Realizing features: A case study of the syntax-morphology interface

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Abstract. The conceptualization of FEATURES has remained a central theme in generative approaches to the syntax-morphology interface since the early 1990s. They have played an enhanced role in late-insertion approaches to morphosyntax, in which the establishment of feature-exponence relations is of fundamental importance. In this chapter we review, and critique, the advantages and disadvantages of *direct* (Nanosyntax) and *indirect* (Distributed Morphology) approaches to this interface. To illustrate the similarities and differences, we demonstrate how nominal suffixes are realized in varieties of Norwegian (including the heritage variant, North American Norwegian, NAmNo). We show that while both *direct* and *indirect* approaches to the syntax-morphology interface are capable of modeling the alternations observed in Norwegian nominal suffixes, they sometimes do so via different mechanisms, opening the door for future comparative work.

Keywords. exponence; feature; interface; morphology; Norwegian; syntax

1. Introduction. An important question for theories of linguistic competence is how to model the interplay between abstract syntactic structures and their realization. This is often referred to as the syntax-morphology interface, which assumes that syntax and morphology constitute two different components in the grammatical architecture. Under such a view, the question then becomes what this interface looks like: that is, more concretely, how abstract syntactic features are connected to their morphosyntactic exponents. The main purpose in this paper is to test two different models of this interface against the same dataset.

This paper makes use of both monolingual and heritage language data. There are two reasons justifying this. The first relates to what Mahootian (1993) calls the null theory of code-switching, which can be generalized to all multilingual data (Lohndal & Putnam 2024a), namely that a theory of grammar should be able to cover all kinds of populations and not involve specific mechanisms that are defined for particular speaker groups. That is, although different grammars for different speaker populations are allowed and necessary, specific principles that only hold for multilingual speakers qua multilingual speakers are not allowed. The second is to demonstrate the utility of heritage language data for linguistic theory (Polinsky 2018; Lohndal et al. 2019; Lohndal & Putnam 2021).

This paper is organized as follows. Section 2 provides some general background on central issues regarding the syntax-morphology interface. Section 3 describes the system of nominal suffixes in Norwegian, both standard Nynorsk and North American Norwegian (NAmNo). In

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section 4, we provide an analysis of these data in an indirect and in a direct mapping approach. Section 5 summarizes and concludes.

2. The syntax-morphology interface. We adopt an exoskeletal approach to grammar in this paper. A hallmark of such an approach is that it emphasizes the way in which syntactic structure determines both the grammatical properties and "the ultimate fine-grained meanings of lexical items themselves" (Borer 2003: 33). An exoskeletal approach is really a family of related approaches that all are committed to this hallmark, but differ substantively when it comes to details and assumptions regarding the syntax-morphology interface (see Grimstad et al. 2018; Lohndal & Putnam 2024b). They range from *Distributed Morphology* (Halle & Marantz 1993; Embick & Noyer 2007; Embick & Marantz 2008; Embick 2015; Alexiadou et al. 2015; López 2020, in press), to Borer's specific version (Borer 1994, 2003, 2005a,b, 2013, 2014, 2017), to *Nanosyntax* (Caha 2009; Blix 2021; Fischer et al. 2022; Natvig et al. 2023).[1] Given this diversity, there is also no consensus on what a lexical item amounts to. The majority assumes that the basic unit in the lexicon is an uncategorized and featureless root, and that this root gets categorized in the syntax. But beyond that, the mechanisms differ substantially, as we will also see in the course of this paper.

These approaches stand against lexicalist approaches, where properties of lexical items govern their syntax. Additionally, lexicalism is typically committed to the *Lexical Integrity Hypothesis* (Lapointe 1980), which di Sciullo & Williams (1987: 49) formulate as follows: "Words are atomic units at the level of phrasal syntax and phrasal semantics. The words have FEATURES, or properties, but these features have no structure and the relations of these features to the internal composition of the word cannot be relevant in syntax." In exoskeletal approaches, words and sentences are construed based on the same mechanisms.

As mentioned, a crucial architectural property of exoskeletal models is that they allow us to separate atomic units (roots and features) from their associated exponents. However, this separation can happen in different ways. In what follows, we distinguish between a mapping that is indirect and a mapping that is direct.

2.1. AN INDIRECT MAPPING BETWEEN FEATURES AND EXPONENTS. An *indirect* mapping system between features and exponents permits a number of operations that can adjust licit syntactic structures postsyntactically prior to the syntax-morphology interface. Such an approach is relatively commonplace in *Distributed Morphology*. In fact, in their exhaustive treatment of the morphotactics of Basque auxiliaries, Arregi & Nevins (2012) deploy a number of postsyntactic operations (i.e., *Fission, Dissimilation, Impoverishment, Metathesis,* etc.) that can take place prior to Vocabulary Insertion (VI). Another guiding principle found in *indirect* mapping systems concerns the relationship that exists between features and exponents. To illustrate this, let's adopt the standard assumption that Vocabulary Items are featurally compatible with the nodes they apply to. This compatibility requirement also extends to contextual conditions that determine exponence. Consider the realization of past tense in English, which we represent with a T(ense)-head endowed with the feature specification of T[+past]. Although the majority of past tense verbs in English are created with the *-ed* suffix, this isn't the case for *all* verbs. For

[1] It is worth noting that Borer's model is often referred to as the exoskeletal model, but as she says, the technical implementation she has adopted does not follow from the conceptual framework: "… the validity of postulating an impoverished lexicon, in the sense employed here, is quite independent of the validity of any specific functional structure I will propose" (Borer 2005b: 10).

example, verbs like *leave* or *hit* are not compatible for the insertion of *-ed*: **hitted* and **leaved*. In order to derive the correct distribution of past tense forms in English, we need to propose additional Vocabulary Items that are contextually specified. A sample of these rules are provided in (1):

(1) Vocabulary Items for T[+past], ordered (Embick 2015: 95)
   a. T[+past] ↔ -t/{$\sqrt{\text{bend}}$, $\sqrt{\text{leave}}$, …}___
   b. T[+past] ↔ -Ø/{$\sqrt{\text{hit}}$, $\sqrt{\text{quit}}$, …}___
   c. T[+past] ↔ *-ed*

