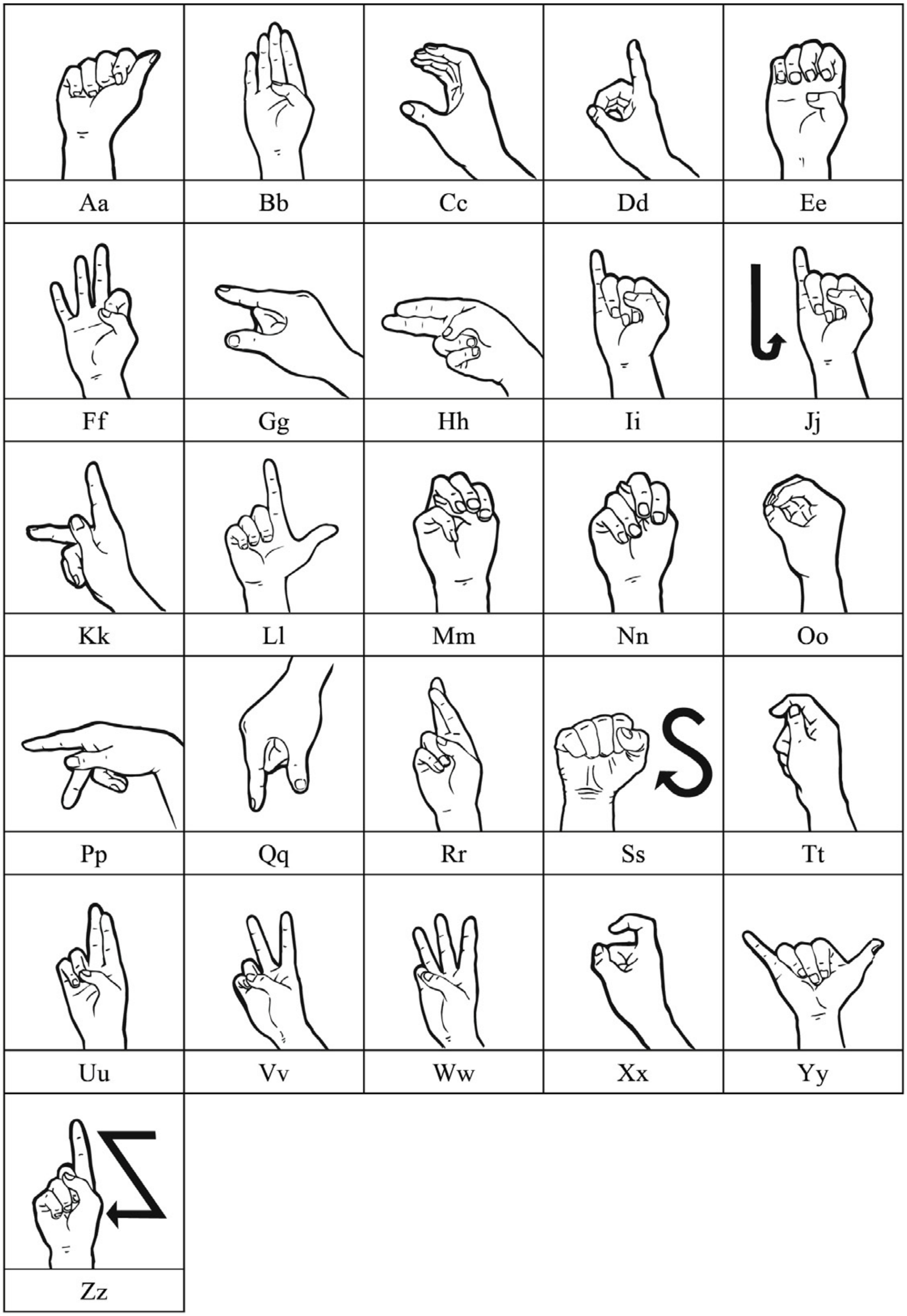


middle+thumb-open

Appendix 4: *Chart of handshape minimal pair contrasts*

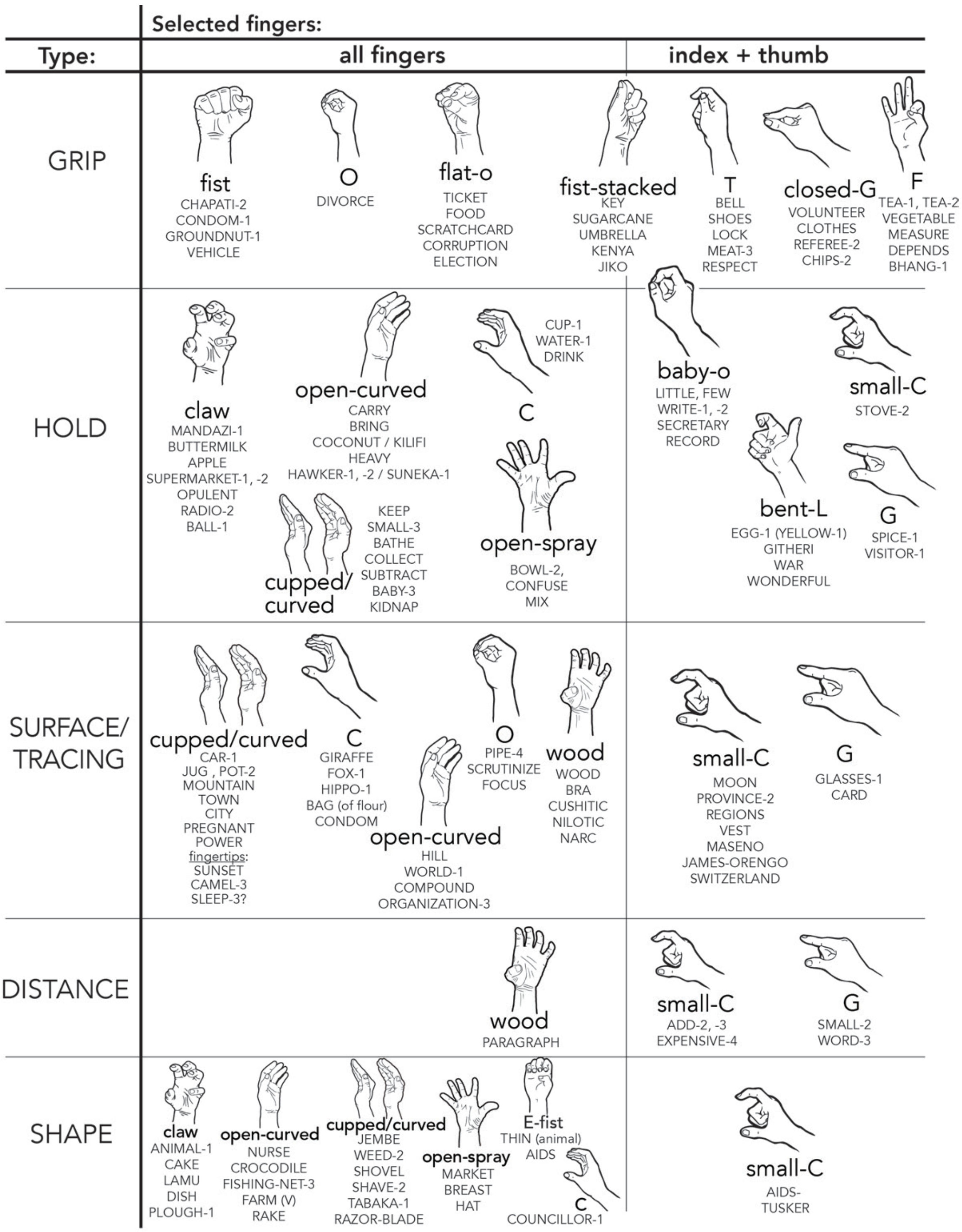
	1 flat	2 1	3 fist	4 open	5 claw	6 X	7 bent	8 C	9 F	10 flat-o	11 A-thumb	12 V	13 L	14 H	15 T	16 open-curved	17 i	18 K	19 B	20 E	21 bent-V	22 small-C	23 Y	24 lax	25 G	26 open-spray	27 W	28 closed-G	29 D	30 R	31 uganda	32 bent-L	33 wood	34 mid-bend	35 N	36 H-thumb-closed	37 Thumb-in-fist	38 V-L	
V-L																																						1	1
Thumb-in-fist																																					2		2
H-thumb																																				3			3
N																																			6				6
mid-bend																																		3					3
wood																																	1						1
bent-L																																1							1
uganda																															2								2
R																														2									2
D																													4										4
closed-G																												3											3
W																											8												8
open-spray																										1													1
G																									5														5
lax																								2															2
Y																							8													1		1	8
small-C																						7											1						7
bent-V																					9	1					1		1					1					9
E																				3																			3
B																			10				1													1			10
K																		8							1					1					1				8
i																	12										1								1				12
open-curved																2																							2
T															5										1						1								5
H														7							1	1	1																7
L													4						1																				4
V												3							1																				3
A-thumb											4		1																										4
flat-o										15				1			1				1		1					1	1						1				15
F									9		1					1	1		1				1																9
C								12							1	1	1	1	1			2			1				1						1				12
bent							7			2							1	1							1		1								1				7
X						9															1							1	1					1					9
claw					23	2			1	2	1			1			1		1	1			2			1	1	1								1			23
open				13		1		1		2					1				2			1																	13
fist			15	1		1			1	1			1							1							1												15
1		33	4	4	1			1	2			1		1	1			2	1	1	1	1		1	1		1			1		1		1	1		1		33
flat	32	4	4		6	1				1	1	1	1	1			5	1			1			1			2				1						1		32

Appendix 5: *Fingerspelling alphabet in KSL (southwestern Kenya)*

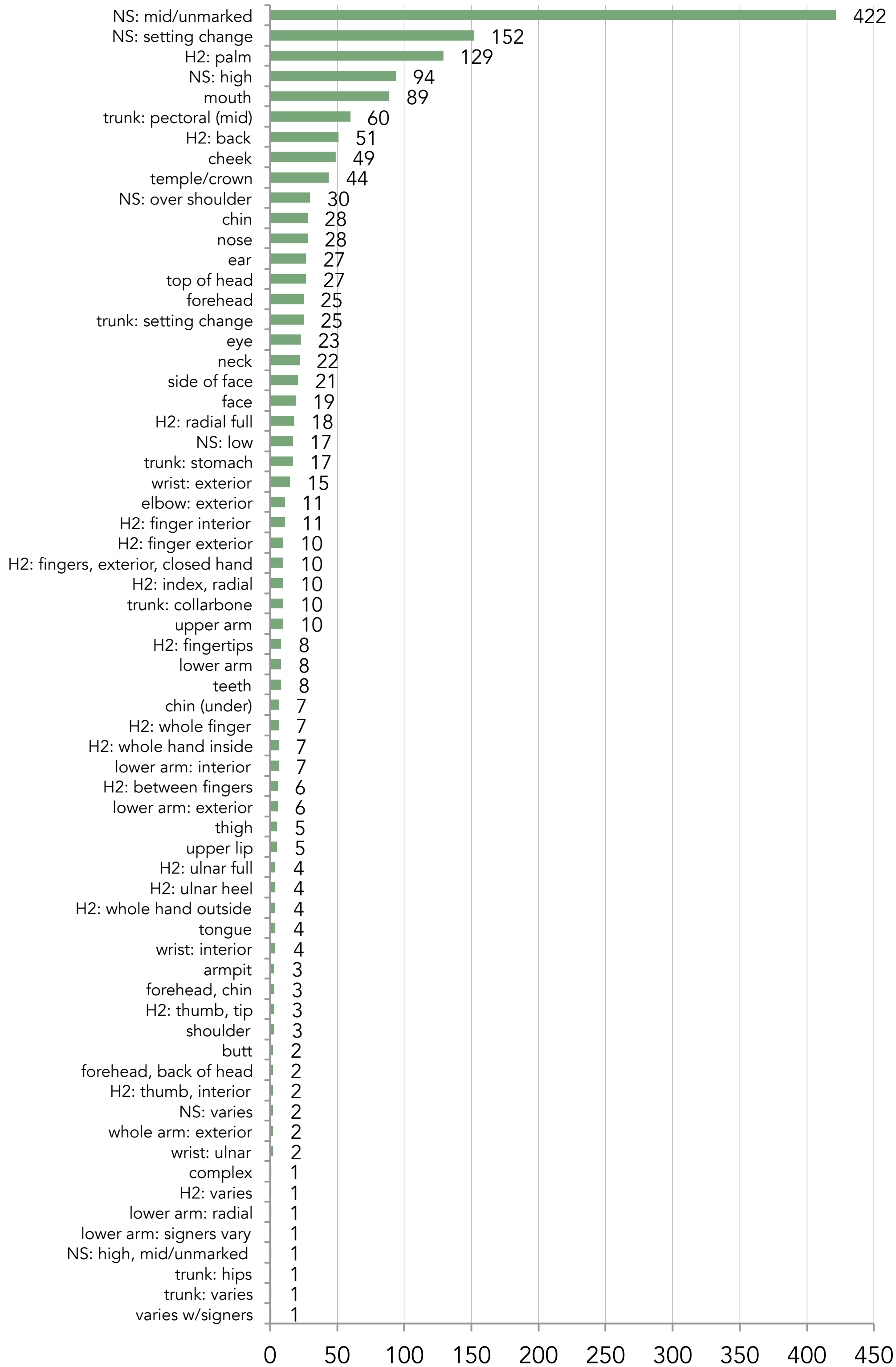


All handshapes except 'S' courtesy of Gladys Tang

Appendix 6: ***Motivated handshapes in KSL*** ***(with two sets of selected fingers)***



Appendix 7: *Phonetic Locations in KSL Database (65 total, in 1,631 signs)**



* This total number of signs does not include signs that were uncertain for location, or were coded as having two simultaneous or sequential locations.

Appendix 8: *Chart of location minimal pair contrasts*

	1 neutral space	2 h2 palm	3 mouth	4 forehead	5 trunk-upper	6 cheek	7 forearm dorsal	8 h2 back	9 trunk-whole	10 top of head	11 forearm ventral	12 nose	13 chin	14 h2 radial	15 ear	16 face	17 neck	18 eye	19 h2 whole	20 side of face	21 trunk-lower	22 over shoulder	23 forearm whole	24 elbow	25 h2 fingertips	26 upper arm	27 teeth	28 chin-under	29 h2 ulnar	30 h2 between fingers	31 shoulder	32 thigh	33 upper-lip	34 hip	35 tongue	36 arm whole	37 armpit	
armpit																																					0	0
arm whole																																				0		0
tongue																																			3			3
hip																																		2				2
upper-lip																																	2					2
thigh																																0						0
shoulder																															6				1			6
h2 between fingers																														6								6
h2 ulnar																													7		1							7
chin-under																												0										0
teeth																											5		1						1			5
upper arm																										4												4
h2 fingertips																									2													2
elbow																								12						1								12
forearm whole																							0															0
over shoulder																						2																2
trunk-lower																					7																	7
side of face																				7				2									1					7
h2 whole																			0																			0
eye																		9						1														9
neck																	11													1								11
face																6					1																	6
ear															18	1		1			1						1											18
h2 radial														0																								0
chin													13		1					1		1							1									13
nose												18			1		1	1												1	1							18
forearm ventral											3																											3
top of head										15		3				1		1						1							1							15
trunk-whole									3											1																		3
h2 back								18		1			1				1	1		1				2	2	1												18
forearm dorsal							9				1		1		1	1					1																	9
cheek						20				1		1	2		2		1				1					1			1		1				1			20
trunk-upper					23	2		1		2	1	1			2	1	2	1			1			1										1				23
forehead				33	1	2	1	1		2		4	3		2		1	1						1			1		1	1	1		1					33
mouth			35	5	2	2	2	1		2		2			4	1	2	1			1			3						1								35
h2 palm		26	1	2	2	2		4			1	2	2		1		1									1	1		2	1								26
neutral space	23	3	5	2	2		1	1	2								1	1		1	1	1				1								1				23

Appendix 9:
Inventory of KSL Locations

This appendix contains an annotated registry of the 37 phonological locations in the KSL Lexical Database of 1,880 signs collected in southwestern Kenya. The description of locations is followed by a profile of 9 sign types that are indeterminate for location (pages 635-652).

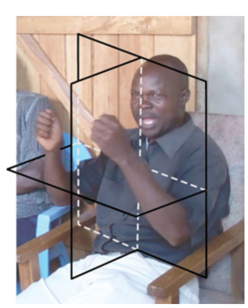
For each location entry, the following information is provided:

- **Index number** of the handshape, listed in order of greatest to least frequency in the lexical database (#1-37)
- The **name** of the location used in this dissertation
- **Hamburg Notation System symbol** of location
- **Number of signs** in which this location is found in the database
- **Drawing(s)** of the location
- **Photographs** of KSL signs with the location taken from video elicitation
- Number and examples of the **minimal pairs** in which this location is found; the first sign listed in a pair contains the location of that entry; see Chapter 3 for methodology of determining minimal pairs and Appendix 8 for a chart of all location contrasts
- Description of **sign evidence** that demarcate the boundaries of the location:
    a. **Parallel path/continuous contact signs**: straight or circle paths that move parallel to the surface of the body location and
    b. **Dispersed signs:** the same syllable is repeated at two sub-locations that are evenly distributed within the boundaries of a phonological location; e.g., 'double contact' signs, such as HOME-2 in KSL (cognate with HOME in ASL)
    c. **Arc path signs**: those that have begin and end on the location
    d. **Delineation/extent**: the hand's contact point on the location that spreads throughout the extent of the phonological area and generally not beyond; includes the extent of both hands in a two-handed sign
    e. **Phonetic tokens/variation**: especially for highly frequent signs, individual instances of the same sign elucidate the allowable boundaries of a phonological location
    f. **Center point**: a handpart with small surface area, such as a fingertip, contacts the canonical center of the phonological location
- **Motivated origins**: the semantics of each location has not been analyzed systematically, but noteworthy patterns will be mentioned for some locations

1. *neutral space*	14. *h2 radial*	27. *teeth*
2. *h2 palm*	15. *ear*	28. *chin under*
3. *mouth*	16. *face*	29. *h2 ulnar*
4. *forehead*	17. *neck*	30. *h2 between fingers*
5. *trunk upper*	18. *eye*	31. *shoulder*
6. *cheek*	19. *h2 whole*	32. *thigh*
7. *forearm dorsal*	20. *side of face*	33. *upper lip*
8. *h2 back*	21. *trunk-lower*	34. *hip*
9. *trunk whole*	22. *over shoulder*	35. *tongue*
10. *top of head*	23. *forearm whole*	36. *arm whole*
11. *forearm ventral*	24. *elbow*	37. *armpit*
12. *nose*	25. *h2 fingertips*	
13. *chin*	26. *upper arm*	

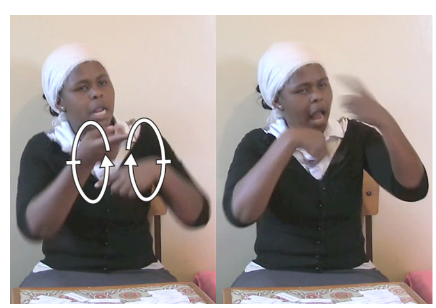
List of 37 KSL locations (ordered by most-to-least frequent in the KSL Lexical Database)

1. ***neutral space*** 726 signs



neutral space (NS)

BADO (‘not yet’)



COME-3

EVERYTHING

Minimal pairs: 23 pairs. Neutral space contrasts with 14 locations in all major areas, including the neck and leg; contrasts with *forearm dorsal* and *mouth* shown below

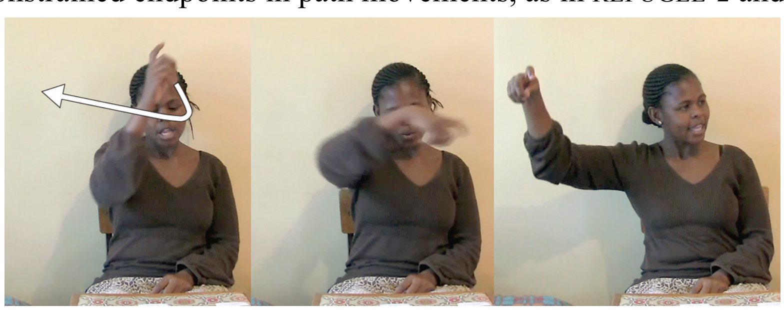
LOOK-FOR (*neutral space*)

INVIGILATE (*forearm dorsal*)

FRESH (*neutral space*)

FRUIT (*mouth*)

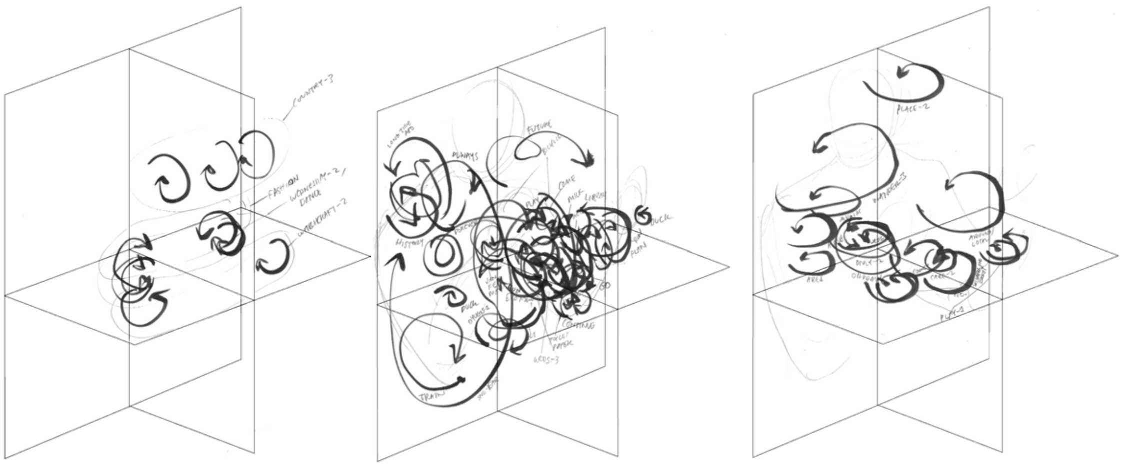
Parallel path/continuous contact: This type of evidence for the boundaries of a location is not applicable for neutral space because there is not the same requirement to respect adjacent boundaries in the same way as on the body; in NS, the hands are free to move between relatively unconstrained endpoints in path movements, as in REFUGEE-2 and BOSS-1



REFUGEE-2

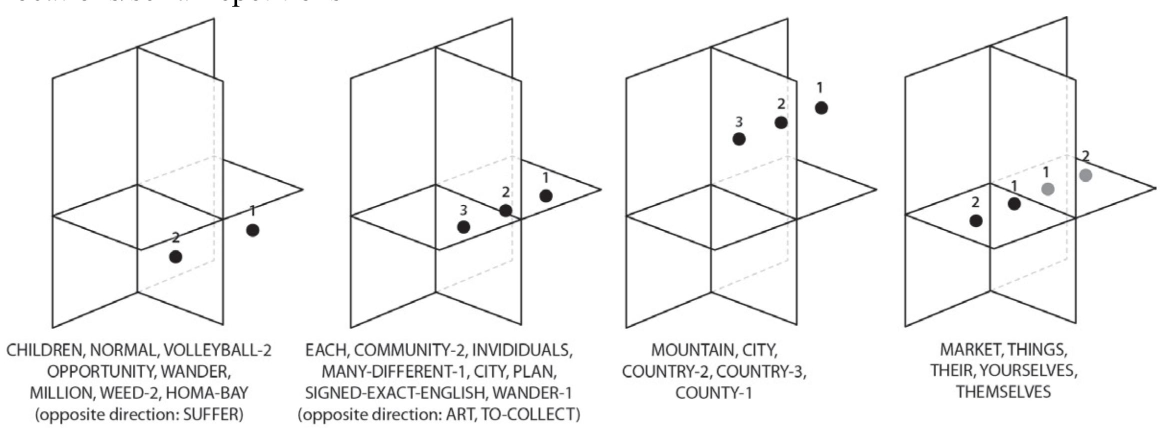
BOSS-1

Another indication of delineation used for body locations are circle path signs. In neutral space, these are not constrained by physical landmarks and can even be contrastive by size in a small group of signs (see §7.4). These circle paths can be grouped by those along the vertical/frontal, midsagittal, and horizontal planes, as shown below, in hand drawings based on videos of signers.

