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Tone

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Tone

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Key Points

- A tone language uses pitch as a contrastive feature of at least morphemes.
- Tone languages are found around the world, with particular concentrations in several areas like (South) east Asia and sub-Saharan Africa.
- Tone systems vary along a number of parameters, including number of contrastive pitch levels and/or contours.

Abstract

A tone language uses pitch as a contrastive feature of at least morphemes. Tone languages are found around the world, with particular concentrations in several areas like (South) east Asia and sub-Saharan Africa. Tone systems vary along a number of parameters, including number of contrastive pitch levels and/or contours.

Introduction

A **tone language** is a language in which pitch is a contrastive feature of at least some morphemes. While users of all spoken languages manipulate pitch to express meaning, a large number of the world's languages are tonal, as they exploit pitch to make lexical contrast. In Black Miao (hea, Hmongic, China), for instance, the syllable [pa] has eight meanings, depending on tone (Table 1).

This definition of tone excludes intonation, the use of pitch for signaling sentence-level meanings, like questions versus statements (though see Kratzer and Selkirk (2020) and others who analyze intonational contours as information structural grammatical morphemes). Tone is also distinct from stress, a structural property of a language in which syllables are metrically categorized as relatively strong versus weak. Tone and stress are not mutually exclusive: rather, many languages make use of both, and the systems often interact. The term "pitch accent" is sometimes used to refer to languages like Tokyo Japanese (jpn, Japonic, Japan), in which syllable prominence is cued through pitch: phonologists now generally accept, however, that such languages should be considered restricted tone systems (Hyman, 2009).

Areal Distribution

Tone languages abound across the world. Some estimates state that 60–70% of the world's languages are tonal (Yip, 2002); of the 526 languages included in the World Atlas of Language Structures (WALS), 220 (41.8%) are classified as tonal (Maddieson, 2013), and (Maddieson, 2023), consulting a sample of 6520 languages, finds indications that 3044 (46.7%) are tonal. The geographic distribution of tone is uneven: nearly all of the languages of sub-Saharan Africa are tonal, and concentrations of tone languages are found in East and Southeast Asia, as well as in regions in North, Central and South America. Tone is also reported for many languages of the Pacific, particularly those spoken in Papua New Guinea. A few geographic areas, on the other hand, seem to lack tone altogether: for instance, no Australian language has been reported to be tonal, and languages without tone predominate

Table 1 Eight-way tonal contrast in Black Miao (Kuang, 2013).

Tone	*Word*	*Gloss*
High (level 5)	pa	"full"
Mid-High (level 4)	pa	"send"
Mid (level 3)	pa	"fail"
Mid-Low (level 2)	pa	"net"
Low (level 1)	pa	"drive away"
Falling (5–1)	pa	"drop"
High rising (4–5)	pa	"pig"
Low rising (1–3)	pa	"father"

in areas including far southern South America and northwestern North America. Additionally, most of the languages of Europe and South Asia are not considered to be tonal, with several notable exceptions like Swedish, some varieties of Slovenian, and Punjabi.

Types of Tone Systems

While tone languages are plentiful around the world, individual tone systems differ from each other on a number of parameters. For one, a tone system may be defined by its number of possible pitch contrasts. In a **simple** tone language, a two-way contrast is made, in which each tone-bearing unit is produced with relatively high or relatively low pitch. In some languages, the relevant contrast is analyzed as a phonological opposition between one High (H) tone and one Low (L) tone, as in Mani (buy, Mel, Sierra Leone) (**Table 2**).

Other languages with a phonetic opposition between a relatively high pitch and a relatively low pitch have been analyzed as having a phonological opposition between the presence and absence of a tone: only one tone is phonologically active. This type of analysis is particularly common for Bantu languages, and has also been applied to a variety of other languages around the world including Slave (den, Athapaskan, Canada), Somali (som, Cushitic, Somalia), Chimila (cbg, Chibchan, Colombia), and Paicî (pri, Oceanic, New Caledonia) (Rivierre, 1978; Hyman, 2001, 2010a; Malone, 2006). In such languages, labeled as having **privative** tone systems, a given tone-bearing unit may be analyzed as having an underlying specification for a High tone, and other units are pronounced with "default" low pitch. It has been proposed for a few languages, like Ruwund (rnd, Bantu, Democratic Republic of the Congo/Angola), that Low tone is marked, and non-low pitch is default (Hyman, 2001; Nash, 1994).

A **complex** tone language, on the other hand, contrasts at least three distinct tones. Of the 220 tone languages represented in WALS, 25% are classified as having complex tone systems. Complex tone languages may distinguish more than two relative pitch levels: three contrastive levels are common, as described for Punjabi (pan, Indo-Aryan, Pakistan/India) (**Table 3**).