How can we ensure that the application of *-ed* does not over-generate and appear in connection with $\sqrt{\text{roots}}$ in which this exponent is not compatible? *Indirect* approaches to the syntax-morphology interface adopt an axiom to address this matter: Vocabulary Items exist as sets of *lists* for contextually specified exponents that target the same feature (bundles). With this axiom in place, we still need an overarching principle to dictate that the appropriate Vocabulary Item will be selected under the right conditions. The strategy opted for here is one that relies on specificity: that is, the insertion of a more specific Vocabulary Item takes precedence over those that are less specified (all things being equal). The **Subset Principle** in (2) represents a more precise statement of this specificity condition on VI:

(2) **Subset principle:** The phonological exponent of a Vocabulary Item is inserted into a position if the item matches all or a subset of the features specified in the terminal morpheme. Insertion does not take place if the Vocabulary Item contains features not present in the morpheme. Where several Vocabulary Items meet the conditions for insertion, the item matching the greatest number of features specified in the term morpheme must be chosen. (Halle 1997: 428)

According to the **Subset Principle**, more specific Vocabulary Items, namely, those applied to $\sqrt{\text{roots}}$ such as $\sqrt{\text{bend}}$ (-t) and $\sqrt{\text{quit}}$ (-Ø), would apply before the elsewhere suffix. Thus, the **Subset Principle** blocks the overapplication of less specific exponence in favor of more specific forms.

2.2. A DIRECT MAPPING BETWEEN FEATURES AND EXPONENTS. Theoretical approaches that adopt a *direct* mapping between features and exponents, such as *Nanosyntax* (Starke 2009), opt for a different set of axioms than those commonly found in those that make use of an *indirect* mapping algorithm. In fact, although *Distributed Morphology* and *Nanosyntax* share a number of architectural similarities – i.e., they are both late-insertion, realizational approaches to the syntax-morphology interface – upon closer inspection, these distinctions can be quite significant. Caha (2018) lists three primary differences that exist between *Distributed Morphology* (indirect) and *Nanosyntax* (direct) with respect to lexical insertion. The first difference concerns *the nature of the basic building blocks* of linguistic structure. Whereas *Distributed Morphology* projects syntactic structures that correspond to "prepackaged" feature bundles, *Nanosyntax* interprets the syntax as the only component of grammar capable of building complex feature structures. This proposal comes with a number of consequences, such as the lack of a pre-syntax lexicon (of any sort), the interpretation of lexical items as hierarchical trees (i.e., L-trees), and the requirement of a number of movement operations in order to achieve congruence at the syntax-morphology interface; these operations are presented as the algorithm in (3). Here, we discuss structures that do and do not instantiate movement following these principles and refer readers to Starke (2018),

De Clercq (2020), Blix (2021), Caha (2021), and Caha et al. (forthcoming) for detailed treatments of the spellout algorithm in *Nanosyntax.* For our purposes, the main distinction is that lexicalization with suffixes requires movement, whereas lexicalization via √roots often does not. We expand on this in section 4.2.

(3) **Spellout algorithm** (Caha 2021: 412; adapted from Starke 2018: 245)
   a. Merge F and spell out.
   b. If (a) fails, move the Spec of the complement and spell out.
   c. If (b) fails, move the complement of F and spell out.

A second difference between these two related approaches, as reported by Caha (2018), concerns the conceptualization of *phrasal spellout*. In *Nanosyntax*, individual, singleton "morphemes" often express multiple features. This is especially true in the case of portmanteau structures. *Phrasal spellout* is governed by a contrastively different statement that determines conditional allomorphy. *Nanosyntax* makes use of a **Superset Principle** (4) concept (as opposed to the **Subset Principle** (2) found in *Distributed Morphology*):

(4) **Superset Principle:** In case a set of syntactic features does not have an identical match in the lexical repertoire, use a lexical form, which contains a superset of the features present in the syntax. (Fábregas & Putnam 2020: 40)

In other words, exponents may be featurally overspecified relative to syntax in *Nanosyntax*, so long as those features are configured in a proper superset of the syntactic structure that is generated. The opposite relationship obtains in *Distributed Morphology*, where vocabulary items may be underspecified relative to feature bundles in the syntax. Adopting the **Superset Principle** as a conditioning axiom for the distribution of exponence opens the door to non-terminal lexical insertion. In sum, in *Nanosyntax*, "*phrasal spellout* inserts Vocabulary Items into phrasal nodes" (Caha 2018: 58).

The third key point of divergence between these two approaches with respect to lexical insertion centers on the question of whether *a separate module of grammar* exists (or not). At first glance, this question may seem to be a misunderstanding in terminology, since both *Distributed Morphology* and *Nanosyntax* view "morphology" as distributed across multiple modules. In reality, this point represents the key element of contrast between the *direct* nature of *Nanosyntax* in calling for the abandonment of postsyntactic operations that change constituency and/or linear order. Although such operations are common place in *Distributed Morphology* (e.g., *Fission*, *Fusion*, *Impoverishment*, *Obliteration*, etc.), *Nanosyntax* eliminates these axioms entirely. This factor, plus the view of syntax being the only component of grammar capable of constructing feature bundles, leads to the need to ensure that all features are exponed. This is captured by the **Exhaustive Lexicalization Principle** in (5):

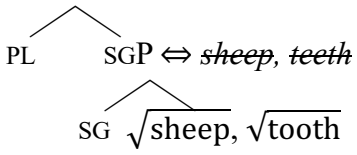
(5) **Exhaustive Lexicalization Principle:** All syntactic features present in the derivation must be matched exhaustively with lexical items. (Fábregas 2007)

It bears repeating that these differences result in quite contrastive, and in some instances, radically different, views between these two late-insertion, realizational models of the syntax-morphology interface, which otherwise appear to be quite similar to one another. By expunging all postsyntactic operations, *Nanosyntax* reduces allomorphy (in a traditional sense) to the size of L-trees in the mental lexicon (Starke 2014), which pertains to structures for both √roots and