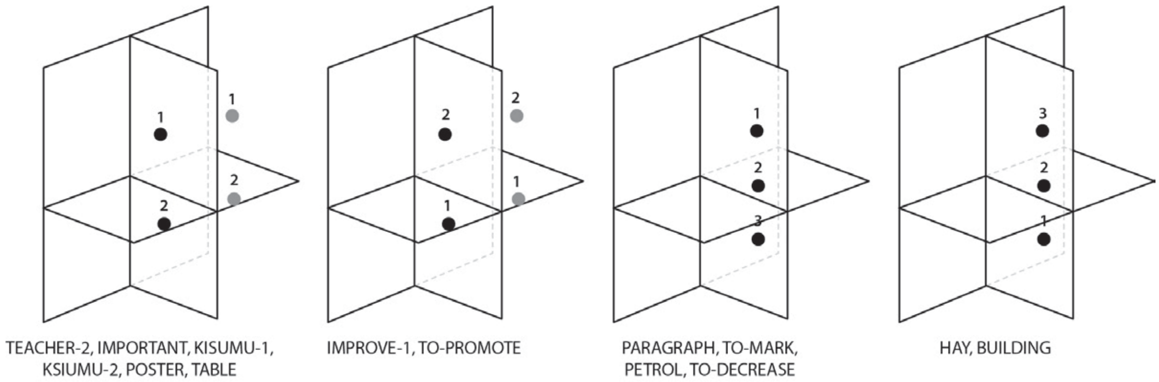


circle path signs on vertical/frontal, midsagittal, and horizontal planes (left-right)

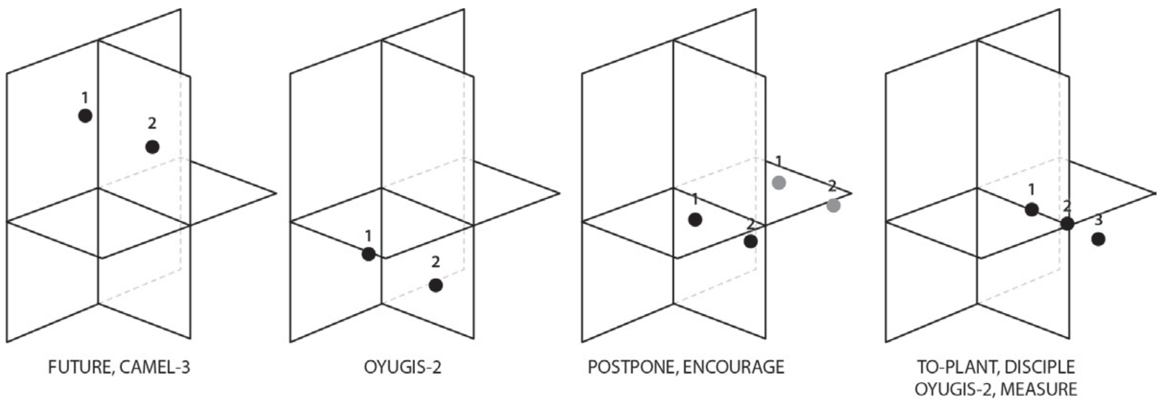
Dispersed signs: 37 dispersed signs; 19 on the horizontal axis, 11 on the vertical axis, and 7 on the midsagittal axis. While dispersed signs on the body are limited to two repetitions of a syllable (in two sub-locations), some dispersed signs in neutral space can have three sub-locations/serial repetitions



dispersed signs, horizontal axis



dispersed signs, vertical axis



dispersed signs, midsagittal axis

Arc path: 89 signs in the KSL Lexical Database are coded as having a phonetic *arc* path shape in *neutral space*, though not all of these have a phonological arc path but HILL and TOWN are examples of NS arc signs that do have a phonological specification for arc; however, without the designation of a specific location …

HILL

TOWN

Delineation/extent: *neutral space* is so large that even both hands cannot simultaneously spread throughout the entire location; IMPORTANT (and EVERYTHING, above) show how two *flat* hands can spread throughout most of the area in the same sign.

IMPORTANT

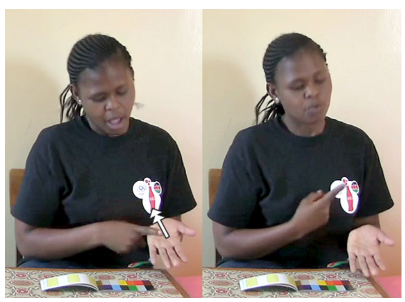
Center point: N/A

Phonetic variation: not analyzed; without body landmarks, fine phonetic distinctions are difficult to see across video tokens from different angles[1]

Motivated origins: not analyzed

2.	***h2 palm***	154 signs

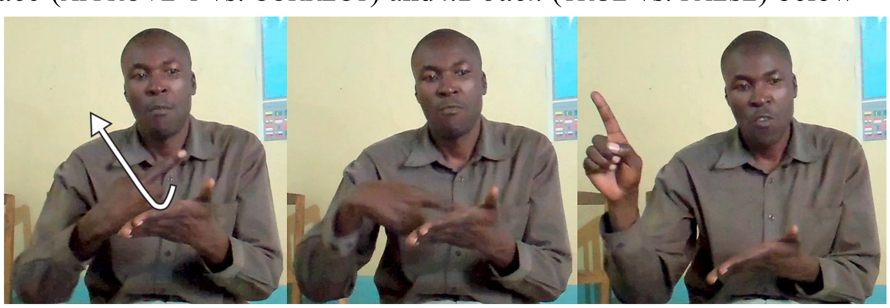
h2 palm



BROWN-1

OFFICE

Minimal pairs: 26 pairs. *h2 palm* contrasts with 15 locations in all major areas; contrasts with *neutral space* (APPROVE-1 vs. CORRECT) and *h2 back* (TRUE vs. FALSE) below



APPROVE-1 (*h2 palm*)

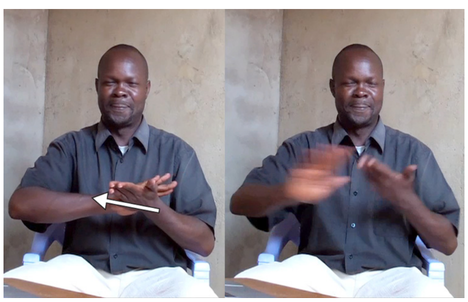
[1] Advancements in motion tracking software will eventually be able to determine the phonetic regularities among different types of neutral space signs.

CORRECT (*neutral space*)

TRUE (*h2 palm*)

FALSE (*h2 back*)

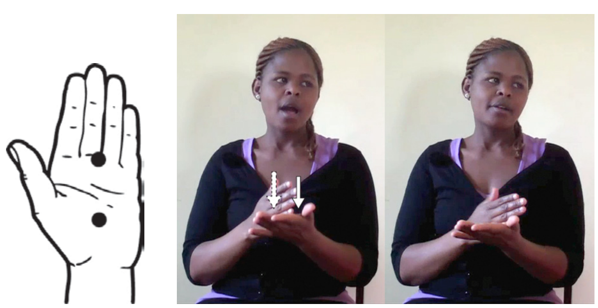
Parallel path/continuous contact: around 20 signs on *h2 palm* have continuous contact, including 15 straight path signs (e.g., EMPTY-3) and 5 circle path signs (e.g., BASIC)



EMPTY-3 (straight path)

BASIC (circle path)

Dispersed signs: at least two dispersed signs stay within the boundaries of the palm (LESSON-1, ADDRESS), though other dispersed signs can start on the palm and continue down the ventral forearm



LESSON-1

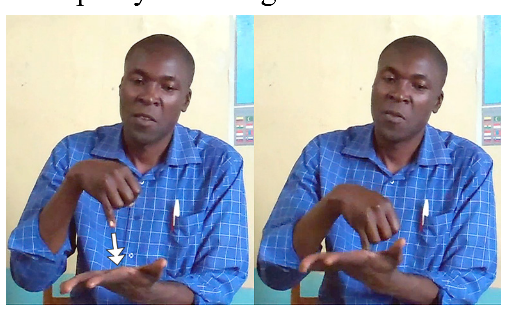
ADDRESS

Arc path: 14 signs are coded phonetically on h2 palm as having an arc path, but none of these make contact with *h2 palm* at both the beginning and end of the sign and are therefore not evidence for the boundaries of the location

Delineation/extent: signs with a *flat* handshape, such as EMPTY-3 and BASIC (above) contact the full area of *h2 palm* including the fingers, while the sign SITUATION with a *claw* handshape shows that the aperture only opens wide enough to include the center of the palm without fingers included

SITUATION

Center point: The fingertip of the pinky/little finger contacts the center of the palm in INVOLVE



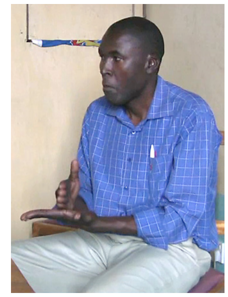
INVOLVE

Phonetic variation: there can be some idiolectal difference in the exact contact point on the hand for some signs; e.g., BELOW and STOP-2 shown below vary by contact on the fingers versus on the palm; however, there is no evidence that these differences are contrastive

BELOW (Signer O1)

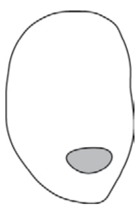
BELOW (2004 dictionary)

STOP-2 (Signer K1)



STOP-2 (Signer B1)

3. ***mouth*** — 99 signs

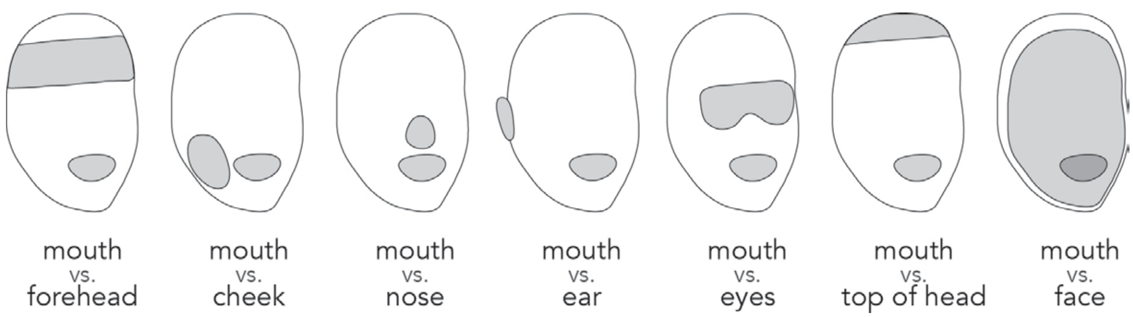


mouth

BORED-2

SUGAR-1

Minimal pairs: 35 pairs. *mouth* contrasts with 16 other phonological locations in all major areas; this includes 7 other locations on the head, as shown below; e.g., MANGO-1 (*mouth*) vs. BEER (*forehead*); PASSIONFRUIT-2 (*mouth*) vs. GROUNDNUT (*neutral space*)



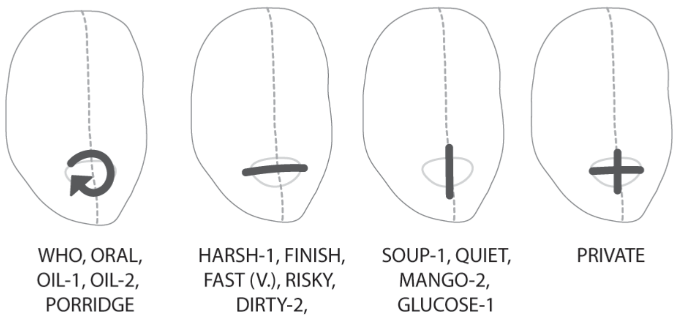
mouth minimal pairs within the head

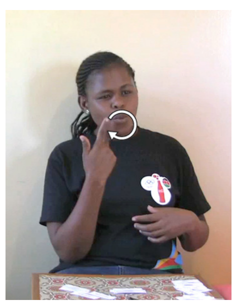
MANGO-1 (*mouth*)

BEER (*forehead*)

PASSIONFRUIT-2 (*mouth*) GROUNDNUT/PEANUT (*neutral space*)

Parallel path/continuous contact: there are 15 signs with continuous contact on the mouth. These include both circle paths and straight paths; it should be noted that a few parallel path signs on *mouth* appear to be more likely than on other locations to extend past the boundaries of the mouth, but are nonetheless centered at that location; e.g., SOUP-1 (vertical axis) and HARSH-1 (horizontal axis)



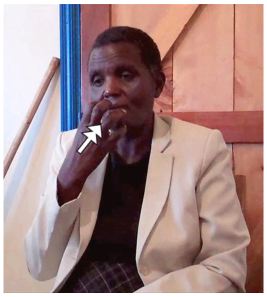


WHO RISKY

Dispersed signs: *none*

Arc path: *none*

Delineation/extent: the extent of this location is demonstrated in APPLE with a *claw* handshape and EAT-3 with two hands positioned at either side of the mouth; also MANGO-1 above shows the edge of the *flat* hand making full contact with this location



APPLE

EAT-3

Center point: the index finger contacts center of the *mouth* location in several signs shown below

MEDICINE

ONE-HUNDRED

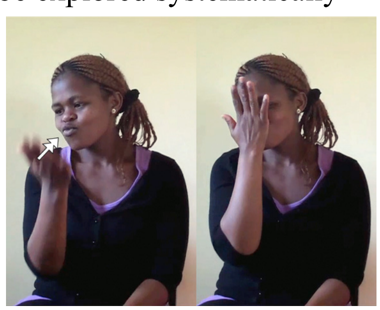
PEPPER-HOT-1

SUCKLE/NURSE-2

Phonetic variation: N/A

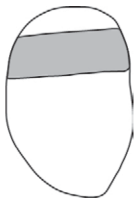
Motivated origins: the most common semantic category coded for this location is 'food & cooking' with 29 signs (e.g., FRUIT, MEAT-3, SORGHUM, SUGARCANE, FORK-3, etc.); there are also signs that reference vocalizing (e.g., REPORTER, ORAL, ORDER, ANSWER, COMPLAIN-3, SPEAK-1, INFORM, ANNOUNCE, etc.) and animal beaks and snouts (e.g., FOX-1, DUCK-1, CHICKEN, DONKEY-3, MOSQUITO-1, etc.)

Comments: a phenomenon that is particularly notable at the *mouth* location, but occurs in other locations, too, are differences in which part of the hand contacts the location; e.g., in BORED-2 above, the fingers make contact, while in PIG-1 below, then palm makes contact with the mouth; these patterns have yet to be explored systematically

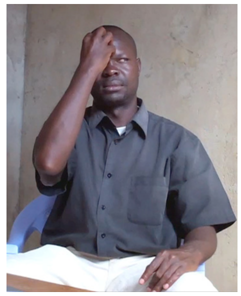


PIG-1

4.	***forehead*** ⌒	79 signs



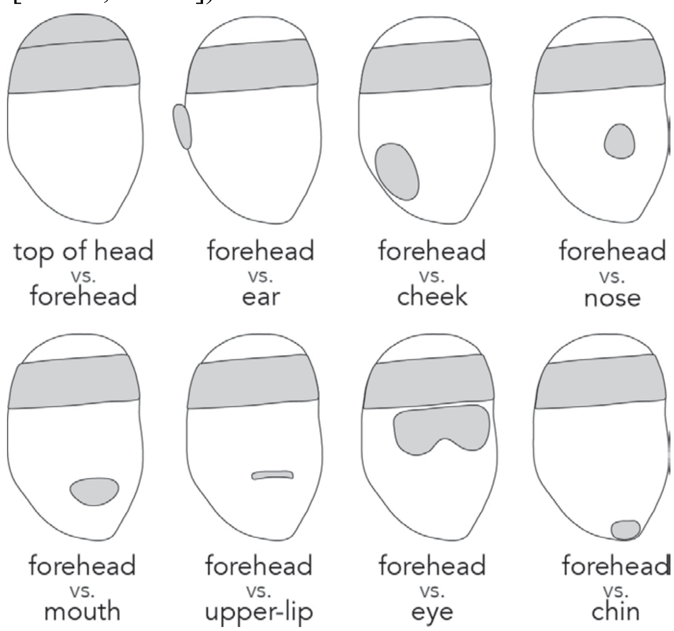
forehead



UPSET-1

ORIGINAL-1

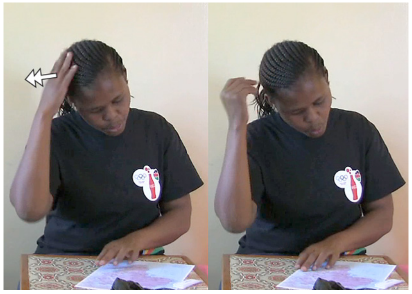
Minimal pairs: 33 pairs. *forehead* contrasts with 19 other locations in all major areas; in *neutral space* (e.g., RESPECT vs. BELL [*NS*]), *trunk* (e.g., BUNGOMA-1 vs. BOARD-OF-GOVERNORS [*trunk upper*]), non-dominant limb (e.g., SOMALIA vs. SWEDEN [*forearm ventral*, below]; BEER vs. MEMBER [*h2 between fingers*; see #30]), *neck* (e.g., DON'T-KNOW vs. DON'T-LIKE [*neck*]), and other locations on the head (e.g., UHURU-KENYATTA vs. WHITE-1 [*teeth*]; DON'T-KNOW vs. SUGAR-1 [*mouth*, below])

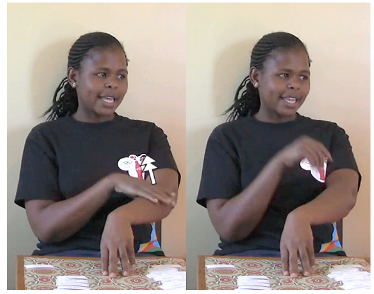


forehead minimal pairs within the head

DON'T-KNOW (*forehead*)

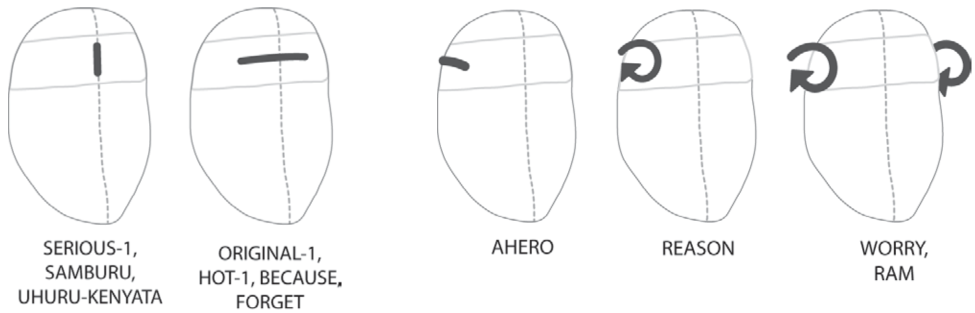
SUGAR-1 (*mouth*)



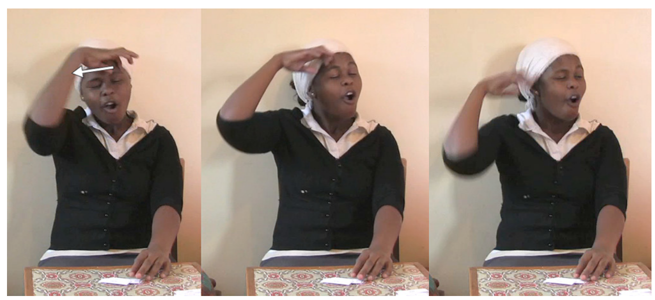


SOMALIA (*forehead*) SWEDEN (*forearm ventral*)

Parallel path/continuous contact: there are ~10 signs with parallel paths on *forehead*; these include both those on the center of the forehead (e.g., SERIOUS and HOT-1, below) and the ipsilateral side of the forehead, or temple (e.g., REASON and AHERO, below)



SERIOUS

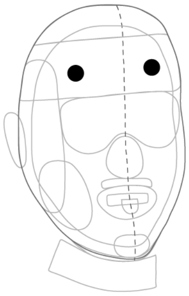


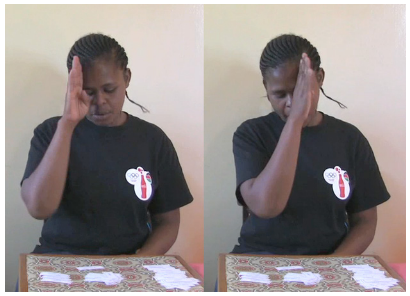
HOT-1

REASON

AHERO (town)

Dispersed signs: there are 2 dispersed signs on *forehead*, BUNGOMA-2 and NAIROBI-2





BUNGOMA-2

NAIROBI-2

Arc path: none

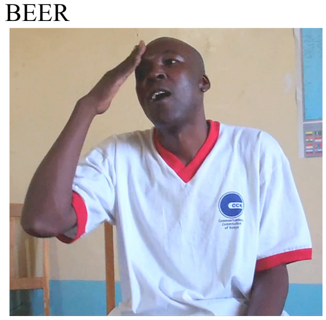
NAIROBI-2

Delineation/extent: the extent of the forehead can be shown by signs with signs with *flat* and *claw* handshapes, such as KAKAMEGA-1 and BEER on the center of the forehead and KITALE and AWARE on the ipsilateral side of the forehead or 'temple'; the extent of locations on the forehead were also documented by using a printout of the head to pencil in the area where the hand made contact by watching videos of all 79 signs and using the eyes and ears as visual landmarks; the drawings are shown below

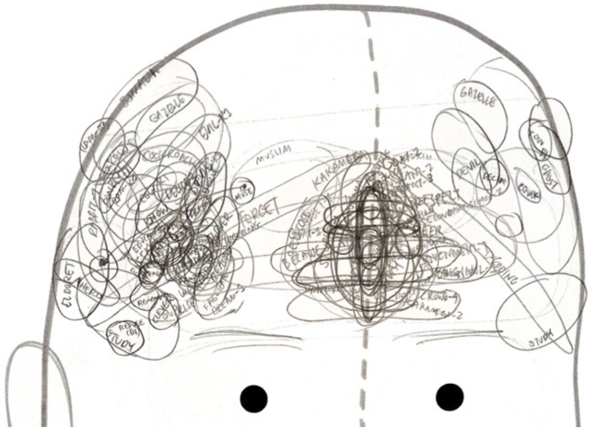
KAKAMEGA-1 (town)

BEER

KITALE (town)



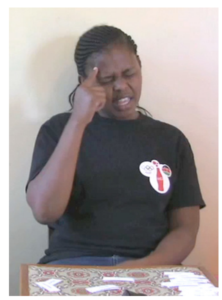
AWARE (beginning location)



pencil drawings of 79 locations on the forehead

Center point: the index finger contacts the center of the forehead in signs like INDIA and the ipsilateral side of the forehead in THINK(HARD)

INDIA



THINK(HARD)

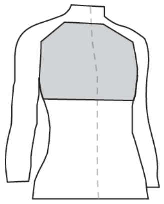
Phonetic variation & motivated origins: The drawing of all locations on the forehead above shows much of the phonetic variation in the *forehead* location (though only one token per sign). Essentially, the laterally-shifted locations (i.e., in the 'temple' area) exhibit wider variation than signs in the center; however, a further distinction emerged from the variation: signs for cognition appear closer to the eye (see first set of 15 tokens below) and are overwhelmingly one-handed, while signs representing the ears, horns, or antennae of an animal are shifted higher and more laterally (second set of 15 tokens) and are largely two-handed. However, there are no minimal pairs that distinguish these slightly different locations. Also, there are 19 signs on the temple that are unrelated to animals or cognition, but also exhibit variation in location in this area; e.g., KITALE (town) and AUNT-2 both have contact points similar to the cognition group, while AHERO and ELDORET (towns) are shifted laterally, like the animal signs. These 19 signs also have fairly consistent locations across tokens and signers, indicating that they are lexically specified. In sum, lateral (ipsi, contra) positions on the forehead can cover a wider area than the center, and within this area, two groups of signs form what might be called allo-phonomorphemes, after Johnston & Schembri's "phonomorphemes" (1999: 118). That is, in these two types of signs, their semantics predicts the specific of contact within the phonological area of *forehead* +*ipsi*. There is a range of acceptable contact points on the ipsilateral side of the forehead, but they are lexically-fixed, often on the basis of semantics.

phonetic tokens of fingertip contact on forehead +ipsi; for 4 signers and 6 signs (THINK, KNOW-THAT, REFUSE, STRESSED, IDEA, FOR)

phonetic tokens of animal signs at forehead +ipsi location. Top row (left-right): RAM, DONKEY; middle row: COW, COCKROACH, GAZELLE; bottom row: AFRICAN-BUFFALO, RABBIT