Languages have been reported to contrast as many as five distinct pitch levels, as in Black Miao (see **Table 1**), Bench' (bcq, Omotic, Ethiopia) (Wedekind, 1985), and Chiquihuitlan Mazatec (maq, Oto-Manguean, Mexico) (Jamieson, 1982). A language which distinguishes only between level tones may be labeled a **register tone language**. In many complex tone languages, however, tones are differentiated not just by the relative level of their pitch but also by their contour: rising, falling, or, less commonly, more elaborate sequences of rises and falls. These languages are termed **contour tone languages**. Cantonese (yue, Chinese, China), which contrasts multiple levels as well as both rising and falling contours, is a well-known example of a contour tone language (**Table 4**).

Table 2 Two-way tonal contrast in Mani (Childs, 2011).

High		*Low*	
Pá	"cut, sore"	pà	"arm"
tɔ́k	"wash"	tɔ̀k	"tree"
ból	"lie"	bòl	"head"

Table 3 Three-way tonal contrast in Punjabi (Bhatia, 1993).

Tone	*Word*	*Gloss*
High	kár	"boil"
Mid	kar	"bottom"
Low	kàr	"chisel"

Table 4 Seven-way tonal contrast in Cantonese (Yip, 2002).

Tone	*Word*	*Gloss*
High (level 5)	si:	"poem"
Mid-High (level 4)	si:	"to try/taste"
Mid-Low (level 3)	si:	"affair, undertaking"
High rising (3–5)	si:	"to cause, make"
Low rising (2–4)	si:	"market, city"
Low falling (2–1)	si:	"time"
High falling (5–3)	si:	"silk"

In tone languages, pitch is a contrastive feature of (at least some) morphemes, and may be used to signal lexical and/or grammatical contrasts. **Lexical tone** differentiates individual lexical items by their pitch, as exemplified in Tables (1–4). Many tone languages also make use of **grammatical tone**: pitch specifications or alternations that are restricted to the context of a particular morpheme or construction (Rolle, 2018). In Iau (tmu, Lakes Plain, West Papua), for instance, there are eight possible tone melodies on nouns, including two level melodies, two rising contours, three falling contours, and one falling-rising contour. Verbs, however, are underlyingly unmarked for tone, and their surface tone is determined wholly by the relevant grammatical context (Foley, 2018). In other cases, lexical and grammatical tone specifications interact with each other. In Kpokolo Bété (btg, Kru, Côte d'Ivoire), for example, each verb has one of six possible lexical tone melodies; this six-way contrast is visible in certain grammatical contexts, like the imperative. When marked for imperfective aspect, a verb surfaces with either a Mid-High or Mid level tone: the surface realization is determined by the interaction of the verb's lexical tone with the imperfective grammatical tone (**Table 5**).

The distribution of lexical and grammatical tone differs across language families and geographic areas: all tonal languages in Africa exhibit grammatical tone, with most reported to have both lexical and grammatical tone. In Asia, on the other hand, lexical tone contrasts tend to be richer, while grammatical tone seems to be much more restricted. In the languages of the Oto-Manguean family of southern Mexico, both lexical and grammatical tone are key to the exponence of contrast in meaning.

Tone languages differ on several parameters including the number of contrastive pitch levels and the number of contrastive tone melodies (levels and/or contours). Tone itself can be broken down into two broad categories, lexical and grammatical, the relative distribution of which is connected to typological generalizations about tone languages across different geographic areas.

Phonetics of Tone

The primary acoustic correlate of tone is the fundamental frequency of the speech signal, typically notated as F_0. This represents the rate of vibration of the vocal folds: the faster the vibration of the vocal folds, the higher the pitch of the voice. The actual pitch of a tone is always relative, as each speaker has their own pitch range. Larger vocal folds vibrate more slowly than smaller vocal folds, so the high tone of one speaker may be realized at a lower pitch than the low tone of another speaker, for instance.

As pitch distinctions are produced by changing the tension and position of the vocal folds, tone is often connected to other laryngeal phenomena like voicing, aspiration, and voice quality. Experiments in a number of languages have found that F_0 is lower following voiced obstruents than voiceless ones (Chistovich, 1969; Clements & Osu, 2002; Hombert, 1978). The larynx is lower for voiced stops than for voiceless ones, in turn resulting in a decrease in stiffness of the vocal cords, thus lowering F_0. In some tone languages, a set of voiced consonants, often termed **depressor consonants**, may restrict the possible tone melodies with which they occur. In Geji (gyz, Chadic, Nigeria), for instance, every verb with an initial voiced obstruent carries a Low tone, while verbs beginning with all other consonants may have any of three tone melodies (High, Mid, or Low) (Caron, 2008). On the other side, F_0 is always slightly higher following aspirated stops than following voiced stops. Contemporary Seoul Korean (kor, Korean, South Korea) has a three-way laryngeal contrast in voiceless stops between aspirated, lenis and fortis: previous studies found that this contrast is made by a combination of acoustic cues, including voice onset time and F_0 (Cho et al., 2002; Han & Weitzman,

Table 5 Interaction of lexical and grammatical tone in Kpokolo Bété (Vahoua, 2018).