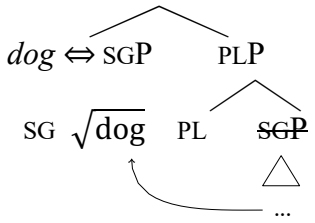
exponents (Blix 2021; Caha 2021; Fischer et al. 2022; Natvig et al. 2023). To illustrate the interplay of the Superset Principle and the Exhaustive Lexicalization Principle, we refer to English plurals, based on discussions in Caha (2021) and elsewhere in the *Nanosyntax* literature. Specifically, we look at two types of plurals that do not receive a suffix, here *sheep* ~*sheep* and *tooth* ~ *teeth* (6a), and the regular pattern represented with *dog* ~*dog-s* (6b). We furthermore adopt the position that the grammatical and semantic distinctions between singular and plural are expressed through the size of trees, such that singular is contained within the plural (see Caha 2021). In (6), we refer to these features as SG and PL for simplicity. Furthermore, the trees in (6) demonstrate lexicalization through cyclic spellout, where spellout occurs at each cycle in the derivation (phrasal spellout) via superset mapping conditions, while the structures in (7) indicate the underlying L-trees for each form that lexicalize generated structures (S-trees).

(6) Cyclic spellout and lexicalization of English plurals (following Caha 2021)

a. PLP ⇔ *sheep, teeth*



b. PLP ⇔ *s*



(7) Spellout of nominal roots based on the size of √root and affix L-trees.

a. [PL[SG[√sheep]]] ⇔ *sheep*
b. [SG[√tooth]] ⇔ *tooth*
c. [PL[SG[√tooth]]] ⇔ *teeth*
d. [SG[√dog]] ⇔ *dog*
e. [PL] ⇔ *s*

For the noun *sheep* and others that do not alternate between singular and plural, their L-trees are stored containing both SG and PL, as in (7a). In terms of the syntactic derivation, the L-tree in (7a) spells out the merger of [SG[√sheep]], resulting in singular *sheep*, because the L-tree is a superset of the S-tree. The merger of PL to create the plural, i.e., [PL[SG] sheep] is also lexicalized with the L-tree in (7a), overwriting spellout at the previous cycle. The spellout of *tooth* proceeds following the same steps, with the exception that although *tooth* spells out the S-tree at the first cycle, it is overwritten by *teeth* at the second. Both of the plurals are lexicalized following (3a), where it's only necessary to merge features and spell out. In contrast to √sheep and √tooth, √dog has no means of lexicalizing the S-tree once [PL] is merged. The {*s*} suffix is only able to spell out [PL] and this cannot overwrite the previous cycle nor lexicalize PLP because its L-tree does not contain a proper superset of the generated S-tree. Since all features in the S-tree must be lexicalized, following the Exhaustive Lexicalization Principle, movement occurs (here, the complement of PL moves to SpecPLP; see (3c)), which creates an S-tree where PLP does not contain any daughter nodes and can now be spelled out by {*s*}.

3. Aspects of the nominal phrase in varieties of Norwegian. In this section, we present the empirical focus of our paper: nominal suffixes in varieties of Norwegian. Specifically, we investigate these suffixes in Norwegian and in the heritage variety NAmNo. In what follows, we present the data in each of these varieties.

3.1. NOMINAL SUFFIXES IN NORWEGIAN. Norway has a vast number of dialects, and these dialects often differ in terms of their nominal suffixes. Here we concentrate on the standard written Nynorsk variety (see Venås 1993; Vikør 1995 for more on the Norwegian language situation). This variety has three genders and it has definite and indefinite forms in the singular and plural. An illustrative paradigm is provided in Table 1.[2]

	Singular		Plural	
Gender	Indefinite	Definite	Indefinite	Definite
Masculine	bil 'car'	bil-en	bil-ar	bil-ane
Feminine	dør 'door'	dør-a	dør-er	dør-ene
Neuter	hus 'house'	hus-et	hus-Ø	hus-a

Table 1. Nominal suffixes in the Nynorsk variety of Norwegian

In the table, we have segmented the morphemes in such a way that the suffixes encode multiple features. Alternatively, one could also segment them as in Table 2, where each morpheme encodes a unique feature.

	Singular		Plural	
Gender	Indefinite	Definite	Indefinite	Definite
Masculine	bil 'car'	bil-en	bil-a-r	bil-a-ne
Feminine	dør 'door'	dør-a	dør-e-r	dør-e-ne
Neuter	hus 'house'	hus-et	hus-Ø	hus-a

Table 2. An alternative segmentation of morphemes in the Nynorsk variety of Norwegian

This latter segmentation is relevant with respect to the most prominent analysis of the structure of the Norwegian noun phrase, namely Julien (2005).

There is substantial dialect variation in Norwegian. Some dialects do not distinguish between the three genders in the plural; i.e., they have many syncretic forms. Dialects differ in terms of exactly how the syncretism manifests itself and in which areas of the paradigm it occurs. Some dialects also distinguish between whether or not a noun ends in a vowel (so-called "strong" and "weak" forms). We set aside this variation here and provide an analysis of Nynorsk and thereby also of spoken varieties that display the same system as Nynorsk.

It is necessary to say something general about noun phrases in Norwegian before we zoom in on the relationship between the noun and its suffixes. As for the structure of nominal phrases, we can illustrate this based on the example in (8), based on van Baal et al. (in press).