Motivated origins: see above

5.	***trunk upper***	61 signs


trunk upper


MOTHER-1


FRIEND

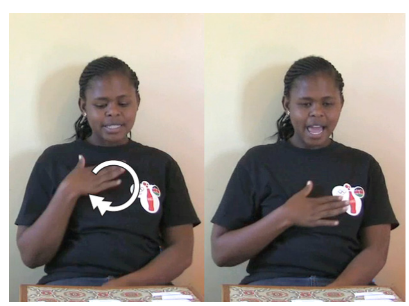
Minimal pairs: 23 pairs. *trunk upper* contrasts with 16 other locations in all major areas; in *neutral space* (e.g., MOTHER-1 vs. LATER [*NS*]), the head (e.g., BOARD-OF-GOVERNORS vs. NYANG'OMA-PRIMARY-SCHOOL [*cheek*; below]); non-dominant limb (e.g., VISITOR-2 vs. GHANA [*forearm ventral*]; *neck* (e.g., T-SHIRT-1 vs. KILL [*neck*]), *leg* (e.g., MOTHER-1 vs. SHEEP-1 [*leg*]); and other locations on the trunk (e.g., HAVE-1 vs. YOUTH [*trunk lower*; see #21]),


BOARD-OF-GOVERNORS (*trunk upper*)


NYANG'OMA-PRIMARY-SCHOOL (*cheek*)

Parallel path/continuous contact: there are around 17 signs with parallel paths (or continuous contact) on *trunk upper*; these include signs with straight vertical paths (e.g., TO-VISIT, SCIENCE-1, VEST) as well as straight horizontal paths (e.g., BRA-1, ZEBRA-2), 4 with circular paths that are parallel to the surface of the body (e.g., SCIENCE-1, LUCK, PLEASE), and one each with a zig-zag path (DENMARK), cross/X path (SWITZERLAND), and 'other' parallel path (EMBROIDERY)


TO-VISIT


SCIENCE-1

Dispersed signs: there are 2 dispersed signs on *trunk upper*, BOARD-OF-GOVERNORS (above) and LANCE-DEAF-ORPHANS (school) (a minimal pair with B.O.G., with an *L* handshape instead of *B*)

Arc path: one sign, US-2 (borrowed from Signed English) has an arc path that begins and ends on *trunk-upper*, and which reinforces the similarity of contact points on *trunk upper* in dispersed signs, this arc sign, and in different lateral positions (see delineation, below)

US-2

Delineation/extent: simultaneous contact on *trunk upper* with signs having large surface area handshapes illustrate properties about this location; first, it is too large for a single hand to cover, but a two-handed sign with *open* handshapes, as in HEALTH-2, shows the spread throughout the area, as does FRIEND (above); second, the *claw* and *C* handshapes help to illustrate the extent of the three different lateral positions on *trunk upper*: ipsilateral in RICH, center in HAVE-1, and contralateral in CANADA (below)

HEALTH-2

HEALTH-1

RICH

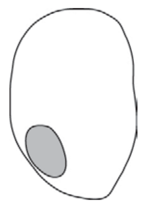
HAVE-1

CANADA

Center point & phonetic variation: index finger contacts the center of *trunk upper* in the sign ME (below, left); this is also a very common word whose phonetic tokens can vary somewhat in location, often toward the ipsilateral side (as well as varying by handshape, as shown below)

ME (phonetic tokens)

6. ***cheek*** 49 signs

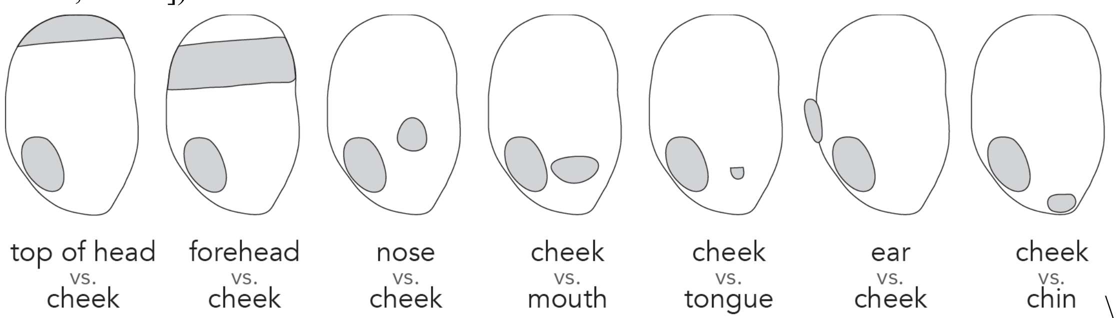


cheek

SIAYA (town)

WARTHOG-3

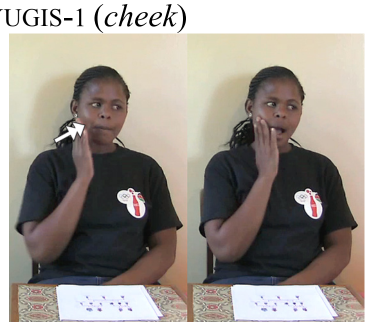
Minimal pairs: 23 pairs. *cheek* contrasts with 14 other locations in all major areas except neutral space: *trunk* (e.g., MOSQUITO-3 vs. NUMBER-1 [*shoulder*]), non-dominant limb (e.g., SHOP-1 (N.) vs. HOSPITAL-1 [*upper arm*]), *neck* (e.g., MEAT-2 vs. ROBBER-1 [*neck*]), and other locations on the head (e.g., OYUGIS-1 vs. SUDAN-1 [*nose*; below]; MOTHER-2 vs. FUNERAL-1 [*mouth*, below])



cheek minimal pairs within the head

OYUGIS-1 (*cheek*)

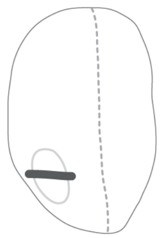
SUDAN-1 (*nose*)



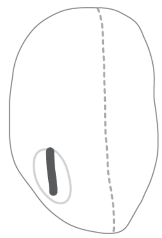
MOTHER-2 (*cheek*)

FUNERAL-1 (*mouth*)

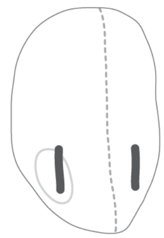
Parallel path/continuous contact: there are at least 8 signs with continuous contact on *cheek*. These include those with vertical paths (e.g., MEAT-2) and horizontal paths (e.g., BREAD-1); there are also signs that contact both cheeks, in a variety of ways: simultaneous contact on both cheeks at the same time, with one hand that spreads to both cheeks (e.g., OLD-1, [below], CUSHITIC) or two hands that move down at the same time (e.g., HIV/AIDS-2), or one hand in a dispersed sign that first contacts one cheek and then the other (e.g., DIRTY-1, [below]), or two hands that alternatingly move down first one cheek and then the other (e.g., TO-CRY-1)



BREAD-1
CAT



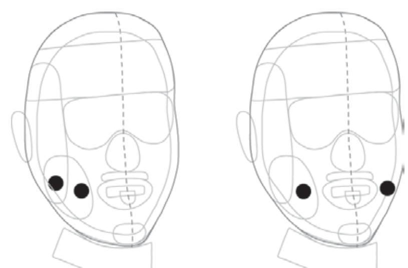
MAN
MEAT-2



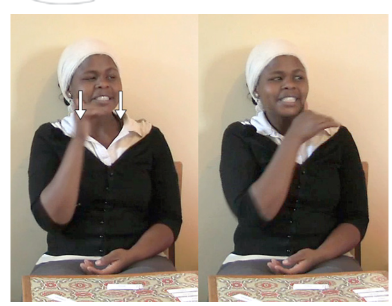
HIV/AIDS-2, OLD-1,
DIRTY-1, CUSHITIC

OLD-1

Dispersed signs: there are 9 dispersed signs on *cheek*; 4 of these have horizontally-positioned sub-locations on the ipsilateral cheek (e.g., SIAYA [above], NAKURU [below]) and 5 have sub-locations on the ipsilateral cheek and then the contralateral cheek (e.g., MOTHER-2 [above], DIRTY-1 [below])



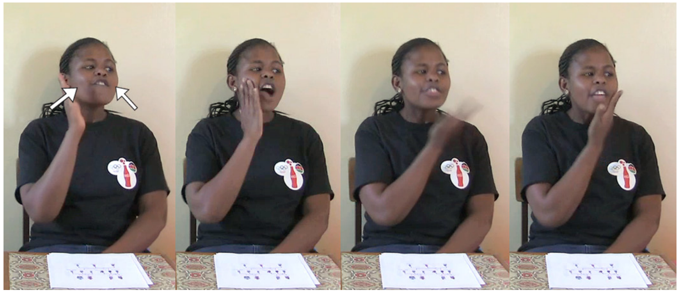
NAKURU (town)



DIRTY-1

Arc path: there are no *arc* path signs on *cheek* in the KSL Lexical Database; however, one person's namesign from the area of data collection has a cupped hand that makes a horizontal arc path on the ipsilateral cheek; the endpoints of contact in this namesign fit the same location boundaries demonstrated by the other sign types here

Delineation/extent: some signs with *flat* handshape contacting the location show the extent of *cheek*, such as MOTHER-2 (above) and FATHER-2 (below), as well as UPSET-4 with a *claw* handshape (below)



FATHER-2

UPSET-4

Center point: the center of *cheek* can be illustrated by fingertip contact with one selected finger; e.g., the index finger in SHOP-1 and the thumb in AIDS-1, below

SHOP-1 (N.)

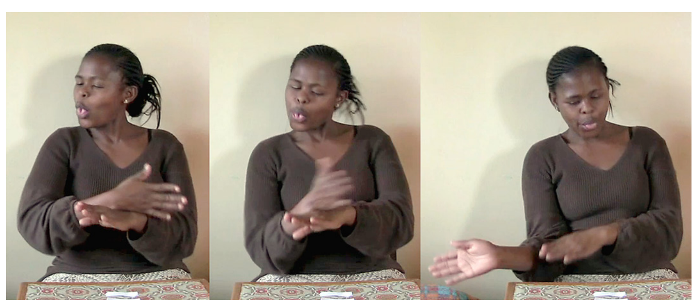
AIDS-1

Phonetic variation: no special information on phonetic variants were found in the data

Motivated origins: van der Kooij finds that the cheek location in NGT is "typically not motivated" (2002: 173); in KSL, however, *cheek* has several semantic mappings: tusks (e.g., WARTHOG-3, TUSKER [brand of beer]), cheekbones in a sunken face (e.g., AIDS-1), and the skin on the face that can become lined in old age (e.g., OLD-1), dirty in appearance (e.g., DIRTY-1), or covered with a beard (e.g., MAN)

7.	***forearm dorsal***	47 signs

forearm dorsal



TIME-FLY

TABAKA-1

Minimal pairs: 9 pairs. *forearm dorsal* contrasts with 8 other locations, on the trunk (e.g., HOUR-1 vs. MALINDI [*trunk-lower*]), head (e.g., MINUTE-2 vs. KIPSIGIS [*mouth*]), and non-dominant limb (e.g., MINUTE-2 vs. INFECT-2 [*forearm ventral*]). The only location on the entire non-dominant limb it contrasts with is *forearm ventral*, highlighting the contrastiveness of the two sides of the forearm.

MINUTE-2 (*forearm dorsal*)

INFECT-2 (*forearm ventral*)

Parallel path/continuous contact: there are 12 signs with parallel paths on *forearm dorsal*, including TO-SHAVE and SLOW-2 (below), AFRICA-2, HOUR, DUTY-TEACHER, BLOOD-2, SHINE-SHOES, etc.

TO-SHAVE

SLOW-2

Dispersed signs: none

Arc path: none

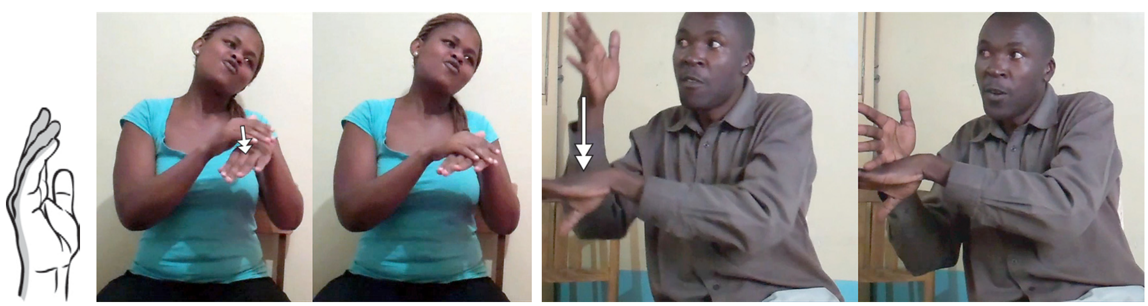
Delineation/extent: due to the size of the location and the fact that both hands cannot be used for simultaneous contact, most of the sign evidence for the extent of the location involve parallel path/continuous contact signs, like those above

Center point & phonetic variation: one particularly frequent sign occurs in this location, TIME, which is frequent both in types and tokens because in addition to the abstract noun meaning, it functions with the adverbial meaning *'at the time when'*, as well as occurring in several compounds (DURING, SOMETIMES-1, MOMENT, etc.). An inspection of these tokens in the video data shows that the actual phonetic point of contact can vary in these signs from just below the wrist to the back of the hand. While it has a semantic mapping to the wrist, this formational data is interpreted as evidence that the sign references the entire back of the forearm rather than a constrained phonological location solely at the wrist

phonetic tokens of TIME

Motivated origins: there are many signs semantically associated with time that happen on forearm dorsal; i.e., TIME, HOUR, MINUTE-1, MINUTE-2, DATE-1, CLOCK, DURING-2, EFFECT-2, WHEN-2, TIME-FLY

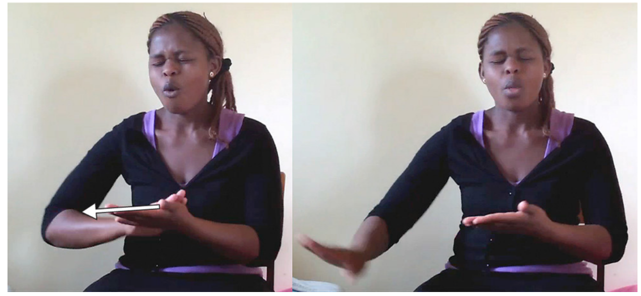
8.	***h2 back***	40 signs



h2 back GOOD FALSE

Minimal pairs: 18 pairs. *h2 back* contrasts with 13 other locations, on the trunk (e.g., ADVISE vs. FEAR [*trunk-upper*]), head (e.g., GOOD vs. SATURDAY-2 [*eye*]), neck (e.g., ADVISE vs. COMLAIN), neutral space (e.g., LAMP-2 vs. WHEN), and non-dominant limb (e.g., GOOD vs. BABY-3 [*elbow*]); h2 back also contrasts with h2 palm in four minimal pairs (e.g., FLAT-2 vs. SMOOTH [below]), illustrating the contrastiveness of the ventral and dorsal sides of the limb

FLAT-2 (*h2 back*)



SMOOTH (*h2 palm*)

Parallel path/continuous contact: there are 5 signs with parallel path / continuous contact on *h2 back*. These include FLAT-2 (above), BIOLOGY and OPPOSITE-1 (below) ENGLISH-1, INFLUENCE, , and COMFORTABLE

BIOLOGY

OPPOSITE-1

Dispersed signs: there are 3 dispersed signs on *h2 back*, two that are homophones, HOW-MANY (below) and MATHEMATICS-2, and a near-homophone, TO-COUNT, which takes the same basic repeat-syllable-in-two-sublocations on *h2-back* and adds a horizontal path movement through space

HOW-MANY

Arc path: no arc paths begin and end on *h2 back*

Delineation/extent: signs with an *open* handshape as in COPY show the extent of the *h2 back* location, as does a sign with a *flat* hand, MENSTRUAL-PAD

COPY (Signer K1)   COPY (Signer B1)   MENSTRUAL-PAD

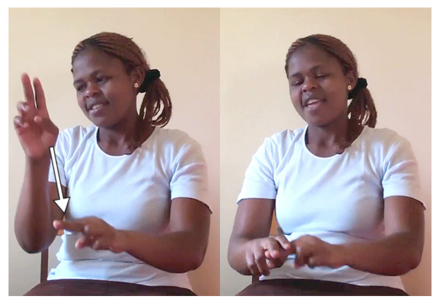
Center point: the fingertips contacts the center of this location in signs like EFFECT-1 and EMBU, below


EFFECT-1

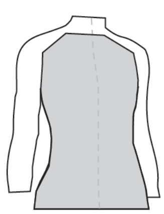

EMBU

Phonetic variation: point of contact on *h2-back* determined by h2 handshape; e.g., when h2 has all fingers extended, contact happens at the center point (e.g., NATIONAL-BANK, EFFECT-1, EMBU), but when less than all fingers are extended, the contact point moves to the center of the extended fingers, as in TO-SIT below


NATIONAL-BANK


TO-SIT

9.	***trunk whole*** ▼	38 signs

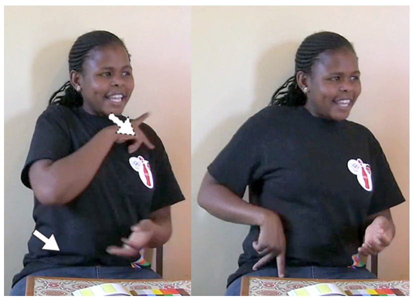

trunk whole

NYANGWESO-SCHOOL (deaf school)

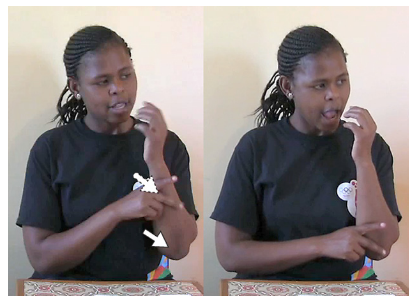
Minimal pairs: 2-4 pairs. *trunk whole* contrasts with 2 other locations in *neutral space*; e.g., OWN-1 vs. ONLY-2 (below), and BELLICOSE-3 vs. COOK-1; also, depending on how differences in lateral symmetry features are calculated for a cluster of dispersed signs on *trunk whole*, including KING (below) and NYANGWESO-SCHOOL (above), this location may also contrast with two additional locations, *elbow* in KERUGOYA-2 and *side of face* in KAREN (both contrasting with KING)

OWN-1 (*trunk whole*)

ONLY-2 (*neutral space*)

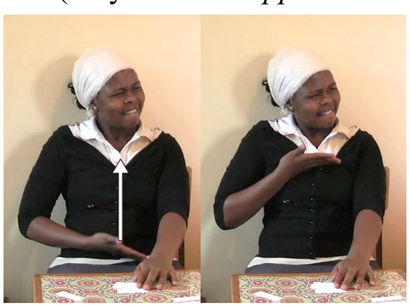


KING (*trunk whole*)

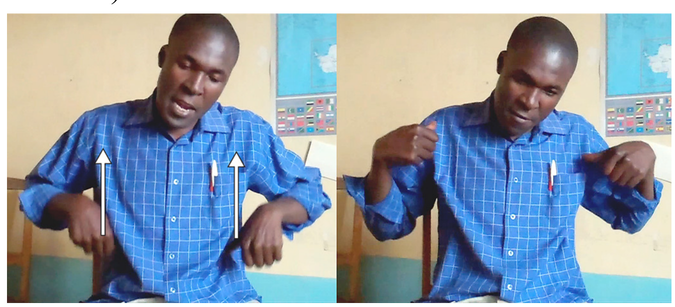


KERUGOYA-2 (*elbow*)

Parallel path/continuous contact: there are around 18 signs with parallel paths on *trunk whole*; these are mostly vertical paths, such as UPSET-3 and LIVE-2 (below), but also a few horizontal paths, such as ZEBRA-3 (below), NORWAY, and JACKET; there are no circle paths on *trunk whole* (only on *trunk upper* and *trunk lower*)

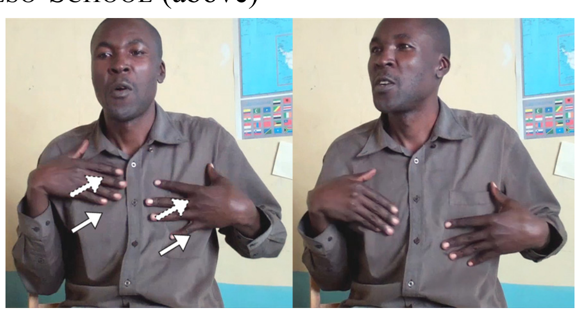


UPSET-3



LIVE-2

Dispersed signs: there are 6 dispersed signs on *trunk whole*; at the word-level, these are positioned vertically in BODY and ZEBRA-3 (below), and diagonally in KING, CHRISTIAN, SISTER, and NYANGWESO-SCHOOL (above)



BODY

ZEBRA-3

Arc path: no relevant signs that begin and end on *trunk upper* with perpendicular path

Delineation/extent: this location is too large for the hands to spread completely throughout it simultaneously, but some two-handed signs that contact the center area of the torso show the extent, including RWANDA and SHOCK, below

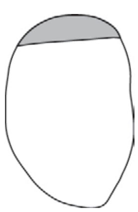
RWANDA

SHOCK

Center point: no relevant signs

Phonetic variation: no relevant signs

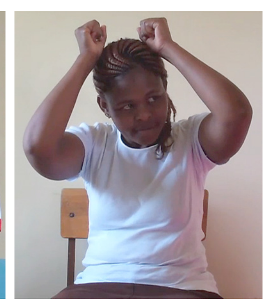
10.	***top of head*** Ō	31 signs



top of head

PINEAPPLE-2

MONDAY

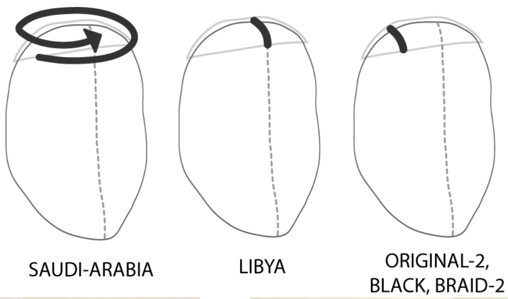


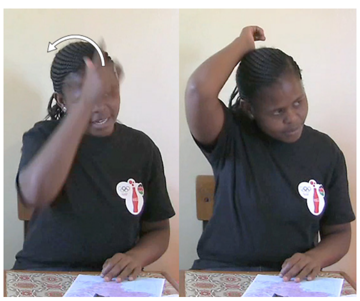
CARRY-ON-HEAD-2

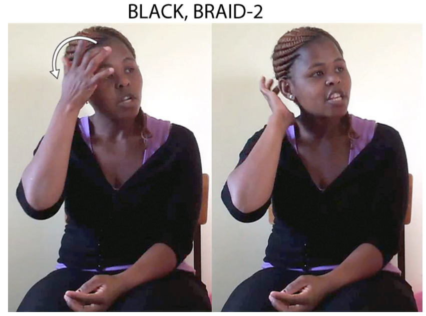
Minimal pairs: 15 pairs. *top of head* contrasts with 10 other locations in three major areas: *trunk* (e.g., DONKEY-2 vs. WOMAN [*trunk upper*]), non-dominant limb (e.g., MONDAY vs. GOOD [*h2 back*]), and other locations on the head (e.g., LAMU [town] vs. WILLIAM-RUTO [politician]; HAT vs. SHAME-1 [*face*, below])

HAT (*top of head*) SHAME-1 (*face*)

Parallel path/continuous contact: there are at least 5 signs with continuous contact on *top of head*. These include straight paths (e.g., LIBYA and ORIGINAL-2, below) and one circle path sign, SAUDI-ARABIA







LIBYA ORIGINAL-2

Dispersed signs: none

Arc path: there are no *arc* path signs on *top of head* that begin and end on the location; only those whose arc path follows the arc of the skull and a couple that arc coming off of the head (e.g., PARLIAMENT-1, BUS-4)

Delineation/extent: a few handshapes with extensive surface area contact *top of head*, include HAT (above) with an *open* handshape, MONDAY (above) with a *flat* handshape, and LAMU (below) with a *claw* handshape whose wide aperture fits the larger area of this location

LAMU

Center point: NO

Phonetic variation: N/A

Motivated origins: types of motivation on the head include reference to things placed on or over a human head (e.g., HAT, LAMU, CARRY-ON-HEAD-2, UNIVERSITY, NURSE, ARMY, BLANKET, PAKISTAN, etc.), references to animal heads (HARE-1, DONKEY-2) and to the metaphorical heads of inanimate objects (PINEAPPLE, TAXI-1 HUT-1); also, behaviors related to the head are refenced in some signs (e.g., POLITE, HONEST-3, MONDAY)