Lexical tone	*Imperfective*	*Word*	*Gloss*
High	Mid-High	ɲʌ	"to offer"
Mid-High	Mid-High	la	"to call"
Falling	Mid-High	de	"to cut"
Mid	Mid	su	"to sting"
Low	Mid	bɛ	"to make"
Rising	Mid	dɔ	"to urinate"

1970). Recent studies, however, show that F_0 is in the process of becoming the primary cue for contrast (Kang & Han, 2013; Silva, 2002; Wright, 2007), exemplifying Contemporary Seoul Korean as a case of **tonogenesis**: the innovation of tone from the reanalysis of laryngeal consonantal contrasts. Finally, in some languages, voice quality and tone are tightly connected. In San Lucas Quiaviní Zapotec (zab, Oto-Manguean, Mexico), for instance, certain phonation types are not allowed with certain tones. Vowels with modal phonation may be associated with all four tones (high, low, rising and falling) in the language, but vowels with breathy phonation are restricted to syllables with low and falling tones, while vowels with creaky and interrupted (glottalized) phonation appear with high, low and falling tones (Chávez Peón, 2010).

Properties of Tone

Tone displays a number of salient properties which underscore its relative independence from the segmental component with which it appears. First, mapping between tone and segmental content may be **non-isomorphic**: the number of discrete tonal units does not always match the number of discrete segmental units. Mappings may be one-to-many, or many-to-one: in a one-to-many mapping, one tone may be realized over the course of several tone-bearing units. For instance, in Shona (sna, Bantu, Zimbabwe), a H-toned noun loses its tone when preceded by a H-tone affix, such as the prefixes /né/ "with" and /sé/ "like" (**Table 6**). A noun with multiple consecutive H tones, like "fish" or "worms", loses all of its high tones, reflecting the one-to-many mapping of a single H tone to multiple syllables.

In a many-to-one mapping, on the other hand, multiple tones may be realized over the course of a single tone-bearing unit. For instance, in Nghlwa (gwa, Kwa, Côte d'Ivoire), a high vowel /i/ or /u/ becomes a glide at the corresponding place of articulation when it precedes a low vowel within the noun phrase. The tone of the original high vowel does not disappear, but rather remains present in the surface tone melody of the phrase: in (1), the final H tones of "leaf" and "donkey" stick around and are realized on the initial vowel of the following word, resulting in a surface falling contour on the first syllable of "fifty".

1. Nghlwa tone stability (Konan & Mando, 2006)
   (a) m̀pí "leaf" + àgbló "fifty" → [m̀pjâgbló] "fifty leaves"
   (b) frúmú "donkey" + àgbló "fifty" → [frúmwâgbló] "fifty donkeys"

The Nghlwa alternation exemplifies **stability**, the tendency of tones to stick around even when the segmental content with which they originated has been deleted, moved or changed. It also reflects the understanding that contour tones are not necessarily phonemic primes, but rather constitute sequences of level tones: the falling contour on the initial syllable of "fifty" in the phrase "fifty leaves" (1a) can be represented as a sequence of a H tone followed by a L tone, pronounced on a single syllable. Similarly, a rising contour can be represented as a sequence of a L tone followed by a H tone, again pronounced on a single syllable.

Mobility is the ability of tone to surface far from where it originates. For instance, in Giryama (nyf, Bantu, Kenya/Tanzania), the verb root "see" carries an underlying H tone. This H tone is not realized on the verb itself, however, but rather on the penultimate tone-bearing unit of the phrase (2b); the combination of a toneless verb root with the object "beard" in (2a) shows that the surface H is attributable to the tone of the verb, not the noun.

2. Giryama tone mobility (Philippson, 1998)
   (a) kutsola kirevu "to choose a beard" (cf. /tsol/ "choose")
   (b) kuona kirévu "to see a beard" (cf. /ón/ "see")

Finally, **zero-representation** is prevalent in tone languages: while a morpheme may carry underlying tonal and segmental specifications, it may be specified for only one component, leaving the other unspecified. A morpheme could have a tonal exponent with no segmental exponent, often labeled as a **floating tone**. For instance, in Sama Nubri (kte, Tibeto-Burman, Nepal, genitive case is marked by the addition of a H tone, with no corresponding segmental morphology (Donohue, 2020). On the other side, a morpheme may have segmental content with no corresponding tonal specification, often labeled as **toneless**. For example, in Yukuna (ycn, Arawakan, Colombia), roots are specified for tone, whereas affixes and clitics are toneless. A root-final H tone spreads onto a toneless syllable: in all other cases, toneless suffixes are produced with a surface L tone (Lemus-Serrano et al., 2021).