(8) a. determiner/possessive/demonstrative > numeral > adjective > noun + suffix > possessive

b.

de	fire	stor-e	bil-ene	mine
DEF.PL	four	big-DEF	car-DEF.PL	my-PL

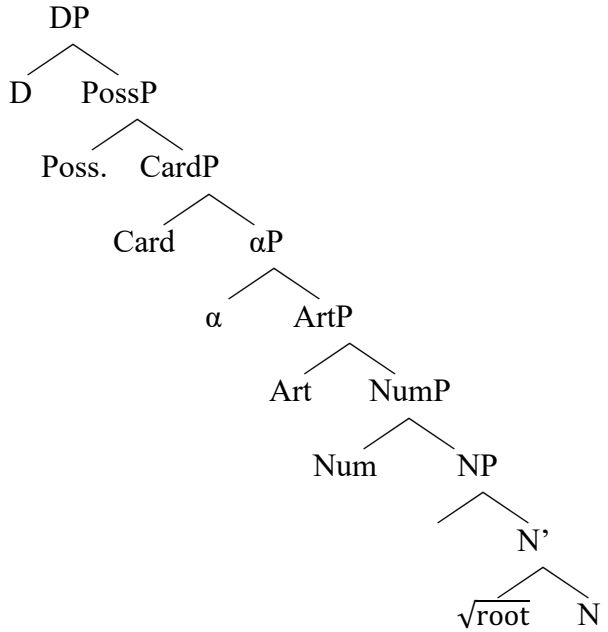
'my four big cars'

As we can see in this example, most functional elements occur before the noun. Some of them are also in complementary distribution, such as determiners, possessives and demonstratives.

[2] For the purposes of this paper, we simply assume that suffixes in Nynorsk can express grammatical gender (see, among others, Faarlund et al. 1997). For more discussion and a different analysis based on ongoing changes in the gender system, see Lohndal & Westergaard (2021).

Based on Julien's (2005) extensive work, and van Baal et al.'s (in press) small adjustments, the structure of Norwegian nominal phrases is argued to be as shown in (9).

(9)



In this structure, we assume that an uncategorized root from the lexicon becomes categorized by merging with a categorizing head (we take no stand on exactly how here; see Alexiadou & Lohndal 2017 for a discussion of possible alternatives). The NP has an available specifier where possessives are born. NumP encodes suffixal number morphology, and then the definite suffix is generated in what we label an Article Phrase (ArtP here and in Julien 2002; van Baal et al. in press; *n*P in Julien 2005). The root and the categorizer move through Num and Art in order to provide the right order of morphemes. Since the rest of the structure is immaterial for present purposes, we won't go into further detail. See Julien (2005) and van Baal et al. (in press) for comprehensive empirical and theoretical discussions.

The analysis in Julien (2005) is based on a mirror-theory approach to word order, where syntactic head movement is utilized to provide the correct linear order of morphemes. Julien builds on a long tradition when arguing that the suffixed definite article is merged in a higher position than the noun and that suffixation happens through head movement (see, among many, Taraldsen 1990; Kester 1993; Santelmann 1993; Vangsnes 1999). Note that the movement of N and the root, via Num, to Art is an obligatory movement, and Julien (2005: 4) compares it to Chomsky's (1995) claim that V obligatorily has to move to *v*.

3.2. NOMINAL SUFFIXES IN NORTH AMERICAN NORWEGIAN. This section is based on data from present-day NAmNo. This is data that been collected since 2010 from current speakers, who are typically elderly and the final generation of speakers. There are recordings of previous generations of NAmNo speakers, but these have been investigated in less detail than the present-day speakers. This section is based on corpus data (from the Corpus of American Nordic Speech, CANS; Johannessen 2015), as well as elicited production data.

A first observation that can be made is that the presence of the suffixes is very stable in NAmNo. In singular definite phrases, the definite suffix is used with very high consistency. In addition, this suffix is also inflected for gender in the same way as in Norwegian. The stable

presence and form of the definite suffix is discussed in (among others) Johannessen & Larsson (2015), Lohndal & Westergaard (2016), and van Baal (2020). In very few cases, however, the masculine definite suffix *-en* can be found on non-masculine nouns. This results in, for example, *flagg-en* 'the flag' and *bok-en* 'the book' where *flagg-et* and *bok-a* are used in Norwegian (cf. Table 1 above).

The indefinite plural suffix is also very stable in NAmNo. As shown in Tables 1 and 2, neuter nouns typically receive no suffix (or a zero suffix in some analyses) in indefinite plural, and this is also found in NAmNo. However, there are no speakers who overgeneralize this pattern to all nouns, and NAmNo indefinite plural phrases include an indefinite plural suffix as expected. The form of the suffix varies from speaker to speaker, and this is expected given the variation that exists in Norwegian dialects. The most frequently used indefinite plural suffixes in the data are *-er* and *-a*, and both are used on masculine and feminine nouns alike. In addition, there are instances of *-o* and *-u* as suffixes on some specific (neuter) nouns. Typically, the NAmNo data do not show different plural suffixes for masculine and feminine nouns. While this system differs from the Nynorsk system displayed in Table 1, this is not a NAmNo innovation. Many Norwegian dialects have syncretic forms for the indefinite plural.

While both the definite and plural suffixes are stable in presence and form, the definite plural suffix in NAmNo provides an interesting innovation compared to European Norwegian. Many speakers use indefinite plural suffixes on phrases that are semantically (or pragmatically) definite. This results in a "unified" plural morpheme that is used in indefinite as well as definite phrases, illustrated below. However, there is no complete overextension of indefinite plurals to definite phrases: all speakers in van Baal (2020, 2024) use both the indefinite plural and definite plural suffixes. There is great interspeaker variation as to how frequently they use the unified plural, and some speakers never do so.

(10) NAmNo

a. to hvite høn-er
two white chicken-INDF.PL
'two white chickens' (context: indefinite)

b. to brune høn-er
two brown chicken-INDF.PL
'two brown chickens' (intended, context: definite)

When NAmNo speakers use the definite plural suffix, they typically use the same suffix for all three genders. Most frequently, this suffix is *-an*, but *-ane* and *-ene* are also found. This differs from the system in Table 1, but syncretism between genders is found in Norwegian homeland dialects too, and is therefore not an NAmNo innovation.