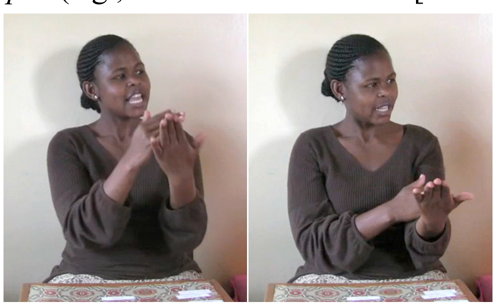
11.	***forearm ventral***	30 signs

forearm ventral

BIBLE-1

TO-STEAL

Minimal pairs: 3 pairs. *forearm ventral* only contrasts with 3 other locations, *h2 palm* (e.g., LESSON-1 vs. PLAN-2 [below]), *forearm dorsal* (e.g., INFECT-2 vs. MINUTE-2 [see #7]), and *trunk-upper* (e.g., GHANA vs. VISITOR-2 [below])



LESSON-1 (*forearm ventral*)

PLAN-2 (*h2 palm*)

GHANA (*forearm ventral*)

VISITOR-2 (*trunk-upper*)

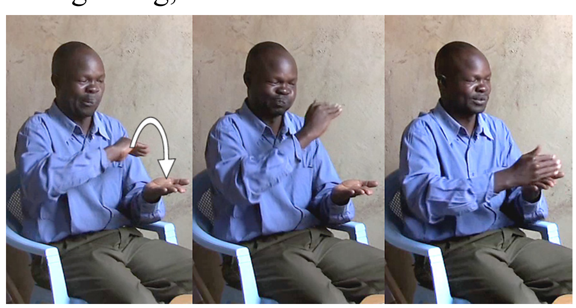
Parallel path/continuous contact: there are around 10 signs with parallel path movement on *forearm ventral*, but while most of these move parallel to the surface of the arm, the are perpendicular to the axis of the arm, such TO-STEAL above, which does not provide information about the extent of the location; GHANA and DESTROY-2 are the only parallel path sign along the axis of the forearm that makes actual contact; the others only move above (MUSIC, UGALI-2, SCHEDULE) or below (STEAL, UNDER, DEPUTY-HEADMASTER) the location (above) (below)

Dispersed signs: there are 5 dispersed signs on *forearm ventral*: LIST and SUPPORT (below), LESSON-1 (above), BIBLE-1 (above), and ENUMERATE/EXPOUND; the exact points of contact in SUPPORT differs, though the *fist* handshape on h2 may play a role in shifting the first sub-location to a more proximal point

LIST

SUPPORT

Arc path: there is 1 arc path sign on forearm ventral, FUND, below; note that this sign does not make body contact at the beginning, but starts over the forearm



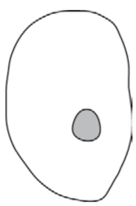
FUND

Delineation/extent: similar to *forearm dorsal*, forearm ventral does not have simultaneous handshape contact that clearly spreads throughout the location; instead there is one sign, ARREST-1 (below), that shows contact along the forearm

ARREST-1

Center point: there are no signs that are informative about the default center of this location

12.	***nose***	30 signs

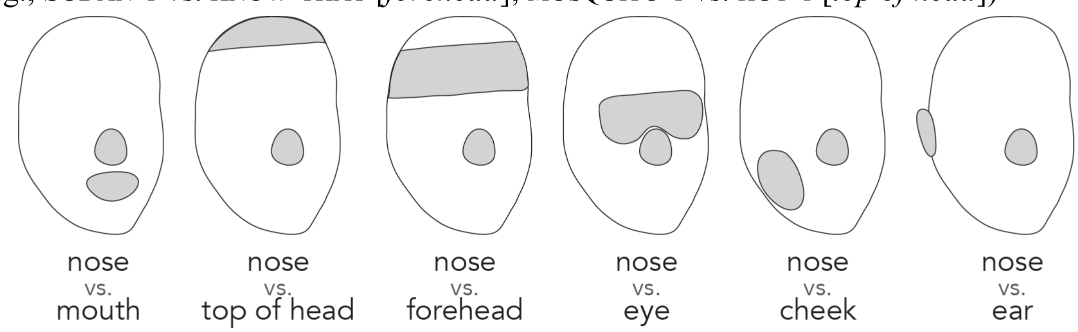


nose

SUDAN-1

KUJA-SCHOOL

Minimal pairs: 18 pairs. *nose* contrasts with 11 other locations in all major areas except neutral space: *trunk* (e.g., INCOME vs. ME [*trunk-upper*]), non-dominant limb (e.g., LIE-1 vs. RANK [*h2 palm*; below]), *neck* (e.g., BORED-1 vs. SWEET [*neck*; below]), and other locations on the head (e.g., SUDAN-1 vs. KNOW-THAT [*forehead*]; MOSQUITO-1 vs. HUT-1 [*top of head*])



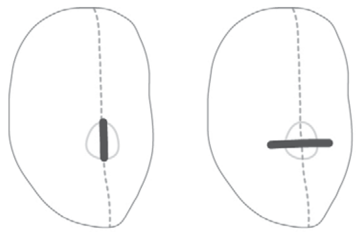
nose minimal pairs within the head

LIE-1 (*nose*)

RANK (*h2 palm*)

BORED-1 (*nose*) SWEET (*neck*)

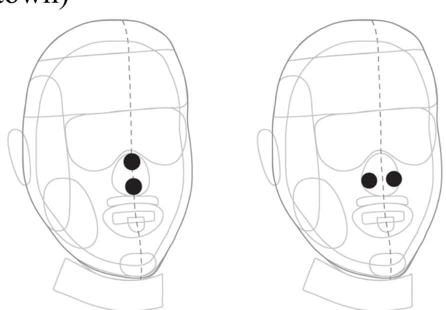
Parallel path/continuous contact: there are 6 signs with a parallel path on *nose*, including vertical paths (e.g., to-SMELL) and horizontal paths (e.g., MONEY-3, below)

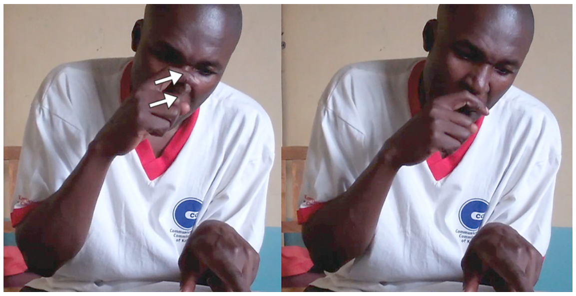


TO-SMELL, GOOD-SMELL MONEY-3, WEBUYE BAD-SMELL, RAT

MONEY-3

Dispersed signs: there are at least 3 dispersed signs on *nose*, one with a vertically positioned sub-locations, AGA-KHAN-SCHOOL, and two with horizontal sub-locations, MWAI-KIBAKI-1 and a homophone, NYERI (town)





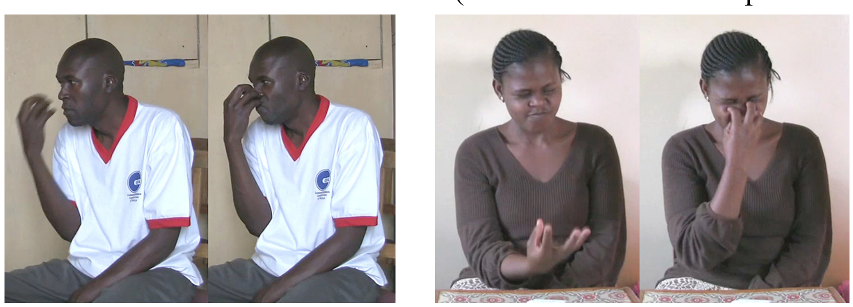
AGA-KHAN-SCHOOL

MWAI-KIBAKI-1

Arc path: one sign, JEALOUS-1, is nearly identical to AGA-KHAN-SCHOOL, except that instead of moving from one point to another, it makes a distinct arc path away from the body, but uses the same beginning and end points

JEALOUS-1

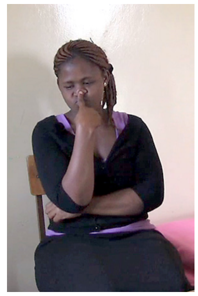
Delineation/extent: JEALOUS-2, below, with a *claw* handshape is semantically related to JEALOUS-1, and seemingly accomplishes the same metaphor of jealousy represented by a large nose, but in a different way;[2] in JEALOUS-2, the claw surrounds the entire nose, though the two signers' articulations shown below differ slightly: the location contact with the lefthand signer touches only the nose, while the *claw* handshape for the righthand signer surrounds the area on the face around the nose (which could be an emphatic form)



JEALOUS-2 (two signers' versions)

Center point: in the sign INCOME, below, the index finger contacts center of the nose

[2] Note: the origin of this metaphor is not known; it is a homophone with a sign 'nosy' in ASL, but has older KSL origins (see Akach 1991a) than most signs that have been borrowed from ASL

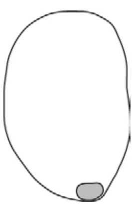


INCOME

Phonetic variation: N/A

Motivated origins: signs on the nose can reference smells (e.g., FLOWER-2, FLOWER-2,WEBUYE, a town with a paper mill), jewelry on the nose (SUDAN-1, RENDILLE), the characteristics of individual noses (e.g., MWAI-KIBAKI-1, WILLIAM-RUTO-1), and metaphors (e.g., LIE-1, JEALOUS-1, JEALOUS-2)

13. *chin* ◡ 29 signs

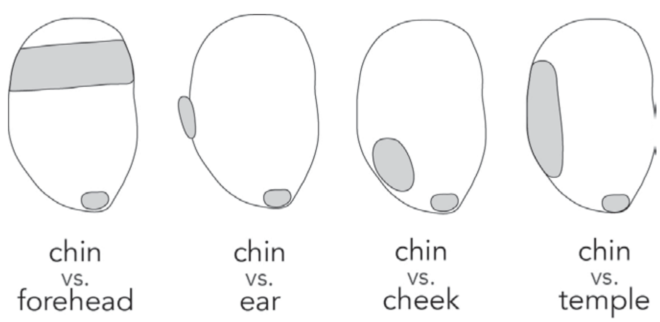


chin

BOY-1/MALE-1

LAUGH

Minimal pairs: 13 pairs. *chin* contrasts with 9 other locations in most major areas: *trunk* (e.g., TURKANA vs. NUMBER-1 [*shoulder*]), non-dominant limb (e.g., LUO-2 vs. AIRPORT-3 [*h2 palm*; below]), and other locations on the head (e.g., BORROW vs. BUNGOMA-1 [*forehead*]; BORROW vs. GOSSIP [*cheek*])

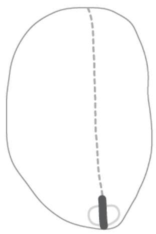


chin minimal pairs within the head

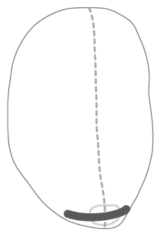
LUO-2 (*chin*)

AIRPORT-3 (*h2 palm*)

Parallel path/continuous contact: there are at least 4 signs with continuous contact on *chin*, including vertical paths like PINK (below) and horizontal paths, like DRY and ADULT-2



PINK, MALE-2



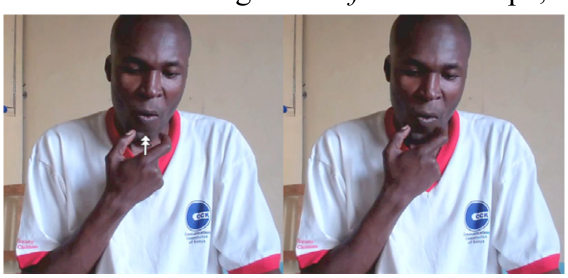
DRY, ADULT-2

PINK

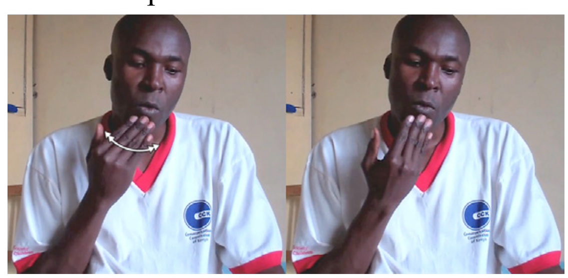
Dispersed signs: there are no dispersed signs on the chin in the database

Arc path: none

Delineation/extent: signs with *flat* handshape, *claw* handshape



LUO-1



LUHYA

Center point: index finger contacts center of location in Turkana, below

TURKANA

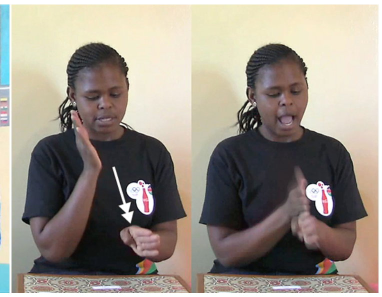
Phonetic variation: N/A

Motivated origins: This location references facial hair to indicate maleness (e.g., MALE-1, MALE-2, BOY-1, FATHER-1); also, it references a specific tribal practice of removing lower teeth or jewelry at this location to indicate historical ethno-linguistic groups (e.g., LUO-1, LUO-2, NILOTIC, LUHYA, BANTU, TURKANA)

14.	***h2 radial*** ⥮	29 signs

h2 radial

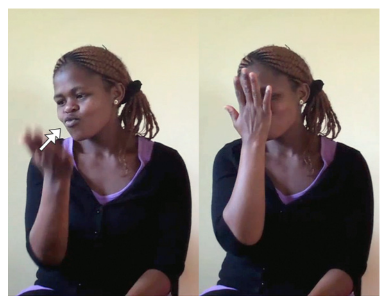
FIGHT-FOR-1



BUSIA-2

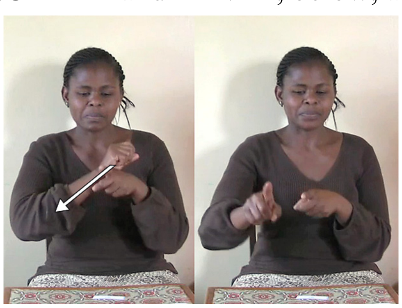
Minimal pairs: 0 pairs. one near minimal pair, MANY-1 vs. PIG-1, is shown below, but these probably differ by the mouth position in PIG-1 as well as the possible additional information about the shape of h2 (i.e., a *fist* handshape)

MANY-1



PIG-1

Parallel path/continuous contact: there are 7 signs with continuous contact on *h2 radial*, such as EJACULATE-1 and MANY-2, below, as well as FULU-FISH-1 (below), TEA-2 and SOON



EJACULATE-1

MANY-2

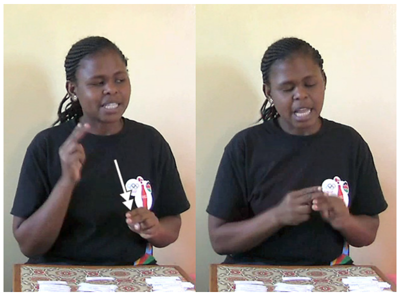
Dispersed signs: none

Arc path: no arc paths begin and end on *h2 radial*

Delineation/extent: a number of signs shown here have handshapes that cover the extent of this location; e.g., BUSIA-2, MANY-1, MANY-2, and WORK

Center point: there are no signs that are informative about the default center of this location because the only fingertip contact is in two variants for FULU-FISH, one shown below, in which the location is shifted

Phonetic variation: the same rule observed for all h2 locations holds here, in which the contact point shifts to the fingers when there are fewer than all extended; this is seen in KAPSABET and FULU-FISH-1 (below); YEAR-1 (below) is the only sign that does not follow this pattern

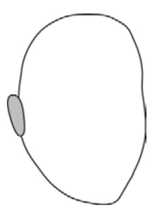


KAPSABET

FULU-FISH-1

YEAR-1

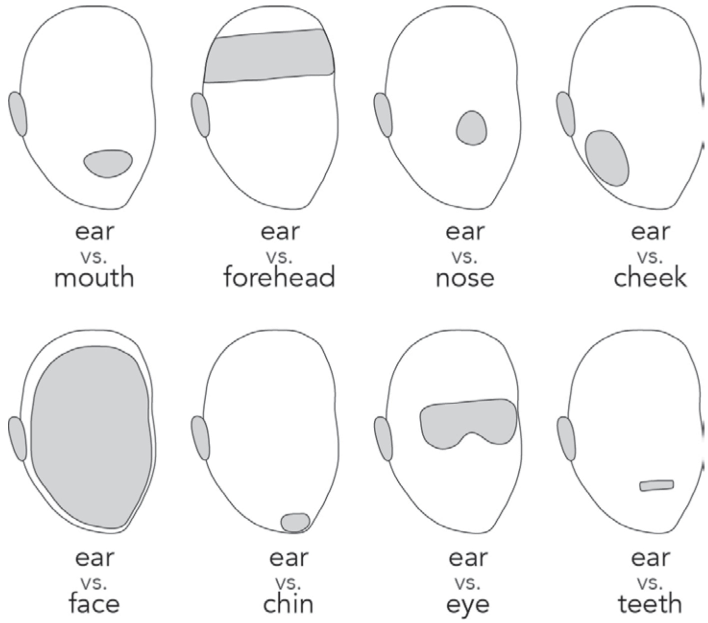
15.	***ear***	28 signs



ear

KISII-1 (town)

Minimal pairs: 18 pairs. *ear* contrasts with 12 other locations in most major areas: *trunk* (e.g., CRAZY vs. MALINDI [*trunk lower*]), non-dominant limb (e.g., COLLEGE-1 vs. SITUATION [*h2 palm*]), and other locations on the head (e.g., HEARING vs. SPEAK-1 [*mouth*]; DEAF-2 vs. SEE-2 [*eye*], COLLEGE-1 vs. MBITA [cheek])

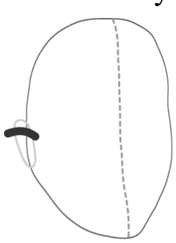


ear minimal pairs within the head

HEAR-1 (*ear*)

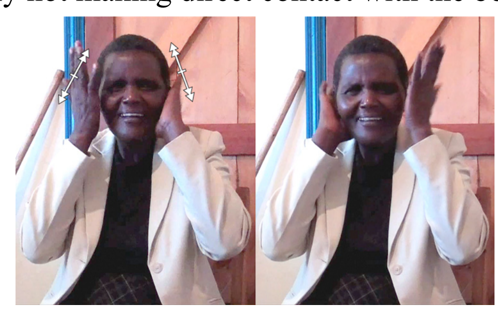
GOSSIP (*cheek*)

Parallel path/continuous contact: there are around 6 signs with parallel path on *ear*; all of these move laterally across the surface of the ear, usually not making direct contact with the body



EGG-1, BAT-1, COLLEGE

EGG-1



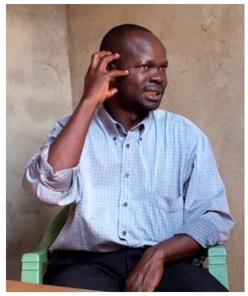
BAT-2

Dispersed signs: none

Arc path: none

Delineation/extent: the extend of the ear is shown in signs with a *flat* handshape (e.g. DEAF-1, below), *claw* handshape (COLLEGE-1, below); also, a sign that folds the ear down, BAT-2, demonstrates distinction of *ear* as a characteristic place that is not simply the side of the face or head


DEAF-1


COLLEGE-1


BAT-2

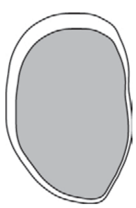
Center point: the index finger contacts the center of *ear* in tokens for DEAF-2, below


DEAF-2

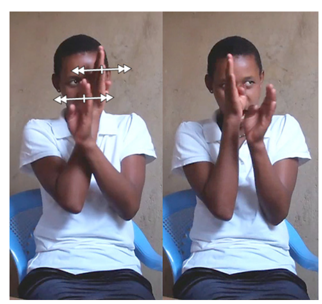
Phonetic variation: N/A

Motivated origins: a large number of signs on *ear* relate to hearing (e.g., DEAF-1, HEAR-1, BUBU, etc.) as well as jewelry or modification of the ear (e.g., MAASAI, NANDI), and physical characteristics of ears (e.g., OBAMA-1, BAT-2)

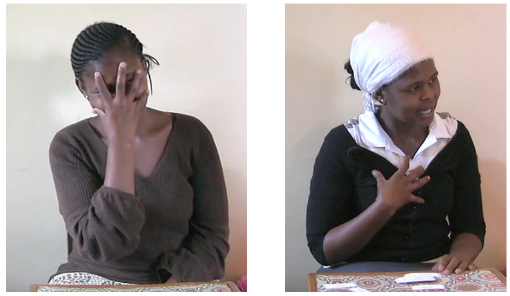
16. ***face*** O	28 signs


face


NILE-PERCH-2

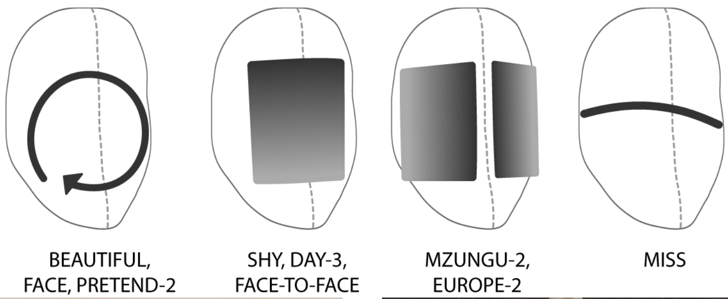

HIDE

Minimal pairs: 6 pairs. *face* contrasts with 6 other locations in most major areas: *trunk* (e.g., SHAME-1 vs. RETIRE [*trunk upper*; below]), non-dominant limb (e.g., FACE vs. HOUR [*forearm dorsal*]), and other locations on the head (e.g., FACE vs. WHO [*mouth*]; SHAME-1 vs. HAT [*top of head*])



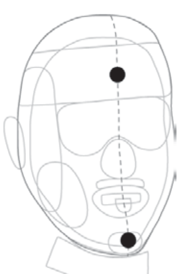
SHAME-1 (*face*) RETIRE (*trunk upper*)

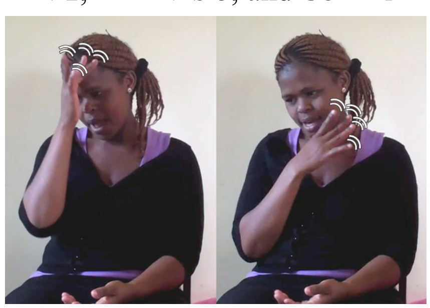
Parallel path/continuous contact: there are at least 6 signs with continuous contact on *face*, some with circle paths (e.g., BEAUTIFUL), and some with straight paths (e.g., SHY, MISS); signs with path shapes that involve a large handshape covering the area during the path (i.e., a *flat* or *open* handshape) are shown as shaded areas below (e.g., DAY-3, MZUNGU-2)



DAY-3 MZUNGU-2 (European person)

Dispersed signs: there are 6 dispersed signs on *face*: PARENTS-2 and PRETEND-1 (below), IGNORANT-3, ORPHAN-2, PARENTS-3, and GOAT-1



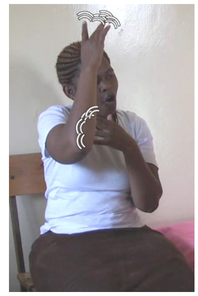


PARENTS-2 PRETEND-1

Arc path: none

Delineation/extent: signs that contact *face* with a single handshape with a large surface area, such as the *open* handshape in SHAME-1, above, exhibit the extent of this location; this is also demonstrated by 2 two-handed signs, SECONDARY-SCHOOL-2 and JOGOO-HOUSE-1 (a Kenyan government building), below, in which both hands simultaneously contact the same sub-locations as in the dispersed signs