Table 6 Shona one-to-many mapping (Odden, 1980).

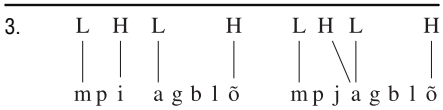
mbwá	"dog"	né-mbwa	"with a dog"
hóvé	"fish"	né-hove	"with a fish"
mbúndúdzí	"worms"	sé-mbundudzi	"like worms"

Frameworks for Analysis

The properties outlined in **Properties of Tone** Section demonstrate the autonomy of tone from segmental content, motivating the adoption of **Autosegmental Phonology**, a theory in which tone is conceived of as belonging to a separate "tier" from segments (Goldsmith, 1976). Within Autosegmental Phonology, tones and segments are linked to each other via association lines. Tone languages may differ according to the identity of the phonological constituent that can bear tone, referred to as the **tone-bearing unit** (TBU). In many languages, the TBU is the syllable: the nucleus of each syllable carries one tone. In some languages, the distribution of tone melodies suggests that the mora, rather than the syllable, should be considered the TBU. In Sezo (sze, Omotic, Ethiopia), for example, there is a two-way contrast between L and H on monomoraic syllables, while there is a four-way tonal contrast on bimoraic syllables between L, H, rising, and falling (Desta, 2016). As contours are composites of level tones, the minimal unit that may bear tone in Sezo is the mora.

The formation of a falling contour, as shown in (1a), can be represented autosegmentally as in (3). When the segmental component of the final vowel of "leaf" is deleted, its original H tone delinks and reassociates to the following TBU, resulting in two tones (H and L) both linked to the same TBU, thus realized as a falling contour on the surface.

3.



Autosegmental theory has been widely adopted for representing tone, as well as for other phonological phenomena like vowel harmony. Since the introduction of autosegmental theory, tone has generally been represented using tonal primitives (H, M, L, etc). However, various proposals in the literature have applied featural representations to tone: Yip (1980) proposed the use of the binary features [+/-upper] and [+/-high] (or [+/-raised], for Pulleyblank (1986)), allowing for the representation of four-way contrast in featural terms. Critics of such featural representations cite a number of issues unresolved by featural representations of tone, including the lack of evidence for subtonal natural classes and ambiguity in representation of mid tones (Hyman, 2010b; G.N. Clements & Patin, 2010). Regardless, some recent work, including McPherson (2016) on Seenku (sos, Mande, Burkina Faso), Akumbu (2019) on Babanki (bbk, Benue-Congo, Cameroon), Gjersøe et al. (2019) on Limbum (lmp, Benue-Congo, Cameroon), Meyase (2021) on Tenyidie (njm, Tibeto-Burman, India), and Lionnet (2022) on Laal (gdm, isolate, Chad), concludes that featural representations of tone are better suited for accounting for a variety of tonal phenomena than tonal primitives.

Some recent work in the phonological literature has looked at tone through a computational lens (Bird & Ellison, 1994; Chandlee, 2019; Gibbon, 1987, pp. 291–297; Jardine, 2016, 2017), couched in frameworks like Formal Language Theory. In such analyses, tonal processes may be modeled with adapted autosegmental representations, translated into string representations. Tone has proven to be important for understanding the types of computational systems needed to account for human language phonology: Jardine (2016) proposes that tone is computationally more complex than segmental phonology, evidenced by typological asymmetries between tonal and segmental processes.

Conclusion

Many of the world's languages are tonal: they make use of pitch as a contrastive feature of at least some morphemes. Tone languages are found across the globe, but are found at a particularly high concentration in certain areas, such as East and Southeast Asia and sub-Saharan Africa. Systems of individual languages vary along a number of parameters, including the number of relevant pitch contrasts, whether contours are contrastive in addition to relative pitch levels, the size and shape of the unit that can bear tone, and whether tone interacts with laryngeal features of consonants. Pitch can be exploited for both lexical and grammatical contrasts, and the relative functional load of each tends to vary by language family and geographic area. Phonologists have found that tone often acts independently from segmental material, motivating the adoption of autosegmental theory, in which tones are represented on their own autonomous tier. Novel findings about tone systems, particularly from those of underdocumented and understudied languages, inform our understanding about what is possible in phonology, and how best to represent it.

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