Summarizing, the presence and form of the NAmNo nominal suffixes is generally stable. Table 3 illustrates the most frequent NAmNo suffixation patterns in comparison with Nynorsk. The grey columns represent NAmNo. We find syncretism between genders within the plural suffixes, and some syncretism between genders within the definite singular suffix. This type of syncretism can also be found in Norwegian and its dialects. Uniquely for NAmNo, however, we observe syncretism between plural indefinite and plural definite suffixes. There is no overextension of definite morphemes to indefinite contexts, or from singular to plural. In general, we can conclude that the plural feature is more stable than the definite feature.

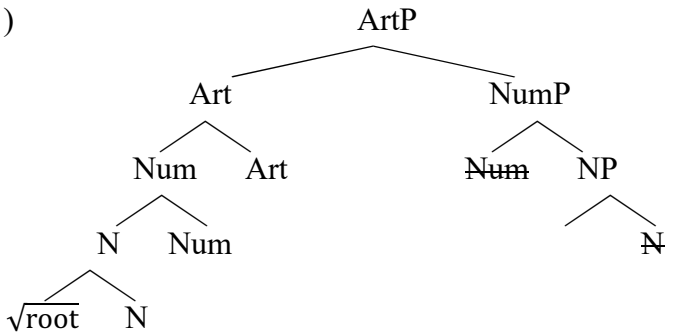
	Singular			Plural			
Gender	Indef	Def	Def	Indef	Indef	Def	Def
Masculine	bil ‘car’	bil-en	bil-en	bil-a-r	bil-e-r	bil-a-ne	bil-a-n
Feminine	dør ‘door’	dør-a	dør-a	dør-e-r	dør-e-r	dør-e-ne	dør-e-n
Neuter	hus ‘house’	hus-et	hus-et	hus-Ø	hus-Ø	hus-a	hus-a-n

Table 3. Suffixes in Nynorsk compared to NAmNo

4. Late-insertion analyses of the Norwegian data. We now consider two possible analyses of the data. The first is an *indirect* mapping between features and exponents, whereas the other is a *direct* mapping analysis. A key distinction between the two approaches involves the relationship between generated (morpho)syntactic structures and the representational content of the exponents to which these structures are mapped.

4.1. AN INDIRECT MAPPING ANALYSIS. Here, we present an analysis of the Norwegian and NAmNo data based on an indirect mapping analysis, consistent with Julien (2005) and starting from the syntactic tree in (9). For an analysis of the nominal suffixes, the relevant part of the tree is from ArtP and downwards. In Julien’s analysis, there is a series of head movements in all noun phrases. The N head (consisting of the root and the nominalizer) moves to the Num head, and this complex head moves on to the Art head, resulting in a complex Art head as in (11). The combined heads in this complex Art head contain the three features relevant for suffixes: gender, number, and definiteness. Definiteness is located in Art, the number feature originates on Num, and the gender features originate on the nominalizer.

(11)



After syntax creates the structure above, there is a process of VI. However, in an indirect mapping analysis like *Distributed Morphology*, certain postsyntactic operations can take place first. As one of these postsyntactic operations, there is Fusion, which combines features into a feature bundle. For Norwegian, the gender, number, and definiteness features that are each present in their own location in the syntax are bundled together into a single feature bundle. These feature bundles are then matched onto Vocabulary Items through the Subset Principle, unless other postsyntactic operations alter the feature bundles.

An indirect mapping approach can work with binary features (e.g., [+DEF] and [-DEF]) or with privative features (e.g., the absence or presence of [DEF]). Julien (2005: 18–19) works with privative features and assumes that the absence of a [DEF] feature leads to an indefinite interpretation. In a similar way, we assume that the absence of a [PL] feature creates a singular phrase. However, an analysis with binary features would follow similar principles for VI as the analysis outlined below. Given that VI follows the Subset Principle, the Vocabulary Items need not be

fully specified. For the eight different suffixes found in Nynorsk (see Table 1 above), the following Vocabulary Items can be proposed:

(12) Vocabulary Items for Norwegian nominal suffixes
  a. Art[PL, DEF, M] ↔ *-ane*
  b. Art[PL, DEF, F] ↔ *-ene*
  c. Art[PL, M] ↔ *-ar*
  d. Art[PL, F] ↔ *-er*
  e. Art[DEF, M] ↔ *-en*
  f. Art[DEF, N] ↔ *-et*
  g. Art[DEF] ↔ *-a*
  h. Elsewhere ↔ *-Ø*

The majority of these Vocabulary Items (VIs) are rather straightforward: they form a combination of the full feature bundle created by syntax (e.g., [PL, DEF, M] in (12a)) or a subset thereof (e.g., [PL, M] in (12c)) and are therefore the only VI that can be inserted. There are two VIs that will be inserted for several feature combinations (they occur in multiple cells in Table 1 above): *-a* and *-Ø*.

First, the suffix *-a* is found on definite singular feminine nouns (such as *bok-a* 'the book') as well as definite plural neuter nouns (such as *hus-a* 'the houses'). Both contain a [DEF] feature, and we propose that the VI matches [DEF] with *-a*. Since the other VIs are more specific (and, for example, include a plural or gender feature), these will be inserted in other contexts. However, for definite plural neuter nouns to match with this VI, another postsyntactic operation is necessary. If syntax creates the feature bundle [PL, DEF, N], the most specific VI in (12) is (12f), which would lead to insertion of the suffix *-et*, contrary to fact. Following previous research where Impoverishment operations often delete gender features in plural contexts (Bobaljik 2002; Kramer 2019), we therefore propose an Impoverishment operation that deletes the [N] feature in the context of a [PL] feature.[3] The result of this Impoverishment is that the feature bundle becomes [PL, DEF] and then the only VI that can be inserted under the Subset Principle is (12g).[4]

The other suffix that occurs in multiple contexts is the zero suffix. Given the Elsewhere Vocabulary Item, a zero suffix will be inserted in all cases where no more specific VI can be inserted. This applies to singular indefinite nouns, because all other VIs contain either a [DEF] or a [PL] feature not present in the syntax of singular indefinite phrases. The zero suffix is also inserted for indefinite plural neuter nouns: although there are VIs that include a [PL] feature, these also include a [M] or [F] feature and hence cannot be inserted, as the Subset Principle does not allow insertion of VIs that contain features not present in the morpheme.