SECONDARY-SCHOOL-2

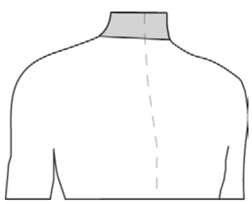


JOGOO-HOUSE-1

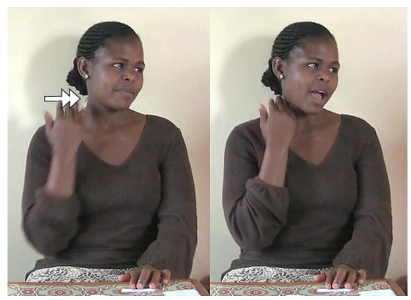
Center point: N/A

Phonetic variation: N/A

17.	***neck***)(	26 signs

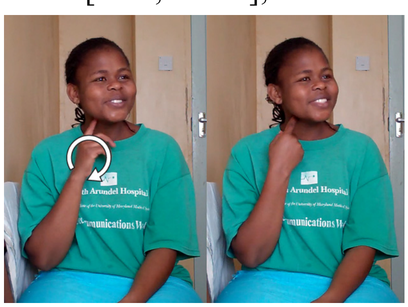


neck

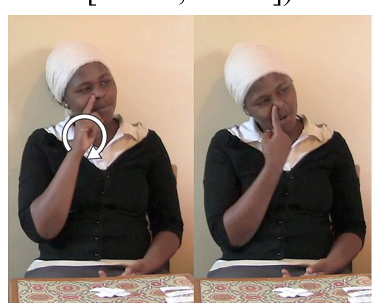


BLOOD-1

Minimal pairs: 11 pairs. *neck* contrasts with 9 other locations in all major areas: *neutral space* (e.g., PASTOR-1 vs. SAMOSA-2), *trunk* (e.g., KILL vs. T-SHIRT-1 [*trunk upper*]), non-dominant limb (e.g., SWEET vs. START-2 [*h2 between fingers*]), and other locations on the head (e.g., SWEET vs. BORED-1 [*nose*; below]; EASY-2 vs. MEAT-3 [*mouth*; below])



SWEET (*neck*)

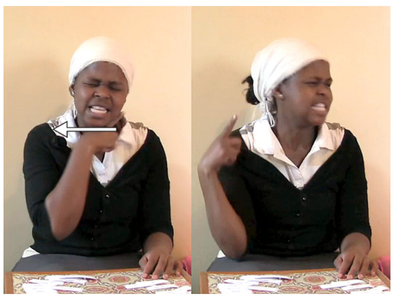


BORED -1 (*nose*)

EASY-2 (*neck*)

MEAT-3 (*mouth*)

Parallel path/continuous contact: there are around 9 signs with a parallel path on *neck*; these include lateral paths, such as KILL and ROBBER-1 (below), as well as vertical paths, such as LIKE (below), WANT, VOICE, THIRSTY and VOMIT-1



KILL

ROBBER-1

LIKE

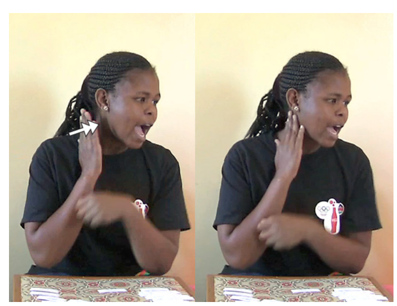
CRY-FOR-HELP

Dispersed signs: none

Arc path: none

Delineation/extent: the sign INTERNATIONAL-CRIMINAL-COURT-2, with an *open* handshape grips the entire front of the neck, the sign MURGAN’A with a *flat* hand contacts the ipsilateral side of the neck, and the sign ROBBER-2 contacts the contralateral side of the neck with the forearm

INTERNATIONAL-CRIMINAL-COURT-2



MURGAN’A (deaf school)

ROBBER-2

Center point: SWEET, above, shows the canonical center point on the ipsilateral side of *neck*, but there are no signs with a single fingertip contact at the center of the neck in the database (the 2004 video dictionary [Mjitoleaji Productions] shows a sign variant for COMPLAIN with a *1* handshape on the center of the neck, but it has not been observed in use in the research area for this project)

Phonetic variation: N/A

Motivated origins: signs on the neck reference voicing (VOICE, SOUND, COMPLAIN-1 and CRY-FOR-HELP), or relate to savoring (SWEET, LIKE, and WANT), or to an assault to the vulnerable neck (BLOOD-1, KILL, ROBBER-2 and INTERNATIONAL-CRIMINAL-COURT-2)

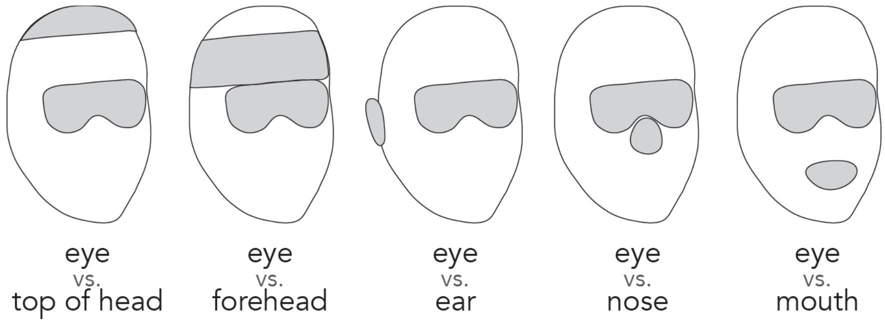
18.	***eye*** ∞	24 signs

eye

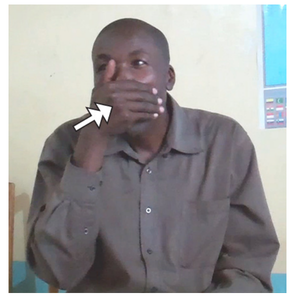
NILE-PERCH-1

COAST-3

Minimal pairs: 9 pairs. *eye* contrasts with 9 other locations in all major areas; in *neutral space* (e.g., GLASSES-1 vs. CARD [*NS*]), *trunk* (e.g., SEE-1 vs. ME [*trunk upper*]), non-dominant limb (e.g., SATURDAY-2 vs. BABY-3 [*elbow*]; and other locations on the head (e.g., SATURDAY-2 vs. AL-SHABAAB [*mouth*, below]; SEE-2 vs. HOME-1 [*nose*])

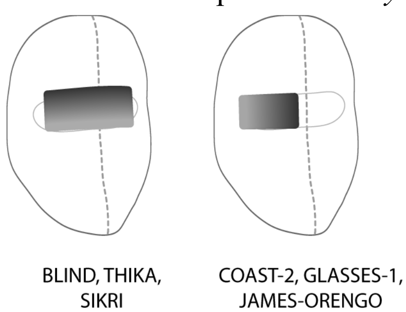


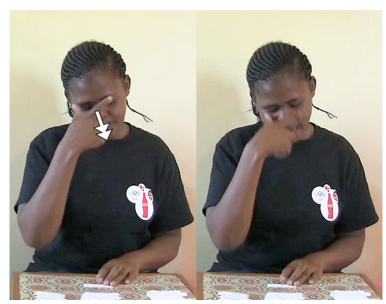
SATURDAY-2 (*eye*)



AL-SHABAAB (*mouth*)

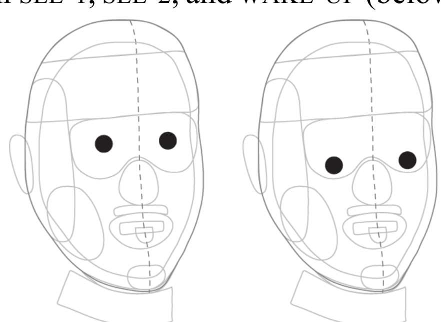
Parallel path/continuous contact: there are 7 signs with continuous contact on *eye*; this includes vertical straight paths, such as THIKA (below), as well as horizontal paths, such as GLASSES-1; there are no circle paths in the *eye* location





THIKA (town)

Dispersed signs: there are 2 dispersed signs on *eye*, MARTHA-KARUA and SLEEP-6, below; SLEEP-6 does not contact the body and has been interpreted as being connected to the same area below the eye shown in SEE-1, SEE-2, and WAKE-UP (below)



MARTHA-KARUA SLEEP-6

Arc path: none

Delineation/extent: the extend of the *eye* location is shown in a sign with a *curved/cupped* handshape that covers the eyes, such as SATURDAY-2 (above), as well a *claw* handshape in the sign MARTHA-KARUA (above), which shows the delineation of this location on either side of the midline of the body

Center point: when the index finger contacts this location, it does not do so at the center of the eye, but is shifted to a position just below the eye, on the cheekbone, which is why the area is depicted as it is in the shaded areas above

SEE-1 SEE-2 WAKE-UP

Phonetic variation: N/A

Motivated origins: some of the signs in the *eye* location reference vision (e.g., BLIND, SEE-2, VISION); reference objects at the eyes, either as the objects themselves (e.g., GLASSES-1, JAMES-ORENGO) or handling the object (e.g., BINOCULARS); reference behaviors involving the eyes (e.g., SEVENTH-DAY-ADVENTIST, SATURDAY-2); or reference characteristics of particular eyes (e.g., MARTHA-KARUA, CHINA)

19.	***h2 whole***	24 signs

h2 whole

AVOCADO-2

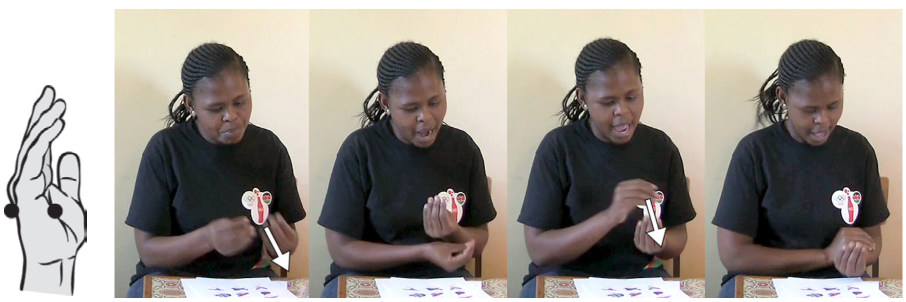
ACHIEVE

Minimal pairs: 0 pairs.

Parallel path/continuous contact: there are 6 signs with parallel path / continuous contact on *h2 whole*. These include signs with physical contact, such as U.S.-DOLLAR and DIVORCE, as well as signs that do not make direct contact; e.g., AVOCADO-2 (above), BANANA (below), and CONDOM-2

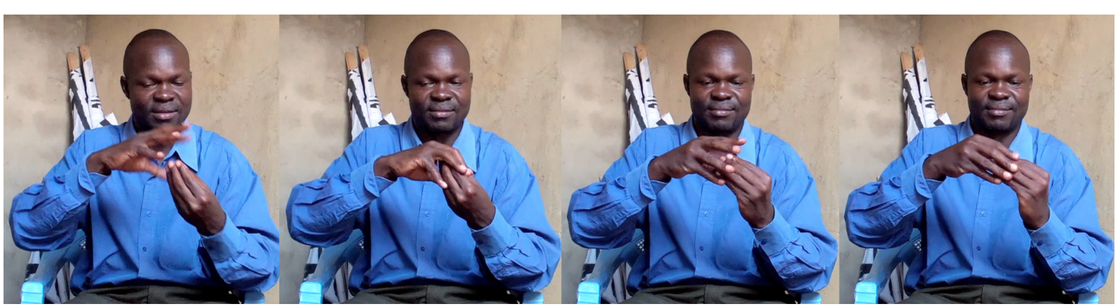
U.S.-DOLLAR

Dispersed signs: there are 3 dispersed signs on *h2-whole*; in the case of BANANA and SYLLABUS-1, these are designated as *h2 whole* because the sub-locations implicate the entire hand (note: ventral/dorsal sides appear to be the default sides of the hand on the basis of frequency and lexical contrast, as opposed to the ulnar/radial sides)



BANANA

SYLLABUS-1



TO-CREATE

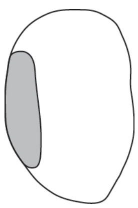
Arc path: there are no arc path signs on *h2 whole*

Delineation/extent: delineation is somewhat unique for the *h2 whole* location; for this location, much of the hand (or extended fingers on h2) can be surrounded at the same time, as in ACHIEVE and TO-CREATE (above)

Center point: this criterion does not seem to apply to *h2 whole*

Phonetic variation: the same shift in exact contact point depending on the extended fingers of h2 also applies for the *h2 whole* location; e.g., contact in achieve is only on the extended finger (also applies to signs FROM-2 and CHAIR and with one and two extended fingers, while the sign U.S.-DOLLAR with all fingers extended; notably, the contact pattern in TO-CREATE is different because only the fingers are contacted, which may be because their bent flexion indicates only the fingers are implicated in the sign, not the entire hand

20.	***side of face***	23 signs

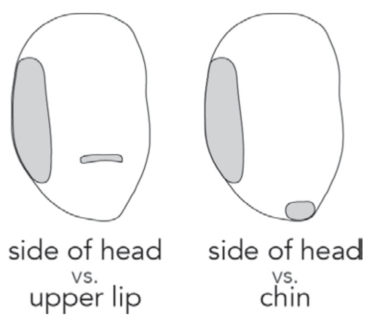


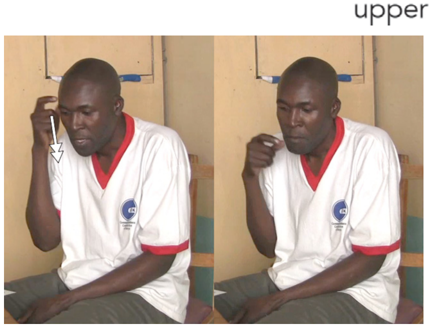
side of face

FOCUS-1

CONDOM-1

Minimal pairs: 7 pairs. *side of face* contrasts with 6 other locations in all major areas; in *neutral space* (e.g., MOBILE-PHONE-1 vs. WHEN [*NS*]), *trunk* (e.g., KAREN vs. KING [*trunk whole*; possible near minimal]), non-dominant limb (e.g., KAREN vs. KERUGOYA-2 [*elbow*]; and other locations on the head (e.g., MASENO (deaf school) vs. TANZANIA [*upper lip*, below]; UNDERSTAND vs. MOI [*chin*])

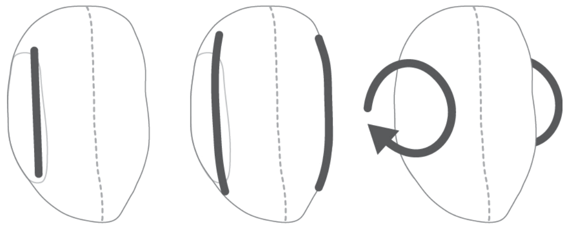




MASENO (*side of face*)

TANZANIA-1 (*upper lip*)

Parallel path/continuous contact: there are at least 5 signs with parallel path on *side of face*; this includes vertical straight path signs with one hand (e.g., ALL-1, below) or two hands (e.g., STRESS-1, below) and one two-handed circle path sign, WORRY

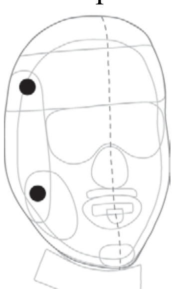


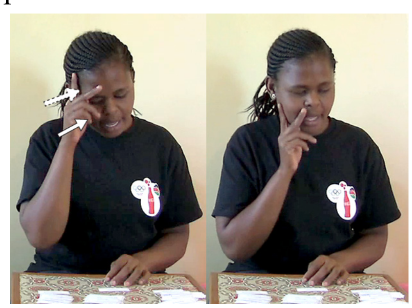
ALL-1, MASENO   CONDOM-1, STRESS-1   WORRY

ALL-1

STRESS-1

Dispersed signs: there are 4 dispersed signs on *side of face*: KAREN and JUDGE (n.) (below), HEADTEACHER-1 and GOVERNMENT-3; note that GOVERNMENT-3 has a smaller distance between contact points than the other three, but there is only one token in the data and follow-up is required



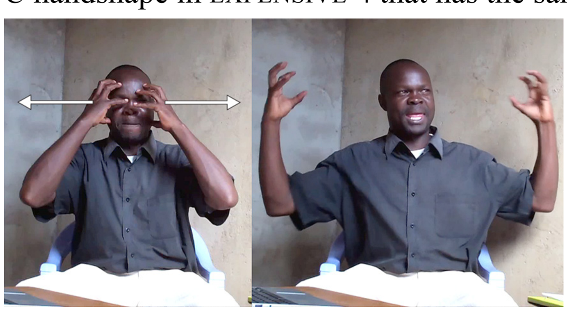


KAREN (place name)

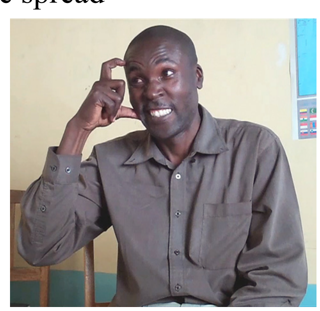
JUDGE (n.)

Arc path: none

Delineation/extent: the extent of this location is shown by signs with handshapes with variable aperture, such as the *claw* handshape in JERK (below) that spreads throughout the location or the *small-C* handshape in EXPENSIVE-4 that has the same spread

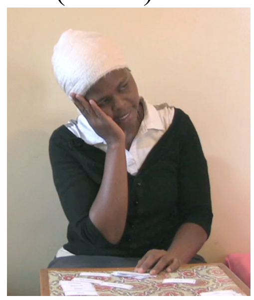
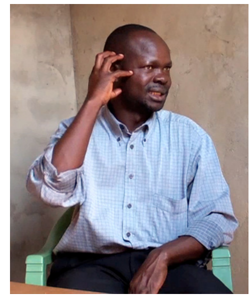


JERK



EXPENSIVE-4

The delineation of this location compared to the nearby location *ear* can be seen in the different contact patterns between signs like DEAF-1 on *ear* (below) and a one-handed variant of SLEEP-1 on *side of face* (below); or comparing the extent of *claw* in JERK (above) with the same signer's sign for COLLEGE on *ear* (below)

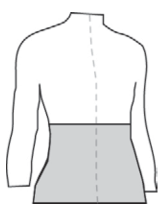




DEAF-1 (*ear*) SLEEP-1 (*side of face*) COLLEGE (*ear*)

Center point: N/A

Phonetic variation: there are not enough candidates to evaluate phonetic variation in this location

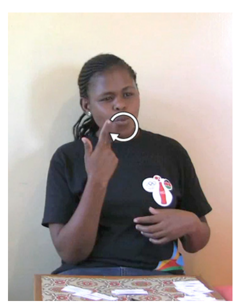
21.	***trunk lower***	19 signs



trunk lower

SKIRT

Minimal pairs: 7 pairs. *trunk lower* contrasts with 7 other in all major areas; in *neutral space* (e.g., PENIS vs. TO-WARN [*NS*]), *trunk* (e.g., YOUTH vs. HAVE-1 [*trunk upper*; see #5]), non-dominant limb (e.g., PREGNANT vs. POWER [*upper arm*; below]; and on the head (e.g., SATISFIED/NIMESHIBA vs. TOMORROW [*cheek*])

MALINDI WHO

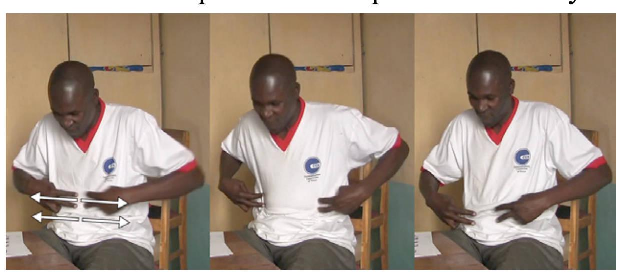
PREGNANT (courtesy Mjitoleaji Productions) POWER

Parallel path/continuous contact: there are 6 signs with continuous contact or parallel paths on *trunk lower*; these include 4 straight path signs that are horizontal (e.g., REFUGEE, HUNGRY-1, and ZEBRA-1, below), a straight path that is vertical (HUNGRY-3), and one circular path *trunk lower*, MALINDI (above)

REFUGEE

HUNGRY-1

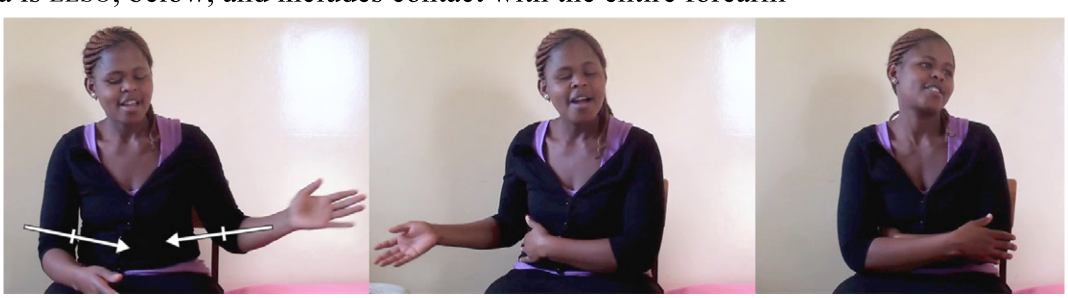
Dispersed signs: There is one dispersed sign on *trunk lower*, a variant of ZEBRA-1, shown below, which has a symmetrical horizontal path that is repeated vertically



ZEBRA-1

Arc path: the one arc sign on *trunk lower*, PREGNANT (above), shows the range of this area, from the line at/under the breast to below the bellybutton

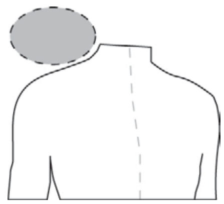
Delineation/extent: an example of a sign with two *flat* handshapes that shows the extent of this area is LESO, below, and includes contact with the entire forearm

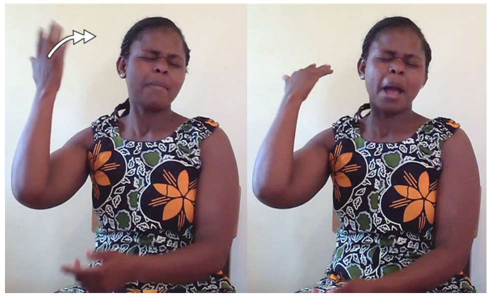


LESO (a cloth wrap)

Center point: no relevant signs
Phonetic variation: no relevant signs

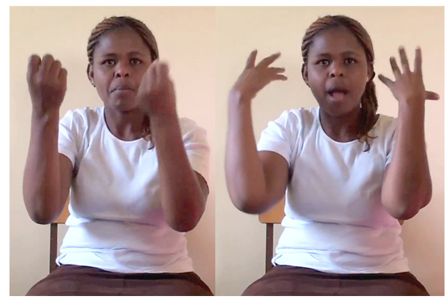
22. *over shoulder* ▪▪ɿɾ 18 signs


over shoulder


AGO/IN-THE-PAST


PANGA-1 (machete)


KERICHO (town)


BUS-1

Minimal pairs: 1-2 pairs. *over shoulder* contrasts with *neutral space* in one or two pairs: EXPERIENCE vs. YEARS, below, and EAGER vs. MUNGIKI, but this last sign lacks video representation (note: is the sign name for a banned quasi-political sect in Kenya)


EXPERIENCE (*over shoulder*)


YEARS (*neutral space*)

Parallel path/continuous contact: just as with neutral space signs, the *over shoulder* location is not as constrained to a physical place on the body and therefore the boundaries are somewhat variable; at the same time, this location is characterized by being within the approximate bounds of the area over the shoulder and next to the head of the signer; this is illustrated by the circle paths in history (below) and straight paths in the many signs shown here, such as KNOW-2 and VOLLEYBALL-1 (below), AGO, KERICHO, and EXPERIENCE (above)

HISTORY

KNOW-2

Dispersed signs: there is 1 dispersed sign in the *over shoulder* location: VOLLEYBALL-1, below; at the word-level, this sign is ordered ipsilateral-to-contralateral, meaning that it patterns with other body locations; see ‘Locations that are indeterminate or complex,’ below, for more details

VOLLEYBALL-1

Arc path: no relevant signs

Delineation/extent: no relevant signs

Center point: no relevant signs

Phonetic variation: no relevant signs

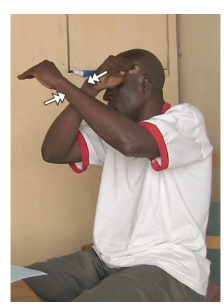
Motivated origins: many signs in this location are motivated by the metaphor of ‘the past is behind and the future is ahead’; i.e., AGO/IN-THE-PAST, FUTURE-2, HISTORY, EXPERIENCE, KNOW-2, CULTURE, FOREVER-1, and BEFORE-1; motivations for the other signs vary, from shaking a coconut at the side of the head (COCONUT, KILIFI [town]) to wielding a machete (PANGA-1) to enacting gestural behaviors with the hands (VOLLEYBALL-1, PREACHER, MERU-1 [town/ethnic group])

23. ***forearm whole*** 14 signs

forearm whole

SCHOOL

CONDOM-1

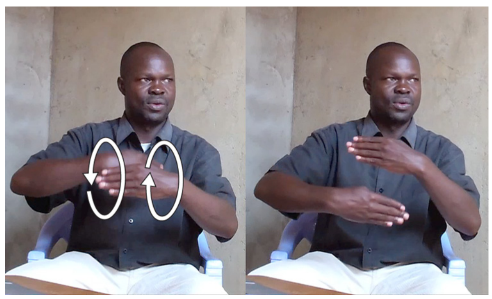


ZIMBABWE

Minimal pairs: 0 pairs.