The VI and Impoverishment rules described above account for the Nynorsk data presented in section 3.1. As discussed in section 3.2, NAmNo differs in certain aspects from these Nynorsk data. One difference is that most NAmNo speakers do not use different plural suffixes for distinct genders. This difference can quite easily be captured by assuming a different VI, one that is

[3] Note that this deletion is a PF-deletion process only; it does not affect semantic interpretation.
[4] One common criticism of Impoverishment is that it is too stipulative and powerful. As Embick (2015: 141) points out, the context where Impoverishment can apply "can in principle be very specific, or very general." However, as he also says, "Impoverishment rules are posited only when necessary" (162), so it is a mechanism that should be used with caution.

less specific and does not contain gender features. For example, most NAmNo speakers produce the suffix *-an* with definite plural nouns of all genders. This can be captured by the Vocabulary Item in (13), which is present in NAmNo instead of the more specific VIs in (12a) and (12b).

(13) Alternative Vocabulary Item for NAmNo
Art[PL, DEF] ↔ *-an*

As noted in section 3.2, these suffixes are not specific to NAmNo, but also found in various Norwegian dialects. The alternative VI in (13) is therefore likely "inherited" from the baseline dialects that differ from Nynorsk, and not an invention in NAmNo. Yet, we observed an innovation in NAmNo: the use of a unified plural, where both indefinite and definite plural phrases receive the same suffix. Under an indirect matching analysis, this could be captured by the introduction of an Impoverishment rule that is unique to NAmNo and not found in Nynorsk or the homeland dialects. Under this Impoverishment rule, which is stated in (14), the feature [DEF] is deleted in the context of [PL]. As a result of this rule, the feature bundle no longer contains a [DEF] feature and the VI in (13) cannot be inserted.

(14) [DEF] → Ø / [[PL]]

Note, however, that this Impoverishment rule has to be a probabilistic rule, as it does not apply everywhere and there are NAmNo speakers who (with varying frequency) produce definite plural suffixes. See Nevins & Parrott (2010) on the existence of probabilistic Impoverishment rules.

It is worth reiterating the appeal to the null theory made in the introduction. In this section, we have seen that the same general mechanisms can be applied to both monolingual and heritage language data. Even though the rules for VI are slightly different between the two varieties, the fundamental grammatical operations remain the same, and no additional operations need to be proposed specifically for the heritage language data.

4.2. A DIRECT MAPPING ANALYSIS. We now present the Norwegian nominal allomorphy that follows from the principles of *Nanosyntax*. Recall that this approach assumes a direct mapping between syntactic derivations (S-trees) and stored lexical structures (L-trees) operating under the **Superset principle**, and that differences in morphological expressions within a given domain obtain from the size of L-trees associated to $\sqrt{\text{roots}}$ and exponents. In order to present representations required in *Nanosyntax*, we adapt the syntactic structures for Norwegian nominals discussed above and "build out" both NumP and ArtP to distinguish respectively between singular ([Num_1]) and plural ([$\text{Num}_2[\text{Num}_1]$]) on the one hand, and indefinite ([Art_1]) and definite ([$\text{Art}_2[\text{Art}_1]$]) on the other. We draw on the same logic for contrasting gender distinctions, where neuter is the "smallest" gender ([Ref]), followed by masculine ([Class[Ref]]) and then feminine [F[Class[Ref]]] (see Caha 2021).[5] Basing our analysis on the decomposition presented in Table 2, we propose the following lexicalization table to model the division of labor between root and suffixes in spelling out S-trees up to and including the plural (Table 4); for reasons we discuss later, we consider definiteness exponents to belong to a separate lexicalization domain or "phase" in this analysis. Although we comment on the differences in predictions related to direct

[5] Note that this is not a standard analysis of grammatical gender. Contemporary approaches to Norwegian typically follow Kramer (2015), where gender is a feature on the categorizing head *n*. See, among others, Lohndal & Westergaard (2021) for such an approach for Norwegian. However, such an analysis is not available within the direct mapping architecture we are exploring here.

and indirect mapping approaches, we leave a full analysis of the realization of definiteness to future work.

√root	Ref	Num$_1$	Num$_2$	Art$_1$	Art$_2$
hus				∅	
hus				e	
hus				∅	
hus				a	

√root	Ref	Class	Num$_1$	Num$_2$	Art$_1$	Art$_2$
bil					∅	
bil					en	
bil		a			r	
bil		a			ne	

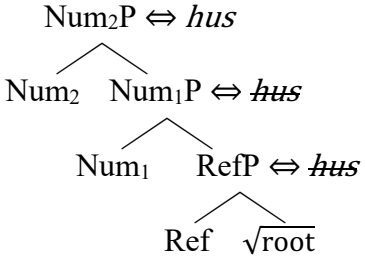
√root	Ref	Class	F	Num$_1$	Num$_2$	Art$_1$	Art$_2$
dør						∅	
dør						a	
dør				e		r	
dør				e		ne	

Table 4. Lexicalization table for Norwegian nouns

The shading in the table indicates the features that a given √root or exponent will lexicalize. Looking at the lefthand side of the table, from the √root through Num$_2$, the dark shading shows what the √roots spell out, so *hus* lexicalizes a treelet up to and including Num$_2$, whereas both *bil* and *dør* can spell out up to and including Num$_1$ for singular, with different features for each gender. Their respective plural exponents {*a*} and {*e*} lexicalize Num$_2$, in addition to other features that these √roots spell out in the singular, an issue we turn to below.