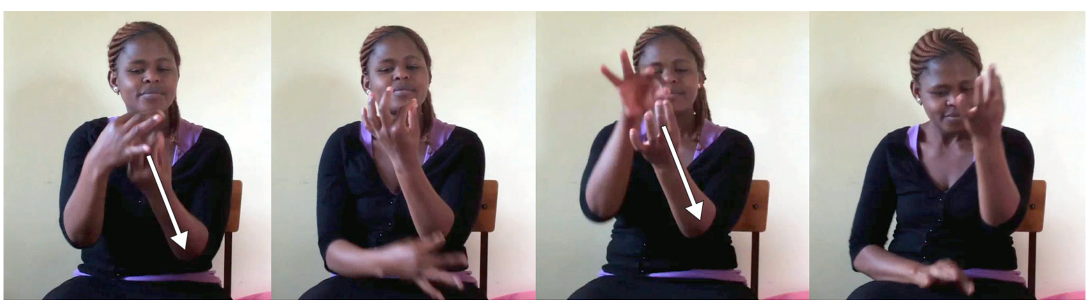
Parallel path/continuous contact: there are 6 signs with continuous contact on *forearm whole;* these include paths that extend along the forearm like THIN-4 and SLOW-3 (in which the exact side of the arm that makes contact is not encoded [and is ambiguous, anyway] because the entire forearm is selected) as well as MATERIAL/CLOTH in which the forearms on each hand circle each other

THIN-4



CLOTH/MATERIAL

Dispersed signs: there are 2 dispersed signs for *forearm whole*: HARVEST and PUMPKIN-LEAF (below); these signs have parallel path movements on both the ventral and dorsal sides of the forearm



PUMPKIN-LEAF

HARVEST

Arc path: none

Delineation/extent: like all signs on the forearm, delineation of the whole location with a single hand is not possible; yet the sign SCHOOL (above) in which both forearms contact each other provides information about the extent of the location

Center point: the sign ZIMBABWE (above) shows contact point at the middle of the location, but otherwise this diagnostic is not relevant for *forearm whole* because it does not implicate a specific side of arm

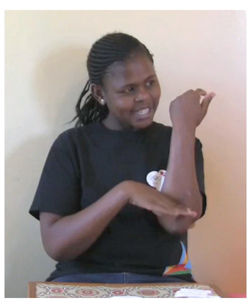
24. ***elbow*** 12 signs


elbow

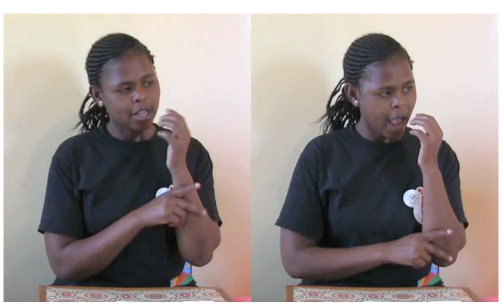

BABY-3

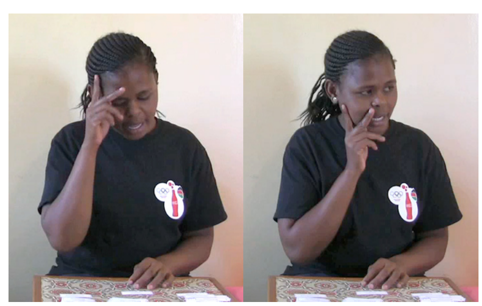

BAD

Minimal pairs: 12 pairs. *elbow* is found in a very high number of location contrasts compared to its frequency in the lexicon; *elbow* contrasts with 8 other locations on the head (e.g., BUSINESS-4 vs. MANGO-1 [*mouth*]), trunk (e.g., COUNTRY-4 vs. PLEASE [*trunk upper*]), and on other locations on the non-dominant limb (e.g., BUSINESS-4 vs. MEMBER [*h2 between fingers*])


BUSINESS-4 (*elbow*)

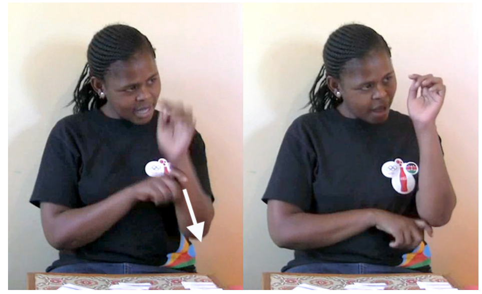

MANGO-1 (*mouth*)


KERUGOYA-2 (*elbow*)


KAREN (*side of head*)

Parallel path/continuous contact: there are 4 signs with continuous contact on *elbow*. These include signs with straight paths, POOR and EXAM-3 (below), as well as two signs with circle paths, COUNTRY-1 and COUNTRY-4

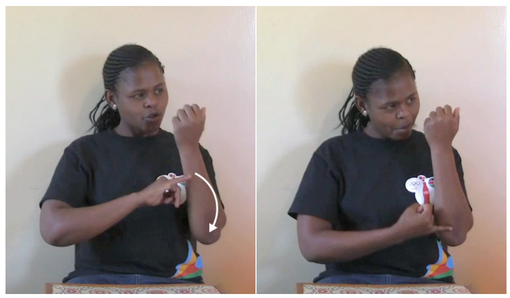
POOR



EXAM-3

Dispersed signs: none

Arc path: there is 1 arc path sign on *elbow*, JOB-2, showing the boundaries of the phonological location on the half of the forearm closest to the elbow



JOB-2

Delineation/extent: the *flat* hand in BABY-3 (above) covers some of the location, but otherwise there are no *open* or *claw* handshapes that extend throughout this location

Center point: there are signs with the fingertips making a single end contact on this location

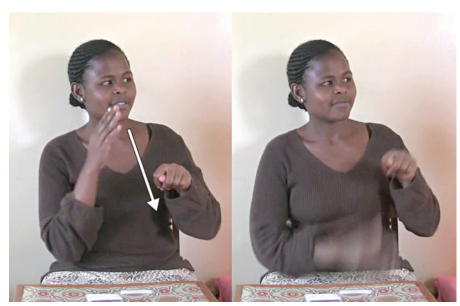
Phonetic variation: N/A

Motivated origins: other than BABY-3 in which the arm represents an infant being held, direct iconic mappings are notably absent in the *elbow* location

25. *h2 fingertips* — 11 signs

h2 fingertips

OMENA-1



FEMALE-CIRCUMCISION-2

Minimal pairs: 2 near-minimal pairs. Both pairs contrast *h2 fingertips* with *h2 back*: TEST vs. EMBU (below), and PERFECT-1 vs. PROVINCE-1; however, in both pairs, the shape on h2 is also different between the pairs, creating an additional difference

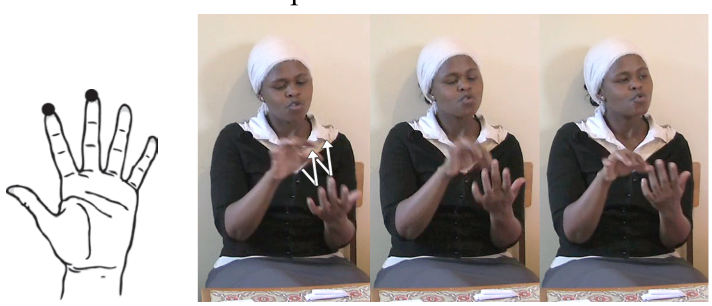
TEST (*h2 fingertips*)

EMBU (*h2 back*)

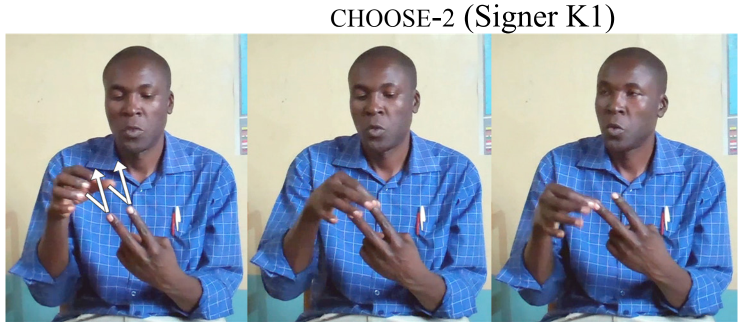
Parallel path/continuous contact: there are 5 signs that have a path that moves parallel to *h2 fingertips*; this includes OMENA-1 and FEMALE-CIRCUMCISION-2 (above) as well as RAZOR-BLADE (below); however, most of these paths are not bound by the location, possibly because it is so small—indeed, RAZOR-BLADE has a very tiny path movement, but it is repeated several times

RAZOR-BLADE

Dispersed signs: there is one dispersed sign on *h2 fingertips*, CHOOSE-2; two versions of this sign are shown below with different contact points



CHOOSE-2 (Signer K1)



CHOOSE-2 (Signer B1)

Arc path: none

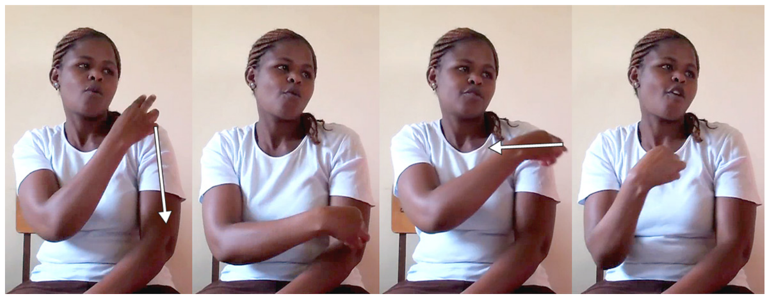
Delineation/extent: N/A

Center point: the index finger contacts a single fingertip in TEST and PERFECT-1

Phonetic variation: N/A

26. ***upper arm*** ʅ	11 signs

upper arm

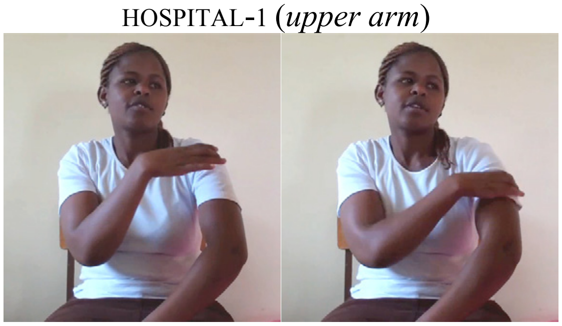


HOSPITAL-2

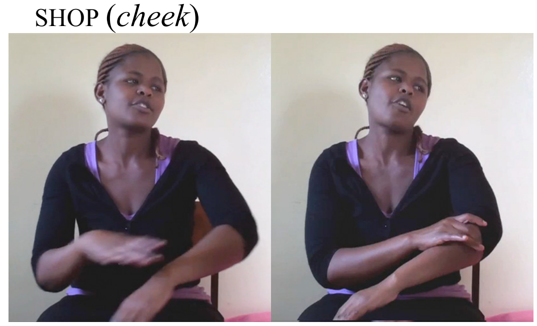
Minimal pairs: 7 pairs. *upper arm* contrast with 7 locations: *cheek* (e.g., HOSPITAL-1 vs. SHOP [below]), *h2 palm* (e.g., HOSPITAL-1 vs. CENT), *h2 back* (e.g., BOTHER vs. EFFECT-1), *forearm dorsal* (e.g., COACH-2 vs. SOCKS-1), *forearm ventral* (e.g., POWER vs. FUND), *trunk lower* (e.g., POWER vs. PREGNANT), and *neutral space* (e.g., TO-BOTHER vs. EARLY)

HOSPITAL-1 (*upper arm*)

SHOP (*cheek*)



COACH-2 (*upper arm*)



SOCKS-1 (*forearm dorsal*)

Parallel path/continuous contact: there is only 1 sign with parallel path / continuous contact on *upper arm*, HOSPITAL-2 above

Dispersed signs: there is 1 dispersed sign on *upper arm*, POLICE-BOSS

POLICE-BOSS

Arc path: there are 2 arc path signs on *upper arm*, POWER and NIGERIA-2

POWER

NIGERIA-2

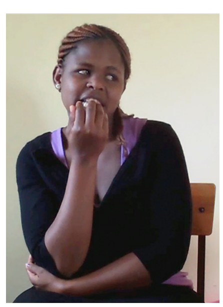
Delineation/extent: like signs on the forearm, *upper-arm* is a large area to cover with the spread of a single hand; COACH-2 above provides the most simultaneous coverage of any sign in this location

Center point: the index finger in HOSPITAL-1 should contact the body at the center of the location, but it lands slightly higher than would be expected based on the endpoints of the two arc signs; however, COACH-2 occurs right in the middle

Phonetic variation: N/A

27.	***teeth***	9 signs

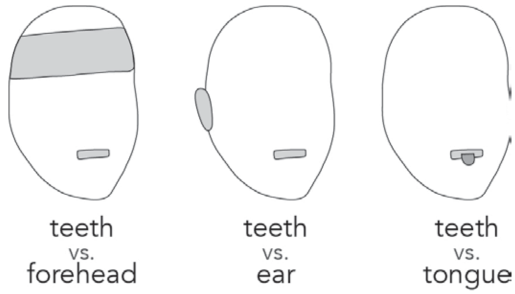
teeth



BISCUIT-1

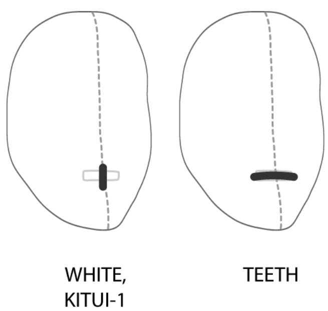
BRITAIN/BRITISH

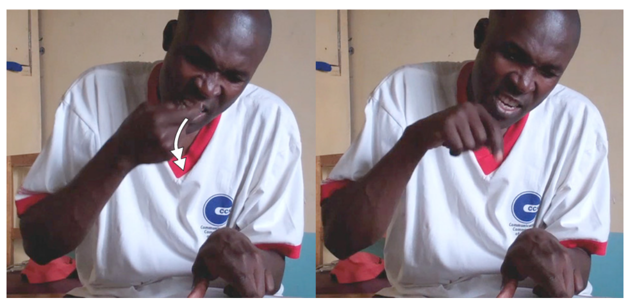
Minimal pairs: 5 pairs. *teeth* contrasts with 5 other locations in two major areas; non-dominant limb (i.e., WHITE vs. RICE-2 [*h2 palm*]; WHITE vs. SWAHILI [*h2 ulnar*]); and other locations on the head (i.e., WHITE vs. UHURU-KENYATTA [*forehead*, below]; TOOTHPICK vs. KISII [*ear*]; ONE-SHILLING vs. ONE-HUNDRED [*mouth*])



WHITE (*teeth*) UHURU-KENYATTA (*forehead*)

Parallel path/continuous contact: there are at least 2 signs with continuous contact on *teeth*; a vertical path, KITUI-1 (below) and possibly WHITE (above), and a horizontal path in the sign TEETH





KITUI-1

Dispersed signs: none

Arc path: none

Delineation/extent: no relevant signs

Center point: no relevant signs

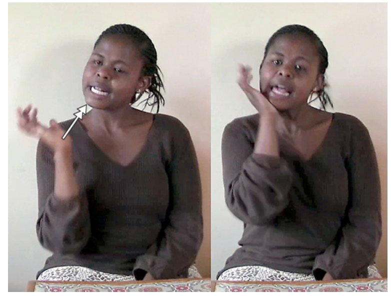
Phonetic variation: no relevant signs

Motivated origins: signs on *teeth* reference the white color of teeth (e.g., WHITE and possibly SHILLING-1) or objects that interact with the teeth (e.g., TOOTHPICK, CARROT-1, BISCUIT-1, BISCUIT-2, BRITAIN/BRITISH)

28. ***chin under*** 8 signs

chin under

DOG



LAZY-1

Minimal pairs: 0 pairs.

Parallel path/continuous contact: there is 1 sign with a parallel path on *chin under*: FUNNY

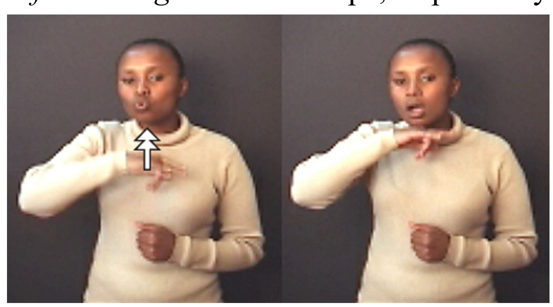
FUNNY

Dispersed signs: none

Arc path: none

Delineation/extent: two signs that show the boundary of *chin under* are DIE-1 and UGANDA-1, which contact the extent of the area with a *flat* and *uganda* handshape, respectively

DIE-1



UGANDA-1

Center point: no relevant signs

Phonetic variation: no relevant signs

29. ***h2 ulnar*** 5l 8 signs

h2 ulnar

DICTIONARY-2

SKILL

Minimal pairs: 7 pairs. *h2 ulnar* contrast with 6 locations: *h2 palm* (e.g., SWAHILI-1 vs. RICE-2 [below]), *forehead* (e.g., HOSPITAL-1 vs. CENT), *cheek* (e.g., TECHNICAL vs. MOSQUITO-3), *chin* (e.g., TECHNICAL vs. TURKANA), and *shoulder* (e.g., TECHNICAL vs. NUMBER-1)

SWAHILI-1 (*h2-ulnar*)

RICE-2 (*h2 palm*)

Parallel path/continuous contact: there are 3 signs with continuous contact on *h2 ulnar*; including OMENA-2, SATURDAY-1 (below), and DICTIONARY-2

OMENA-2

SATURDAY-1

Dispersed signs: none

Arc path: none

Delineation/extent: this type of sign is not found on *h2 ulnar*

Center point: the index finger contacts the ulnar side of the hand at a more distal point than the normal midpoint of the hand; this is a clue that this phonological location is more distalized than the *h2 palm* and *h2 back*


TECHNICAL (Signer B1) TECHNICAL (Signer K1)

Phonetic variation: variation in phonetic tokens for one common sign, NAME-1, shows the range of acceptable variation in location for *h2 ulnar*; this is consistent with a lower midpoint on the hand in several signs, from SKILL to SWAHILI-1 to TECHNICAL; Thus, even though the center of this location is on the hand (and labeled as such), the full phonological location extends down the forearm

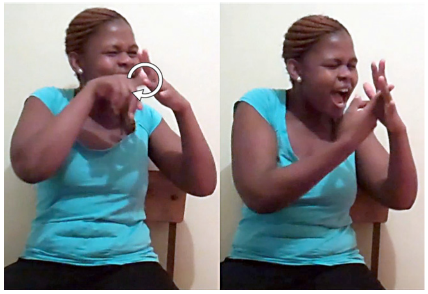
phonetic tokens for NAME-1

30.	***h2 between fingers***	7 signs



h2 between fingers MIDDLE ARISE/OCCUR

Minimal pairs: 6 pairs. *h2 between fingers* contrasts with 6 locations: *h2 palm* (e.g., START-2 vs. POINT), *mouth* (e.g., MEMBER vs. MANGO-1 [below]), *forehead* (e.g., MEMBER vs. BEER [below]), *nose* (e.g., START-2 vs. BORED), *neck* (e.g., START-2 vs. SWEET [below]), and *elbow* (e.g., MEMBER vs. BUSINESS-3)



START-1 (*h2 between fingers*)

SWEET (*neck*)

MEMBER

BEER (vs. MEMBER)

MANGO-1 (vs. MEMBER)

Parallel path/continuous contact: there are a few signs that could be interpreted as parallel paths; e.g., ESCAPE and CHIPS-3 (below), MIDDLE and MEMBER (above)

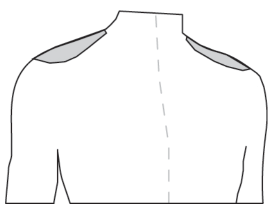
ESCAPE

Dispersed signs: there is 1 dispersed sign on *h2 between fingers*, CHIPS-3 (below)

CHIPS-3 (i.e., ‘french fries’)

Arc path: none
Delineation/extent: N/A
Center point: N/A
Phonetic variation: N/A

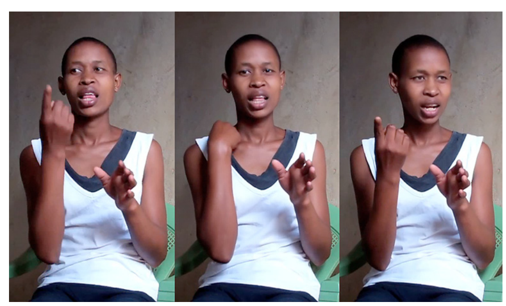
31. *shoulder*	5 signs



shoulder

BATHE

RESPONSIBLE



YESTERDAY-1

Minimal pairs: 5-6 pairs. *shoulder* contrast with 5-6 locations: *nose* (e.g., NUMBER-1 vs. SUDAN-1 [below]), *tongue* (e.g., BEAN-1 vs. RECENT-1), *forehead* (e.g., NUMBER-1 vs. KNOW-THAT), *cheek* (e.g., NUMBER-1 vs. MOSQUITO-3), *h2 ulnar* (e.g., NUMBER-1 vs. TECHNICAL); also NUMBER-1 may contrast with the sign MIND on *top of the head* (video tokens for the same signer are somewhat unclear)

NUMBER-1 (*shoulder*)

SUDAN-1 (*nose*)

Parallel path/continuous contact: no relevant signs; all signs on *shoulder* are perpendicular to the location, not parallel

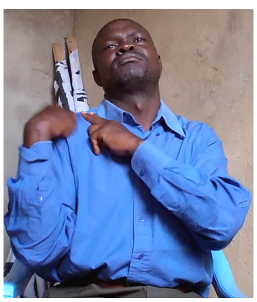
Dispersed signs: there is 1 dispersed sign on *shoulder*, BATHE, above; two other tokens for this sign have sub-locations ordered [ipsi]>[contra] at the word level, but this token is ordered [contra]>[ipsi]

Arc path: none

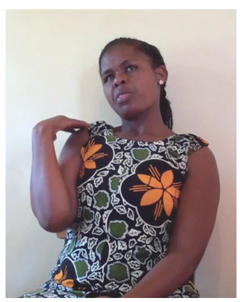
Delineation/extent: no relevant signs

Center point: index finger lands around the horizontal middle of the clavicle in signs like YESTERDAY-1 and NUMBER-1, above

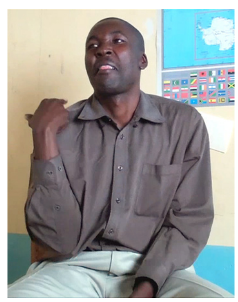
Phonetic variation: signs on *shoulder* range from two-handed signs that contact the extent of the area (RESPONSIBLE, below) to contact at the edge of the shoulder (RECENT-2) to a couple that land just over the location but do not make contact (RECENT-1, NUMBER-1)



RESPONSIBLE



RECENT-2



RECENT-1

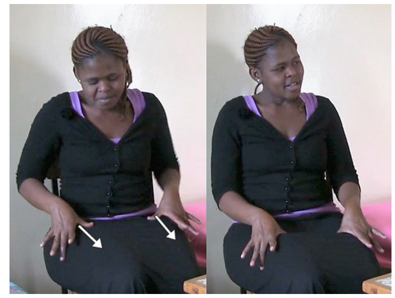
NUMBER-1

32. *thigh* 5 signs

TROUSERS-1

UNDERPANTS-1

TROUSERS-3



UNDERPANTS-2

Minimal pairs: 0 pairs.

Parallel path/continuous contact: there are 4 signs with continuous contact on *thigh*; TROUSERS-1, TROUSERS-2, and UNDERPANTS-2 move vertically along the leg, with the 'trousers' variants extending to the lower thigh, while UNDERPANTS-2 ends on the upper thigh; UNDERPANTS-1 moves horizontally across the upper thigh

Dispersed signs: none

Arc path: none

Delineation/extent: some delineation is seen in UNDERPANTS-2 above, with the *open* handshapes extending across the area; otherwise there are not releavant sign types

Center point: no relevant signs

Phonetic variation: N/A

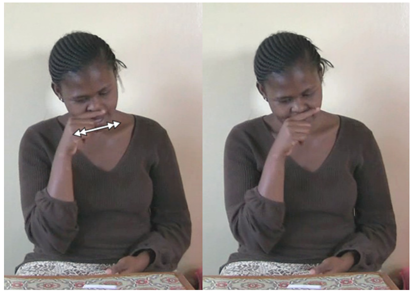
Motivated origins: all of the five signs on *thigh* are for types of trousers/pants and underpants/underwear

33. ***upper lip*** 5 signs

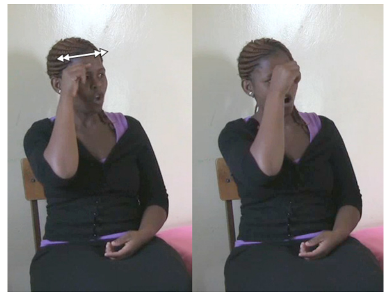
upper lip

KILONZO-MUSYOKA

Minimal pairs: 2 pairs. *upper lip* contrasts with 2 locations, both on the head: SEX-2 vs. ORIGINAL-1 (*forehead*; below), TANZANIA-1 vs. MASENO (*side of head*)



SEX-2 (*upper lip*)

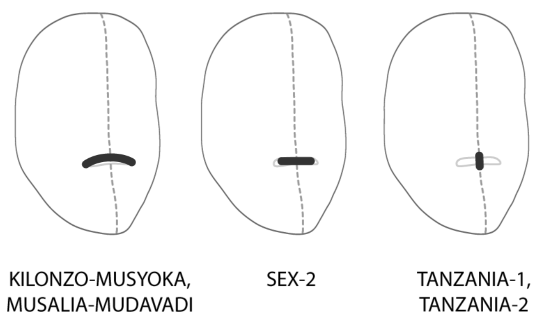


ORIGINAL-1 (*forehead*)

TANZANIA-1 (*upper lip*)

MASENO (*side of head*)

Parallel path/continuous contact: all 5 signs on *upper lip* have path shapes that move parallel to this location; these include both horizontal paths (e.g., SEX-2 and KILONZO-MUSYOKA, above) and vertical paths (e.g., TANZANIA-1, above); there are no circular paths on *upper lip*



MUSALIA-MUDAVADI

Dispersed signs: none

Arc path: there are no arc paths in this location that begin and end on *upper lip* and move perpendicular to the surface (both arc paths move parallel to the surface)

Delineation/extent: no relevant signs

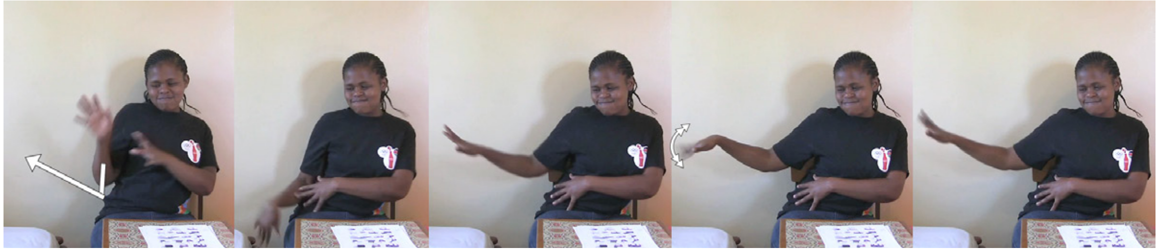
Center point: no relevant signs

Phonetic variation: no relevant signs

Motivated origins: 4 of 5 signs in this location reference characteristic facial hair patterns in three male politicians, Kilonzo Musyoka and Musalia Mudavadi from Kenya and Julius Nyerere from Tanzania (former president)

34.	***hip***	4 signs

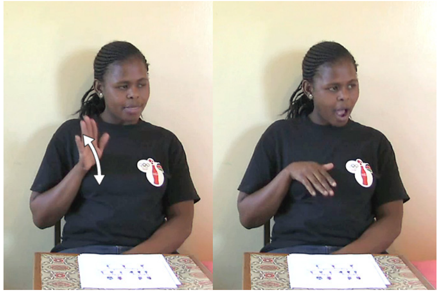
DEFECATE-2



MONGOOSE

Minimal pairs: 2 pairs. *hip* contrasts with 2 locations, both with the sign SHEEP-1: MOTHER-1 (*trunk upper*; below) and LATER (*neutral space*; below)

SHEEP-1 (*hip*)



MOTHER-1 (*trunk upper*)

LATER (*neutral space*)

Parallel path/continuous contact: the signs DEFECATE-2 and DEFECATE-3 move vertically down the *hip* location

DEFECATE-3

Dispersed signs: none

Arc path: none

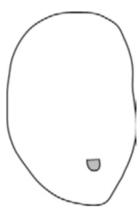
Delineation/extent: no relevant signs

Center point: no relevant signs

Phonetic variation: no relevant signs

Motivated origins: the few signs on *hip* reference animal tails in SHEEP-1 and MONGOOSE and defecation in DEFECATE-2 and DEFECATE-3 (phonological variants based on handshape differences)

35. ***tongue***	4-5 signs*



tongue

RED-1

Minimal pairs: ~2 pairs. *tongue* contrasts with at least 2 locations: *shoulder* in BEAN-1 vs. RECENT (below) and *teeth* in RED-1 vs. WHITE (below); there are also a pair, CANDY-1 vs. SHOP (below) that differ only be the tongue pushing the cheek out, though this is unusual because it is also signed on the cheek; in addition, there are two other potential minimal pairs, GLUCOSE-2 vs. PIG-1 (below), ONE-HUNDRED vs. ONE-SHILLING (*teeth*)

BEAN-1 (*tongue*)

RECENT (*shoulder*)

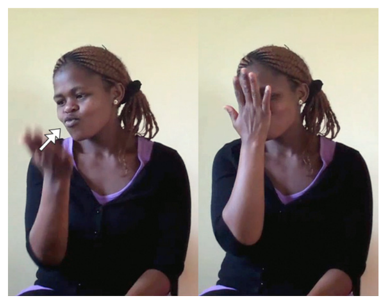
RED-1 (*tongue*)

WHITE (*teeth*)

CANDY (*tongue* in cheek)

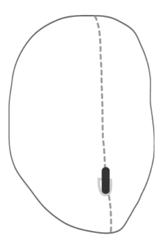
SHOP (*cheek*)

GLUCOSE-2 (*tongue*)



PIG-1 (*mouth*)

Parallel path/continuous contact: there are 2 signs that can be construed as a path movement parallel to the tongue, both vertical paths: RED-1 (above) and GLUCOSE-1 (below); note that RED-1 involves only finger-internal movement, which is not considered path movement in some models, and GLUCOSE-1 is a phonological variant (by path directionality) of GLUCOSE-2 (above)



RED-1,
GLUCOSE-1

GLUCOSE-1

Dispersed signs: none

Arc path: no relevant signs

Delineation/extent: no relevant signs

Center point: index finger contacts the center of *tongue* in RED-1 (above) and TASTE

Phonetic variation: no relevant signs

Motivated origins: the signs in the *tongue* location reference the color of the tongue (RED-1) or tasting/eating (TO-TASTE, CANDY-1, GLUCOSE-1, GLUCOSE-2)

***Comment**: the sign CANDY poses a complication because it essentially specifies two locations simultaneously: *cheek* and *tongue*. There are a couple options for how to treat the tongue in this case. The first is to designate *tongue* as a regular location, and posit that there are two locations in this sign (making the minimal pair a slightly different type than most). Support for this option comes from data on the other 'simultaneous two-location' signs in KSL (e.g., EXPERIENCE, DISAPPOINTED), described in 3B below (pp.630-632). A second option would be posit a +*tongue* feature that could presumably be added to any sign. This would mean that all the signs listed here have a *mouth* location combined with a +*tongue* feature. Support for this second possibility is the use of the tongue for post-lexical morphology in other languages; i.e., the 'tongue wag' in ASL indicates gradual progression when used with verbs and is an emphatic when used with adjectives and adverbs (Brentari 1996: 52). The first option is preferred, however, because signs with two simultaneous locations are already attested in the KSL data, and there is no 'tongue wag' morpheme in KSL.

Note that there is also a slang-like sign not collected for the database meaning 'pregnant', in which the tongue pushes out the cheek, as in CANDY-1, but it has no manual component

36.	***arm whole***	3 signs

arm whole

WORSEN

ARM (from Mjitoleaji Productions 2004)

Minimal pairs: 0 pairs.

Parallel path/continuous contact: the sign ARM, above, has a path that runs parallel along the whole arm

Dispersed signs: there are 2 dispersed signs: WORSEN (above) and IMPROVE-2 (below); note that the two tokens shown here have more than two sub-locations, and this may be an indication that they are not being expresses as normal lexical signs

IMPROVE-2

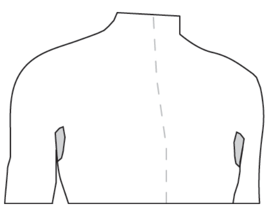
Arc path: none

Delineation/extent: N/A

Center point: N/A

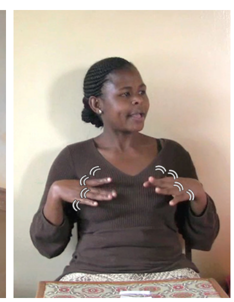
Phonetic variation: N/A

37. *armpit* 3 signs



armpit

CHIEF-1



HOLIDAY-2

WEEKEND-2

Minimal pairs: 0 pairs.

Parallel path/continuous contact: no relevant signs

Dispersed signs: none

Arc path: none

Delineation/extent: no relevant signs

Center point: no relevant signs

Phonetic variation: no relevant signs

Comments: There are only three signs in the KSL lexical database that occur on/in the armpit: CHIEF-1, HOLIDAY-2, WEEKEND-2, above (the latter two are polysemous homophones); in Chapter 5 it was noted that armpit also is attested in at least one sign name; this is an infrequent and typologically unusual location, but it could also not be grouped with the adjacent locations, *trunk upper* or *upper arm*

Locations that are indeterminate or complex

In order to have a complete description of signs encountered in the KSL lexicon and therefore be relevant for future typological comparisons, it is necessary to address the cases for which a straightforward location designation is difficult. While some of these may reflect typologically notable signs in KSL, most are not unusual in the sign languages of the world, nor particularly more difficult to articulate or more complex—though some certainly are, such as 'simultaneous two-location signs.'

These signs fall into three categories as discussed in the following three sections. First, there are locations associated with the body, but whose exact location is indeterminate in some way. This includes signs produced over the shoulder (1A), those with an upright forearm moving into the torso (1B), signs produced off the body, but tied to a body location (1C), and those including a location behind the body (1D).

The second group involves issues arising in two-handed signs. This includes signs in which h2 is a horizontal base (2A), the two hands are connected and act as a single articulator (2B), the two hands have different shapes but symmetrical movement (Type 4 signs) (2C), h1 moves around h2 in neutral space (2D), and the hands rotate but stay 'connected' (2E).

Third, there are two types of signs that have two clear location designations. These are given a more in-depth treatment that the previous types. 'Sequential two-location' signs in which the hands move from one distinct location to another are described in 3A. And 'simultaneous two-location' signs in which there are two location specifications at the same time are described in 3B. This is followed by a discussion of the ramifications of two-location signs on phonological models, in 3C.

1. Locations near the body

1A. Over-shoulder. There are 37 signs in the database that were coded phonetically as 'over shoulder', but which were subsequently apportioned into different locations. Six of these signs were designated as located on the trunk/torso (see *shoulder*, #31 above). Another seven signs are treated separately here, in 1B on 'forearm upright into torso' signs. Then there are five that are also considered 'simultaneous two-location' signs, discussed in below in 3B. And the remaining 18 signs have been labeled for now as being located in the *over-shoulder* phonological location. These are depicted above in #22.

This region was determined to be a phonological location in part because it participates in seven minimal pairs, including YEARS vs. EXPERIENCE (Fig. 290). Also, there is a relatively high number of signs here (compared to some other locations), as well as a distinct morphological role for this location to indicate time; for example in signs like HISTORY (Fig. 272a), YESTERDAY-1, RECENT-2, BEFORE-1, FOREVER, FUTURE-2, LONG-TIME-AGO, CULTURE, and TO-KNOW(UNDERSTAND)-2 (Fig. 272b). Other signs unrelated to time are also produced here; e.g., COCONUT, BUS-2, MERU (town), KERICHO (town), ELEPHANT-3 (Fig. 274), etc.

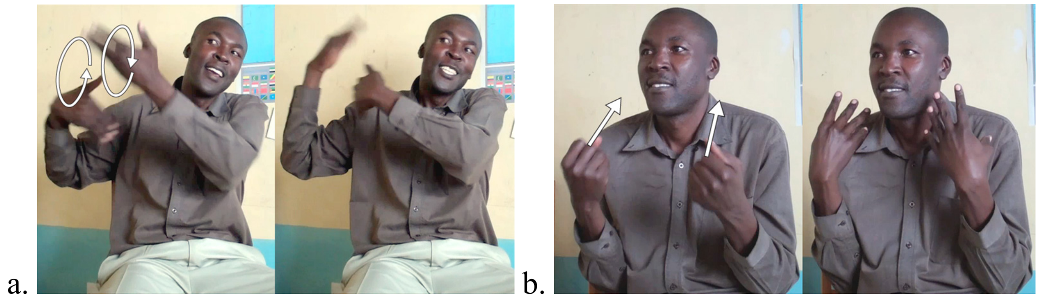


Figure 272. Signs in the *over-shoulder* location: a. HISTORY, b. TO-KNOW/UNDERSTAND

However, questions remain about exactly how to categorize this location. One question is whether it is more like a body location or like a sub-location in neutral space—or perhaps some signs pattern with the body and some with neutral space. There is some evidence that these signs are more likely to pattern with the body, based the order of sub-locations in one 'dispersed' sign, VOLLEYBALL-1, shown in #22. As discussed in §7.9.3, there is a divergence in the horizontal ordering of sub-locations on the body as opposed to sub-locations in neutral space, such that the former are consistently ordered ipsilaterateral-to-contralateral and the latter are consistently ordered contralateral-to-ipsilateral. There are two variants for the sign 'volleyball' which are both dispersed signs, but one is produced low in NS and the other is produced next to the head, in the *over-shoulder* region. In tokens by three different signers, the NS variant is ordered contra-to-ipsi, but the over-shoulder variant produced by the same signers is ordered ipsi-to-contra, thus patterning with other body locations. This suggests that *over-shoulder* should be treated as part of the body.

1B. Forearm upright into torso. In these signs, a raised forearm moves straight backward toward the torso, so that the hand is up near neck-level—physically in the *over-shoulder* region. There are seven of these signs, including TO-GUARD, WATCHMAN (Fig. 273a), LAW, LORRY (truck), LITEIN (Kenyan town), TO-WAIT, TO-REST-1 (Fig. 273b), and TO-REST-2. It is unclear what the location is in these signs because it appears that the forearm itself is the articulator. There are three possibilities. First, these signs could be in *neutral space* because they don't seem to reference a body location. Second, if the forearm is viewed as the articulator and it moves back into the body, then the location could be *torso-upper*. And third, if the hand is perceived as the articulator then the location could be considered *over-shoulder*. In the database, these currently marked as 'unknown' for phonemic location and 'NS: over shoulder' for phonetic location.

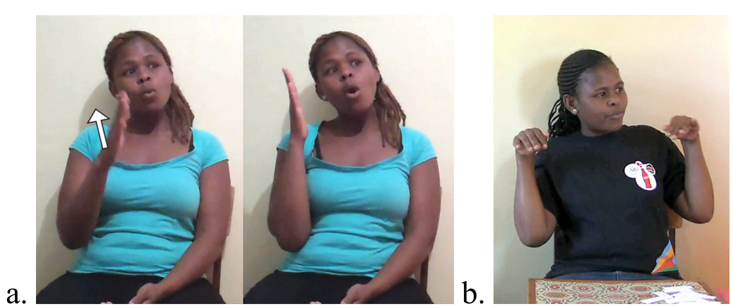


Figure 273. Signs with the forearm upright into torso: a. GUARD-1, b. TO-REST-1,

1C. Off-body but tied to a body location. There are several signs that are articulated at some distance from the body, but are clearly connected to a body location. Many of them also have phonetic variants that contact the body, which helps to verify the location. For example, one signer produced two variants of a sign meaning ‘to complain’. The first is homophonous with the sign ROOSTER-3 and contacts the mouth or chin (Fig. 274a), but the second never contacts the body; it features a raised arm with *K* handshape that slowly rotates, with the body, above the signer (Fig. 274b). This second sign therefore references the mouth semantically, but is not even in proximity to it.[3] However, other signs don’t have variants with body contact; for example ELEPHANT-3 in Figure 274c references the ears iconically, but remains relatively far away from the ears and no variants exist with ear contact. At the same time, the hands themselves are located in a location that has been determined to be distinctive, *over-shoulder*. For these signs, the phonological location is uncertain.


a.
b.
c.

Figure 274. Variants that show degrees of distance from the body location: a. TO-COMPLAIN-1a (on body), b. TO-COMPLAIN-1b (off body), c. ELEPHANT-3

At least eight other signs are of this variety, though some have been coded with a phonological location, especially if a phonetic variant is physically close enough to the location. These include signs semantically linked to *eye* (e.g., SCRUTINIZE, TO-SEE, TO-DETECT), *top of*

3 TO-COMPLAIN-1b with the arm in the air is not included in the KSL database as a stand-alone lexical sign because its conventionality is uncertain, though it is included as a variant in the listing with TO-COMPLAIN-1.

head (e.g., CARRY-ON-HEAD-1, UNIVERSITY), *ear* (ELEPHANT-3, SHEEP-2) and *side of face* (e.g, TO-BRAID, MUNGIKI).

1D. Behind the body. Signs in KSL can include articulation behind the body. In some cases, this happens in two-handed signs in which one hand is positioned on the front of the body and the other hand mirrors it behind the body; e.g., in signs like KAKAMEGA-1 (Fig. 275a), KAKAMEGA-2, YOKE (Fig. 275b), SWAZILAND/BURKINA-FASO,[4] and LION (Fig. 292).

a. b.

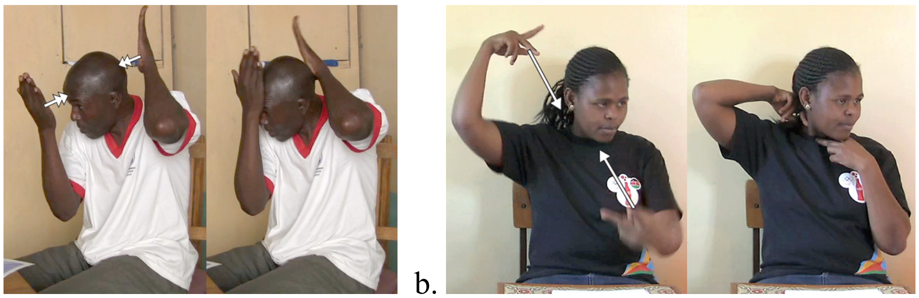


Figure 275. Hands mirrored behind body: a. KAKAMEGA-1, b. YOKE

However, there are other cases, like PLOUGH-1 that seems to entail a position behind the body; this sign starts behind the body and moves next to or in front of the signer (Fig. 276). There are also signs with variants both behind the body as well as in a more typical signing space; e.g., variants for MURANG'A (a deaf school) shown in Figure 277 with contact on the back of the neck in one case and on the ipsilateral neck in another. And finally, there are signs like SHEEP-1 (Fig. 114a) on *hip* and NUMBER-1 on *over-shoulder* that reference a location behind the body, but which are shifted to be visible from the front.

a. b.

Figure 276. PLOUGH-1 behind the body: a. Signer K1, b. Signer V1

[4] Not included for the phonemic analysis because of lack of conventionalization; signers produced the same sign for different countries.

a. b.

Figure 277. Variants for MURANG’A on *neck*: a. behind body, b. ipsilateral side

The canonical literature on sign languages is mostly written from the perspective of ASL and other European sign languages and states that signs are produced in a relatively limited signing space, as illustrated in Klima & Bellugi (1979: 51), shown in Figure 278. Signs on the back of the body (variant of MURANG’A) or behind the body *and* low in space (e.g., PLOUGH-1) certainly fall outside of this boundary.

Figure 278. The signing space in ASL (Reprinted from Klima & Bellugi 1979)

Yet two other phonological descriptions of African sign languages, Schmaling (2000) for Hausa Sign Language in Nigeria and Nyst (2008) on Adamorobe Sign Language in Ghana, both report on signs located behind the body. Schmaling reports that there are only a few of these signs in Hausa SL (not describing them further), but proposes a new feature, [+back], to account for them (2000: 93). Nyst also notes that there are such signs in AdaSL, including YOUNGER and SIBLING on the back (2007: 66).

Nyst points out that a larger signing space has been one of the characteristics commonly associated with small community sign languages (2007: 48). However, Kenyan Sign Language is not a typically small community sign language. As discussed in Chapter 2, the KSL signing community is both large in population and is spread throughout the country, with concentrations in cities and towns. In addition, KSL emerged out of—and is still propagated through—deaf schools, unlike the situation for village sign languages (and other regional sign languages not associated with schools). Another factor affecting signing space could be diachronic change, such that signing space for all languages becomes smaller over time. However, while that is still a possibility, I hypothesize that it is equally possible that a relatively large signing space—which essentially means having locations above the head, below the waist, behind the signer, etc.—could be an enduring characteristic of many African sign languages and may not necessarily attenuate over time. It cannot be ignored that the gestural substrate and norms from which these languages arise and in which they still exist may play some role in a sign language's signing space—not only in Africa, but also in Europe, the United States, and other regions of the world.

2. Two-handed signs indeterminate between h2 and NS

The second group of signs that have phonological classification issues are those in which the source of ambiguity is the relationship between the two hands versus the hands moving through space.

2A. h2 base signs. In some signs, the non-dominant forearm acts as a kind of horizontal base or ballast for the dominant hand. There are 19 signs of this type, and it should be noted that they are counted with *neutral space* signs above (unlike some other signs in this section, which are counted as 'unsure').

There are two sub-types of this 'h2 base' type. In the first case, the non-dominant forearm is a flat base, with all fingers extended and the dominant elbow or forearm intersecting with it. Nine signs have this description, including TO-ASK (Fig. 279a), DISCIPLE-2, GOD-3, HONEST-2, DIRECT, EXAM-4, COBRA, and OSTRICH. In the other sub-type, the non-dominant hand grasps the dominant forearm above the elbow, but still maintains a somewhat horizontal position. There are ten of these signs, including LEAF (Fig. 279a), FOREST, FISH, TRACTOR-1, FLAG, HAWKER-2, HOE[FORKED]-1, ERECTION-1, and HOE[JEMBE]-1.

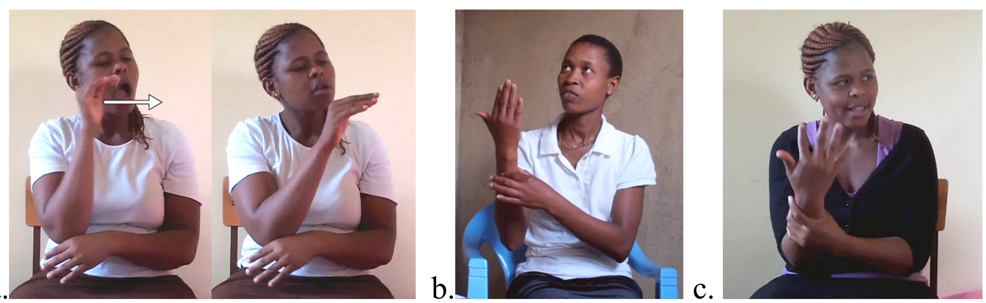
a. b. c.


Figure 279. Two types of 'h2 base' signs: a. TO-ASK (h2 flat base), b. LEAF (h2 grasping; Signer B2); LEAF (h2 grasping; Signer K1)

There is an interesting semantic split between these sub-types that deserves further exploration, with the 'flat base' variety possibly representing the ground, either in a more directly iconic way (COBRA, OSTRICH), or in a metonymic way (GOD-3, DISCIPLE-2, HONEST-2) (Mandel 1977). And the grasping variety has a few possible semantic roots, including potential remnants of gestural "measure stick signs" (Nyst 2007) (e.g., FISH and LEAF), as well as possibly functioning to highlighting the fact that the entire cylindrical forearm is the referent, not just the hand (e.g., FLAG, ERECTION-1, TRACTOR-1, FOREST), or referencing an embodied action (e.g., HAWKER-2, HOE[JEMBE]-1).