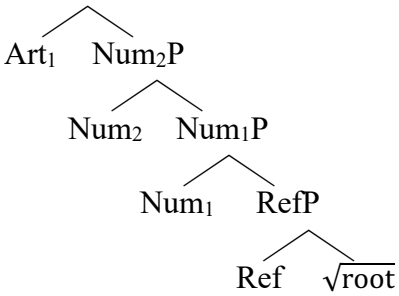
We start with √hus, a neuter noun, meaning that it lexicalizes the feature [Ref] and only [Ref]. In addition, √hus spells out both [Num$_1$] for singular and [Num$_2$] for plural. In short, the form *hus* corresponds to the lexicalization of the entire S-tree up to and including [Num$_2$], at every stage of the derivation, as in (15), exactly like *sheep* does in (6a) following **Superset** principles. We argue that this is the stored L-tree for √hus. That is, the lexical representation includes features for number, but not definiteness, even though there is no overt phonological marking for indefiniteness (Art$_1$P) in the singular or plural. If we attempt to lexicalize number and definiteness features in the same cycle, we derive the indefinite plural *hus* as in (16a). However, the derivation crashes for indefinite singular *hus* following the merger of [Art$_1$] with Num$_1$P (16b). This is because the proposed lexical entry for √hus, an L-tree that exactly matches the S-tree in (16a), does not consist of a proper superset of the S-tree in (16b), due to Num$_2$P intervening between Art$_1$P and Num$_2$P; Spellout-driven movement would create a structure where Art$_1$P does not dominate other phrases, but there is no way to lexicalize that phrase while still lexicalizing [Num$_2$[Num$_1$[…]]]. From this perspective, we therefore consider postnominal definiteness marking in Norwegian to be realized as the outcome of a separate derivation, with gender and number agreement, and leave this to future work.

(15) Neuter

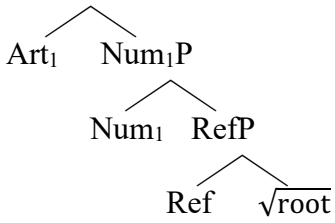


(16) Neuter (with ArtPs)

a. *hus* ⇔ Art_1P



b. $Art_1P \not\subset$ *hus* (CRASH)

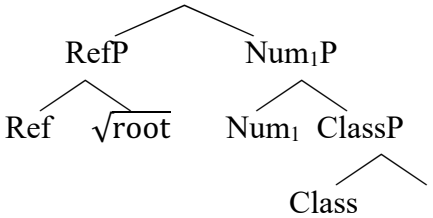


Moving on to masculine $\sqrt{\text{bil}}$ and feminine $\sqrt{\text{dør}}$ in Table 4, we see that each lexicalizes their respective gender features and [Num_1] for singular. However, the exponents for plural {*a*} and {*e*}, are sensitive to gender specifications and require unique L-trees to model their distributions. There are a number of possibilities and for the sake of exposition, we stipulate that {*a*} lexicalizes both Num features, as well as [Class] – i.e., the node that results in masculine gender – whereas {*e*} just spells out the Num features as a pure "plural" suffix. Regardless of whether or not this turns out to be the correct analysis of this allomorphy, one – or both – $\sqrt{\text{roots}}$ must "shrink" in their lexicalization capacity from singular to plural. Two competing proposals for this phenomenon have been proposed in the *Nanosyntax* literature: (1) backtracking (Caha 2021), a set of operations where previous cycles are undone and licit spell outs are replaced with movement, step by step, until a lexicalizable treelet is created; and (2) partial overwrite (Blix 2021), a proposal where L-trees for $\sqrt{\text{roots}}$ are stored with branching tree structures, such that $\sqrt{\text{roots}}$ are able to lexicalize S-trees following movement operations. Once a new feature (not present in the L-tree) is introduced to the derivation, the $\sqrt{\text{root}}$ spells out the left side of the branching structure, following the **Superset Principle**. Our current purpose is not to adjudicate between these two proposals; rather we present branching L-trees, following Blix (2021).

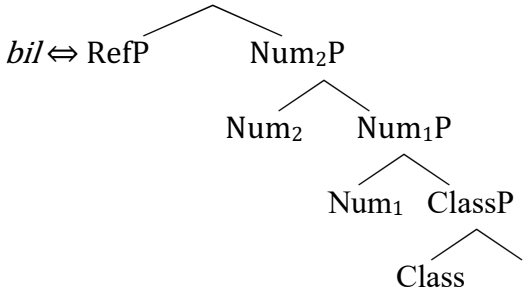
Norwegian masculine singular $\sqrt{\text{roots}}$, as in (17a), are unable to lexicalize their S-trees following merge with [Num_2], and the treelets that are in the Spec of Num_1P, [$RefP[\sqrt{\text{root}}]$], move to Spec of Num_2P according to (3b). This structure is represented in (17b), where the $\sqrt{\text{root}}$ spells out the left side of the branching structures and the appropriate plural exponent {*a*} spells out the right side, i.e., [$Num_2P[Num_1P[ClassP]]$].

(17) Masculine

a. *bil* ⇔ Num_1P



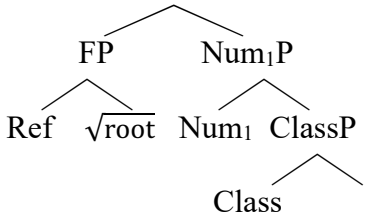
b. Num_2P ⇔ *a*



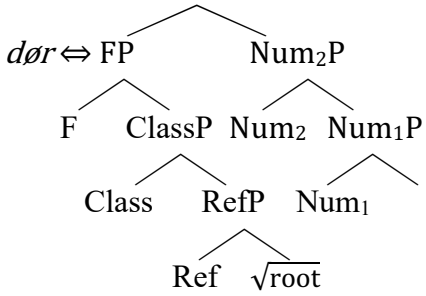
Feminine √roots, on the other hand, are presented in (18), where – like the masculine – their L-trees are stored red as branching structures that lexicalize up to Num_1P in (18a), but "shrink" following merge with Num_2. In this case, [FP[ClassP[RefP[√root]]]] moves to Spec Num_2P, leaving [Num_2P[Num_1P]] to be exposed as {*e*}.