In any case, the relationship between the hands in these signs has not been accounted for in phonological models thus far, which is why they are mentioned in this section.

2B. Two hands, connected, act as a single articulator. There are 27 signs in the database in which the hands stay connected to each other throughout the sign. For example, EXAMPLE-1 in Figure 280a, INTERNATIONAL-CRIMINAL-COURT-3 in Figure 280b, DIE-4 in Figure 282a, TO-LEAD, TO-SHOW, TO-OPPRESS, TANKER-TRUNK, JUNE through SEPTEMBER, and PASSIONFRUIT-1. These signs are among those should take the [+connected] feature described in 5.12.

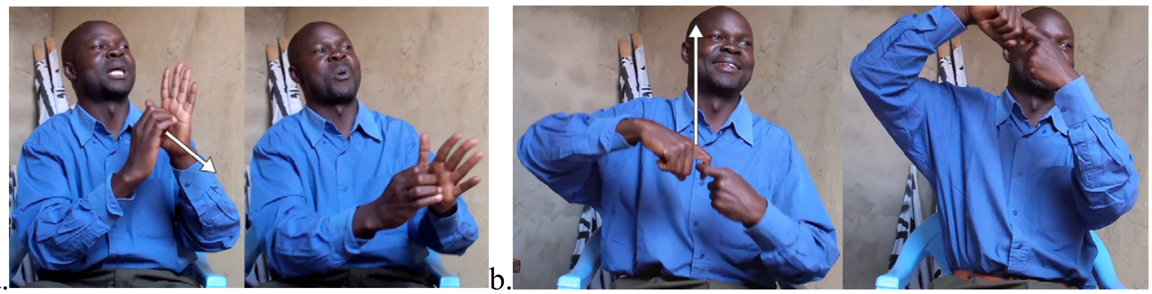

a. b.

Figure 280. Two hands connected as one articulator: a. EXAMPLE-1, b. INTERNATIONAL-CRIMINAL-COURT

The issue with these signs requires a brief excursus into locations in different types of two-handed signs. In "h2-Place" signs, such as POSITIVE in Figure 281, in which the non-dominant hand (h2) acts as the immobile base for the dominant hand, the location in all phonological models is specified as one of those on h2 (e.g., *h2 palm*, *h2 radial*, etc.). In contrast, models differ in their representation of "h2-Echo" signs in which both hands move and h2 mirrors the movement of h1, such as SAME in Figure 281. In this thesis, h2-Echo signs are seen as occurring in *neutral space*, with contact patterns predicted by orientation features (following van der Kooij [2002]). For example,

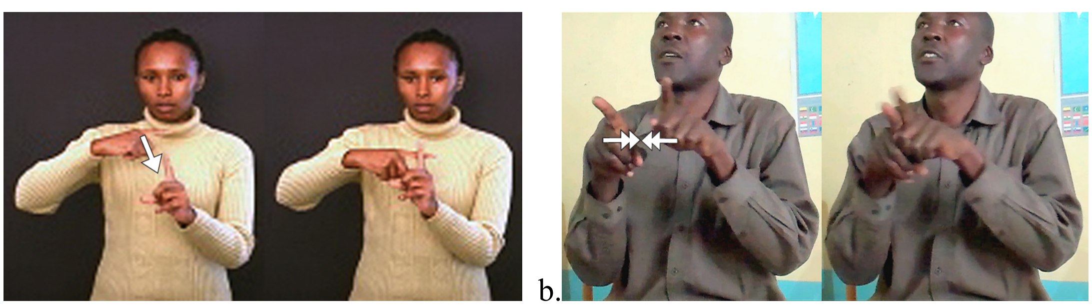

a. b.

Figure 281. h2-Place and h2-Echo signs, respectively: a. POSITIVE (Mjitoleaji Productions), b. SAME

With this in mind, the location of 'two hands as single articulator' signs are in *neutral space* like both h2-Echo signs and one-handed signs in *neutral space* because that is where the movement occurs. The problem is that this leaves a gap in information about the configuration of the hands in these signs. Consider the example of a 'two hands as single articulator' sign, DIE-4 in Figure 282a, with a putative location *neutral space* and a relative orientation of *root* (base of the hand). There is currently no way to know (by phonological specification) or predict (via phonetic tendencies) what the correct arrangement of the two hands should be in DIE-4 if all that is given is the location, directionality of movement, relative orientation, and even absolute orientation of the dominant hand. This is because in this particular—and exemplary—case, there are 66 signs in the KSL Lexical Database with two hands where each hand is a *1* handshape. And among these signs, the hands come into contact in several different ways. Consider the four different configurations of the two *1* hands in POSITIVE, SAME, DIE-4, and MULTIPLICATION (Fig. 282b). How can the correct hand configuration in DIE-4 be assured?

a.  b. 

Figure 282. Signs with *1* handshapes on both hands: a. DIE-4 ('two hands as single articulator'), b. MULTIPLICATION (h2-Echo sign)

It is currently unclear what would be the best way of representing phonological features for this class of signs, but there are a couple possible solutions. One is to posit features specifically related to the arrangement of the hands. A downside of this approach is that it would be highly redundant with other features, especially orientation features. Even more importantly, the geometric arrangement of the two hands was coded as a phonetic aspect of signs in the KSL Lexical Database, and although some trends emerged, this characteristic did not ultimately cohere into clear categories.

Another solution arises out of the discussion of 'simultaneous two-location' signs in section 3, below, which finds that some signs must be specified for two locations at the same time. If some signs can have two simultaneous locations, and *neutral space* is itself a location, then one could ague that these 'two hands connected' should be specified for both a *NS* location and an h2 location. This would have the benefit of encoding a greater structural complexity into these uncommon and presumably more complex signs. However, the same conditions presumably apply to highly common and simple signs, like SAME; and it isn't clear on what grounds to stipulate two locations in one but not the other. Therefore, this remains an issue for future investigation.

2C. Type 4 signs. In Battison's typology (1978), Type 3 signs are those in which the hands have different handshapes and h2 does not move; that is, it acts as a passive place of articulation rather than echoing the movement of h1. In Type 3 signs, therefore, the location is the non-dominant hand. So-called Type 4 signs (Frishberg 1975) also have different handshapes on each hand, but differ from Type 3 because both hands move, which means that the location for these is *neutral space*, just as it is in Type 1 signs (also known as h2-echo or balanced signs). Type 4 signs are thought to be rare, but at the same time, most sign languages seem to have a few of them (Morgan & Mayberry 2012).

There are seven signs in the KSL database have different handshapes and exhibit symmetrical movement (i.e., the hands are not connected here, those were just discussed in the previous passage). Among these, five signs have the two hands moving toward each other horizontally and meeting in the center of the body—SAMOSA-1 (Fig. 283a), WORD-3, PROBLEM, LOCK-1, THORN—and two have the hands starting together and moving apart—TO-START-1 and MONEY-5 (Fig. 283b).

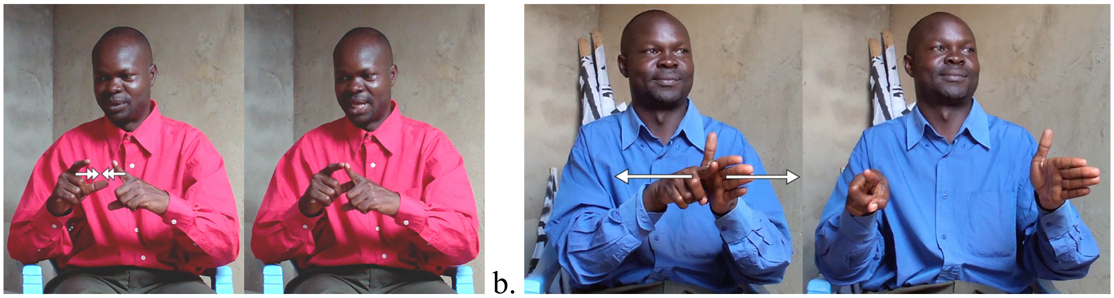
a.  b.

Figure 283. Signs with symmetrical movement, but different handshapes: a. SAMOSA-1, b. MONEY-5

The problem is that in the five signs that come together in the center, the movement of the non-dominant hand is likely to be copying the movement of h1 for purely articulatory reasons (Kita et al. 1998; Börstell & Lepic 2014). However, this minor articulatory change has major consequences in categorization in phonological models, moving a sign from an h2 location to a neutral space location—or, in the case of models with NS as a null value, from a location to a non-location. The leap from one category to another on the basis of such a minor and predictable regularity is problematic.

2D. h1 moves around h2. In at least four signs, the non-dominant acts as a marker in space that h1 moves around; i.e., DIVIDE, NEXT, OVER, and AFTER-2. What is unusual about this cluster is that it is anchored to h2, but the movement begins and ends at space on either side of h2, preventing a clear designation for location.

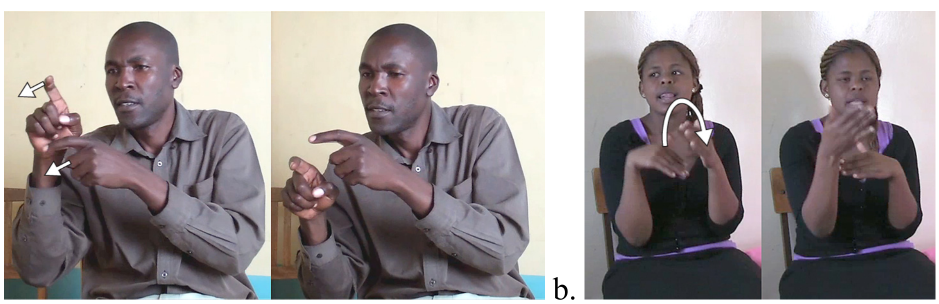
a.  b.

Figure 284. Signs with location on either side of h2: a. DIVIDE, b. NEXT-1

2E. Rotating-connected signs. In their 2003 paper, Napoli and Wu offer a classification for the many different relationships between the two hands, and identify one type as “rotation” signs, with the following definition: “A two-handed sign involves simple rotation if the hands form the same handshape and rotate around a fixed point, maintaining a constant palm orientation with respect to that point” (2003: 160). Those listed by Napoli and Wu as ‘Type 5b’ are produced with a single movement,[5] as in the KSL signs CHANGE-1 (Fig. 285a), CHANGE-2, BECOME-1, and

[5] That is, unlike ASL’s HAMBURGER, which is disyllabic, and treated in this thesis as a ‘switch dominance’ sign; see §7.8 in Chapter 7, *Manner of Movement*.

COMPLEX (Fig. 285b). Other KSL signs in the database that may fit into this category, but don't involve full 180º rotation include ROUGH and INTERNET-1.

In this thesis, these signs have a [+connected] featural designation in order to account for how h2 mirrors h1 vertically instead of staying on its own side of the body (unlike, for example, the sign HOW in which the hands rotate outward, but h2 mirrors h1 across the midline); however, this does not entail that the location is h2. It is still unclear whether the location for these signs should be *h2-palm*, *neutral space*, or both in a 'simultaneous two-location' sign.

a.  b.

Figure 285. Rotating-connected signs: a. CHANGE-1, b. COMPLEX

3. Two-location signs: simultaneous & sequential

In the KSL Lexical Database, the overwhelming majority of signs have a single phonological location, as this chapter has detailed. However, I occasionally encountered signs that appeared to have two distinctive phonological locations—some with two *sequential* locations and some with two *simultaneous* locations. These signs pose different issues for existing models of sign language phonology because of the longstanding morpheme structure constraint that says 'there is one major area per morpheme' (Battison 1978; Sandler 1989). As discussed above in §X regarding Major Area, the sequential location signs challenge even van der Kooij's updated constraint, 'movement stays within a distinctive location'. In this section, I first discuss the sequential two-location signs in §5.12.4, then the simultaneous two-location signs in §5.12.5, and then briefly address how these signs can be included in existing theoretical models in §5.12.6.

3A. Sequential two-location signs. Examples of **sequential two-location signs** are LEARN-1, in which the hand moves from *h2-palm* to *forehead*, (Fig. 286b) and YOGHURT-2, in which the hand moves from *h2-palm* to *mouth*. H2-palm, forehead, and mouth are all phonologically contrastive locations in KSL.

a.  b.

Figure 286. Sequential two-location signs: a. LEARN-1, b. YOGHURT-2

Importantly, these signs are neither reduced compounds nor 'double contact' (i.e., dispersed) signs. That is, they are not derived from separate conjoined lexemes, i.e., 'reduced compounds', which is usually the only type of sequential two-location signs across major body areas that are mentioned in the literature. For example, REMEMBER in ASL, which preserves the sequential locations from its derivatives: MIND at the forehead and STAY on the non-dominant hand. They are also not *dispersed signs*, which have only one phonological location specified and two non-contrastive sub-locations within it (§5.4, §7.9).

There are 22 signs marked in the database as having two sequential locations. Among these, ten move from one body location to another. These include the two in Figure 286 and eight others: CHIPS-1, CHIPS-2, FORK-1, EAT-3, PICTURE-1, REMEMBER-2, GOAL, and LETTER-2. The last four of these appear to be borrowed from ASL, International Sign, or another European sign language.

The other twelve move from a body location to NS (12 signs), and only one moves from NS to a body location (TO-EMPLOY). There were also around 45 other signs that were coded as *possible* two sequential location signs, but upon further analysis, could be categorized differently; these are discussed momentarily. Those that were more unambiguously two locations were designated as such because of added syllabic movement in the neutral space location, making them unusual, not only for location features, but also for movement. For example, in EXPOSE in Figure 287a, the hands with loosely spread and extended fingers briefly tap the lower trunk as the fingers close into a fist as the hands move upward, changing palm orientation and opening as they move outward in what is perceived as a second syllable (i.e., not a smooth single transition, like PICTURE and LEARN-1). Very similar syllable structure—i.e., a body + NS location and a three-stage handshape aperture change (open>close>open)—is seen in four other signs as well, including SUBTRACT-1 (Fig. 287b), MOVIE, BEAUTIFUL, and AUSTRALIA, suggesting that this is an unusual, but reoccurring sign type in KSL. Such prosodically distinct signs are discussed more in §7.10 in Chapter 7, *Manner of Movement*. The other signs in this set are: NAIROBI-1, GAZELLE-1, SELFISH-2, PEPPER-HOT-2, BELLICOSE-1, and PIPE-4.

a. 

Figure 287. Signs with sequential patterning in both location and movement: a. EXPOSE, b. SUBTRACT-1

b. 

Figure 287 (continued). Signs with sequential patterning in both location and movement: a. EXPOSE, b. SUBTRACT-1

Another 45 or so signs were initially coded as possible two sequential locations, and these deserve to be mentioned because they highlight an area where the coding of location can be confusing. Five these signs start in neutral space and end on the body, but the remainder move from the body to NS. I identified three properties of these signs that gave them the impression of being in two sequential locations, all of which involve aspects of their path movements. First, many had very **long paths**; e.g., ADOPT[CHILD] in Figure 288a, TRANSFER, VISION. Second, a small number **end abruptly** at a point in space that makes that location seem highly salient; e.g., ANSWER in Figure 288b, JERK, THANK-YOU. And third, there are signs that come off the body with a notably **different path direction** than most signs to or from that location; e.g., HOT-PEPPER-1 in Figure 288c, GIRAFFE, DECIDE-1. That is, signs with a proximal>distal path off of the body typically move straight outward, or slightly downward, but these signs have a different trajectory. Indeed, HOT-PEPPER-1 (Fig. 288b) that moves horizontally off the tongue is a minimal pair with the sign ONE-HUNDRED that also starts on the tongue but moves straight outward along the midsaggital axis.

a. 

b.  c. 

Figure 288. Signs with path features that produce the impression of two sequential locations: a. ADOPT(CHILD) (long path); b. ANSWER (ends abruptly), b. HOT-PEPPER-1 (unusual path direction)

This last type, signs with an atypical path direction, are adequately accounted for by path axis features (midsagittal, horizontal, vertical), but further investigation is needed to clarify the 'long path' and 'abrupt end' signs. If path length is contrastive, then these signs should be assigned a *path size* feature (see §7.4). And while there is no evidence yet that signs with abrupt path endings are contrastive in KSL, it is in other sign languages: Sandler posits [restrained] for ASL (1989: 131), and van der Kooij uses a [tense] feature for the same kinds of signs in NGT (2002: 248-249). Therefore, such a feature could be included in the phonology of KSL, as a manner of movement feature. In any case, both a typology of signs and a phonology of sign structure should allow for monomorphemic sequential two-location signs.

3B. Simultaneous two-location signs. The second type of two-location sign is one that stays within a single phonemic location, but also has an additional phonemic location on the non-dominant hand. An example of a **simultaneous two-location sign** in ASL is INTERNAL(IZE), shown in Figure 298b, which is articulated on the torso, but also on the non-dominant hand (h2). INTERNAL is related to the sign IN, in Figure 298a, which is produced in neutral space.

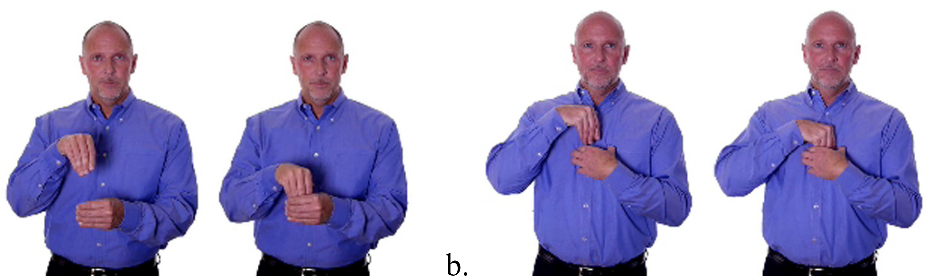
a. b.


Figure 289. Signs with h2 as a location in ASL: (a) IN contacts h2 while in neutral space, (b) INTERNAL(IZE) contacts h2 while on the torso
(Images courtesy of Signing Savvy)

Likewise, the KSL sign EXPERIENCE in Figure 290b is produced next to the head (actually in the phonemic location *over-shoulder*) and derives from the sign YEARS produced in neutral space, in Fig. 290a, in which h1 contacts h2 (the slight movement of h2 in YEARS is an articulatory artifact).

a.


Figure 290. Signs with h2 as a location in ASL: (a) YEARS contacts h2 in NS, (b) EXPERIENCE contact h2 over the dominant shoulder

b. 

Figure 290 (continued). Signs with h2 as a location in ASL: (a) YEARS contacts h2 in NS, (b) EXPERIENCE contact h2 over the dominant shoulder

Signs like IN and YEARS have been referred to as 'unbalanced', 'h2-place', or 'Type 2'/'3' signs, meaning that the non-dominant hand or h2 is an immobile base that h1 acts upon. The phonological location in such unbalanced/h2-place/Type 2 signs is considered to be the non-dominant hand. This means that when the exact same sign is produced in another location—e.g., INTERNAL and EXPERIENCE—the sign now has two simultaneous phonological locations.

There are around 10 of these simultaneous two-location signs in the KSL Lexical Database in addition to EXPERIENCE, including: DISAPPOINTED-1 (Fig. 291a), EXPLOIT, MEAT-1 (Fig. 291b), MENSTRUATION-2, PIPE-1, TOP-2, FOCUS-2, and possibly DEPEND(S) and CULTURE.

a.  b. 

Figure 291. Simultaneous two-location signs: (a) DISAPPOINTED, (b) MEAT-1

There are also a small number of these signs in ASL (Brentari 1998: 264), but it is not known whether the NGT lexicon also contains such signs. The theoretical implications for two simultaneous locations is discussed in the next section.

It should be mentioned that there are a few signs that are confounding signs in terms of both simultaneous and sequential location. A good example is the sign LION in Figure 292 (two different signer productions). It is unclear whether this is an unbalanced Type 2 sign with two locations (h2 and head) or whether it is a balanced/h2-echo/Type 1 sign that simply begins at the face and extends over the entire head (hands moving in opposite directions). These signs require more investigation.

a. 

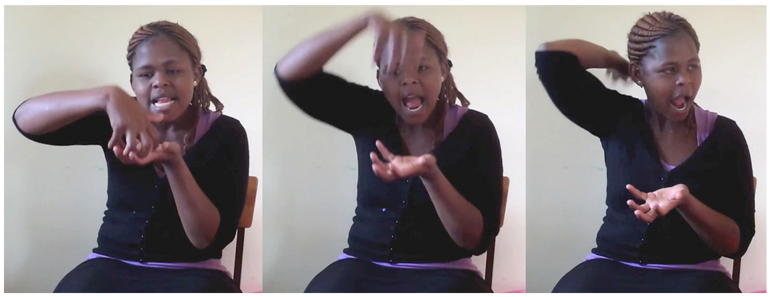
b. 

Figure 292. LION signed by two signers: a. Signer V1, b. Signer K1

3C. Phonological representation of two-location signs. When considering how these types of 'two-location' signs are represented in phonological structure, the simultaneous type poses somewhat more of a challenge than the sequential type. This is because two *sequential* locations can be handled relatively straightforwardly in most models. For the two that posit an empty {X X} skeletal tier (i.e., the Prosodic and Dependency Models), the topmost Location node can bifurcate into two equal branches with two completely different distinctive locations, in the same way Brentari models two branching handshape nodes for the ASL sign BACKGROUND, which has two distinctly different handshapes (1998: 191). In the Hand Tier Model, the implementation is even more straightforward: each L segment is associated to a different Place specification (plus relevant Setting features), and there is no spreading of Place features, unlike in most signs. One advantage for the Prosodic and Dependency Models, however, is that by representing the two locations via a binary branching node, it is possible to represent the greater complexity (markedness) of these rare signs via a more complex tree structure (they are only 1.2% of the lexicon). In contrast, it appears that these signs are actually *less* structurally complex in the Hand Tier model, which requires the spreading of Place node features for 98.8% of signs in the lexical database. That is, the Hand Tier Model is a more natural fit for a very small part of the lexicon.

It is important to note that accommodating two different sequential locations in the phonological representation is also necessary for 'reduced compounds' and other morphological blends with two sequential locations. Although this thesis focuses on the structure of signs that are not compounds nor derived from compounds, a preliminary analysis of such signs in KSL shows quite a few sequential two-location types.

When it comes to the *simultaneous* two-location signs, the implementation in in the three phonological models is more uneven. The model most adept at handling them without modification is the Prosodic Model because its six-tiered branching representation for Place of Articulation (see Appendix 2) appears to be underlyingly present in all signs; therefore, distinctive POAs can simply be filled in as needed and both locations would be constant throughout the sign.

With its binary branching structure, the Dependency Model could presumably extend its Location branch vertically to have two recursively branching heads. Indeed, this would be more similar to van der Hulst's original tree structure in an early version of what became the Dependency Model (van der Hulst 1993). In this scenario, the top/dominant head is the body-anchored location, while the h2 location is the daughter node because it is portable and could be paired with several other locations, while the reverse is not true. Note that this *also* raises the thorny theoretical issue of whether unbalanced two-handed signs with h2 as the location (e.g., IN in ASL, YEARS in KSL) are also specified for a second location, Neutral Space, in the underlying representation. One advantage of such a representation is that it would help to account for the relative complexity of unbalanced signs compared to balanced signs—which would be marked for only one location, NS—but I leave a full analysis for future research.

Simultaneous two-location signs are particularly problematic for the Hand Tier model. As Brentari points out, according to the feature geometry theory that is the basis of this model, each branch of structure may contain only one feature of a given type (Clements 1985; Sagey 1986). Having two simultaneous locations appears to violate this principle (Brentari 1998: 264-265). It is not only hard to see how two different Place features would be organized in the same L segment, but also how their features would successfully spread to the correct corresponding node in the second L segment. This again needs more work to figure out, but may turn out to be an intractable problem for the Hand Tier model—at least on the basis of its current theoretical assumptions.

To summarize section 3, a small portion of the KSL lexicon is made up of signs with two distinctly different locations: some with two sequential locations and some with two simultaneous locations. Altogether, there are 10 simultaneous and 22 sequential two-location signs out of 1,877 total non-compound signs; that is, 1.7% of the lexical database. However, if compounds were taken into account, there would be many more overall. Such signs can be found in other sign languages, as well. Even though they are a small part of the lexicon, these signs need to be accounted for both in coding systems (i.e., have fields or tiers set up for both types), and in representations of phonological structure. A brief review of how the three leading sign phonology models accommodate both two-location sign types shows that sequential locations can be accounted for relatively straightforwardly in all models, but simultaneous locations require a bit more elaboration in the Dependency Model, and probably an even more consequential reevaluation in the Hand Tier model.

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