(18) Feminine

a. *dør* ⇔ Num_1P



b. Num_2P ⇔ *e*



We now turn to a discussion of the allomorphy that is specific to NAmNo, both in terms of the representations for inherited dialect patterns – namely the *-an* suffix – and a proposal for capturing the variable impoverishment discussed above. We depart from the presentation of *Nynorsk* in the following ways: (1) NAmNo plurals for masculine and feminine nouns demonstrated a high degree of overlap; for the sake of simplicity and space, we group them together in order to contrast them against neuter nouns; (2) we assume an indefinite plural consisting of {a} for both masculine and feminine nouns, again contrasting these with null plurals for neuter nouns; and (3) based on an indefinite plural for *-a*, {r} does not expone Art_I as in the *Nynorsk* analysis, such that indefiniteness is not overtly realized for singular or plural. Finally, because the *nanosyntactic* analysis requires the realization of definite suffixes in a separate cycle from the √root and plural exponents, the appearance of a single suffix *-an* for all three genders is not possible. Specifically, the *-a* in both *bilan* 'the cars' and *døran* 'the doors' in this analysis is the realization of [Num_2P[Num_1P]] in the first cycle, whereas the *-a* in *husan* 'the houses' is part of the definite plural exponent, realized in the second cycle.[6] We compare {*an*} and {*n*} in the lexicalization

[6] Supporting evidence can be found in the distribution of tonal accents, i.e., two distinct realizations of stressed syllables, where all monosyllabic words are accent 1 and multisyllabic words can be either accent 1 or accent 2, depending on complex morphophonological patterns (esp. Kristoffersen 2000). Because definite suffixes generally do not alter the tonal accent of the corresponding indefinite form (Wetterlin 2010: 59–63), one can argue that the domain for tonal accent assignment is monosyllabic ([1]*hus*)*an*, but disyllabic ([2]*bila*)*n* and ([2]*døra*)*n*. Additional work

table in Table 5, where for the present discussion gender and number features from the first cycle are also expressed in the second cycle, here beginning with Art_1; for the time being, masculine and feminine consist of the same features, although this needs to be investigated further.[7]

A final comment on the *nanosyntactic* analysis of NAmNo concerns the variable deletion of definiteness (i.e., multiple ArtP projections) in plural contexts. While this phenomenon was explained via Impoverishment in an indirect mapping analysis, where DEF deletes (only as it concerns phonological realization) in the context of PL, a direct mapping analysis can model this by simply not generating the relevant components of syntactic structure following the expression of the plural cycle, as shown in Table 5. By hypothesis, the structures in the plural cycle are spelled out and sent to the phonology for independent reasons (cf. 16b) and, in these instances, mark the end of the syntactic derivation within the nominal domain. It is clear that such a position requires further study, but the framework provides a testable hypothesis for potential cutoff points in the heritage language grammar for the adequate realization of syntactic features, potentially owing to the size of treelets, or number of phrasal projections, within the relevant domain or cycle.

Plural cycle	Art_1	Art_2	Ref	Num_1	Num_2	
hus	an					
Plural cycle	Art_1	Art_2	Ref	Class	Num_1	Num_2
bila	n					
Plural cycle	Art_1	Art_2	Ref	Class	Num_1	Num_2
døra			e		ne	

Table 5. Lexicalization table for NAmNo definite plural exponents

4.3. COMPARING THE ANALYSES. In this section, we have compared two different late-insertion approaches to the syntax-morphology interface: a direct mapping between features and exponents and an indirect mapping. On a direct mapping analysis, a particular exponent can in principle correspond to a range of features. On an indirect mapping analysis, a particular feature corresponds to one exponent (modulo various adjustments that may affect this relationship). *Nanosyntax* allows for a more detailed decomposition of morphemes, which is not usually sanctioned in *Distributed Morphology*.

Relatedly, on the analysis of grammatical gender in *Nanosyntax* employed in this paper, particular grammatical genders are composed of the same subset of features. Feminine gender has the composition [F[Class[Ref]]], whereas masculine has [Class[Ref]]. However, this analysis is not a necessity, and it is possible to develop an analysis of grammatical gender where gender features such as [fem] or [masc] are privative features. On this latter analysis, the difference between *Nanosyntax* and *Distributed Morphology* in this area would be less substantial.

Another difference between these two approaches concerns the notion of cyclicity that they employ. As we have seen above and based on our decomposition of exponents, *Nanosyntax* requires a separate domain for definiteness in order for the lexicalization mechanism to work.

is necessary to arrive at a complete analysis to account for why definite plural *-an* has a different effect on neuter nouns than it does on masculine and feminine ones.

[7] The syncretism in masculine and feminine agreement in the definite article requires further examination into the structure of gender features between ArtP and NumP projections, since including F for feminine nouns will cause the derivation to crash. We present them here as having the same featural makeup for the sake of discussion.

Distributed Morphology is not committed to a specific notion of cyclicity, even though a lot of work assumes that the categorizer and root constitute a cyclic domain.

The two approaches also make fundamentally different assumptions about the content of the mental lexicon and, accordingly, how we can potentially analyze differences in structure and variation from heritage language data. Whereas an indirect approach like *Distributed Morphology* assumes a lexicon that consists of three different lists, a direct approach like *Nanosyntax* eschews any notion of a pre-syntactic lexicon. Instead, lexical items are hierarchical tree structures.

5. Conclusions and outlook. As we have seen in this paper, both the direct and indirect analyses are capable of handling the data we have considered. However, they do so through very different mechanisms, and they also enforce certain theoretical assumptions. For instance, *Distributed Morphology* readily admits zero heads such as null categorizers and null morphemes. Such heads are usually not allowed in *Nanosyntax*. Furthermore, *Nanosyntax* does not have a notion of a "morphological module", which means that all aspects of morphology need to be encoded in the syntax. Again, this is different in *Distributed Morphology*, where it is possible to insert morphemes after the syntactic derivation is finished. For instance, this enables an analysis whereby declension class markers are inserted postsyntactically (see Kramer 2015; Lohndal & Westergaard 2021).

We hope to have demonstrated the usefulness of model comparisons in this short paper. Needless to say, much work remains. For instance, the empirical scope of the present comparison is quite meager. Investigating other and "more complex" data may bring out even more differences between the direct and indirect mapping analyses.

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