Construction morphology and relational morphology

Audring, J.; Jackendoff, R.; Fried, M.; Nikiforidou, K.

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Construction Morphology and Relational Morphology

Jenny Audring and Ray Jackendoff

4.1 Introduction: Constructions in Morphology

The fundamental tenet of Construction Grammar (CxG), and of constructionist approaches more generally, is that knowledge of language consists of patterns of form (phonology, orthography, and morphology/syntax)[1] paired with patterns of function (semantics and pragmatics) – in other words, of Saussurean signs. These patterns, referred to as 'constructions', are pieces of knowledge stored in language users' memory. Constructions can be fully specified words and phrases, such as *princess*, *bittersweet*, and *wait!*. They can also be partially schematic, for example, capturing the fact that the suffix *-ess* in *princess* takes nouns as a base. Yet others are fully schematic, for example, saying that English has AA compounds (*bittersweet*) or that imperatives are formed with the bare verb stem (*wait!*). Concrete, partially schematic, and fully schematic constructions together form a hierarchical network known as the 'extended lexicon' or 'constructicon'. This network is a richly structured space containing all lexical and grammatical knowledge (see Chapters 9 and 3 on networks and constructicons, respectively).

While CxG was originally proposed as an account of syntax, it extends naturally to morphology. In fact, morphology is particularly suited for a construction-based approach. As this chapter will illustrate, a constructionist architecture elegantly accommodates the interplay of regularity and idiosyncrasy that is typical of complex words. Moreover, morphology differs from syntax in its greater use of permanently stored lexical entries: Complex words are often taken 'off the shelf' rather than produced on the fly. The constructionist network architecture is especially well designed for such listed knowledge, in contrast to other theories in which knowledge of language is primarily understood as a set of instructions for deriving linguistic expressions from their constituents.

[1] Whether morphology/syntax belongs on the form side or on the function side, or on both, can be debated.

The basic insight that connects CxG to morphology is that words and the patterns along which they are built are constructions. For instance, the suffix in the word *sharpen* is not just the phonological string /ən/ attached to some base; nor is it just an element building a verb from an adjective; nor is it just the meaning CAUSE-BECOME X. Rather, it involves the linking of these three, with concurrent effects in form and function. This knowledge is stored in the form of a partially abstract construction, a template or 'schema'. Other morphological patterns, from compounding to conversion and reduplication, can likewise be represented as constructional schemas.

The word *sharpen* itself is also a construction, an entry stored in the mental lexicon. This lexical entry shares parts of its form and function with other constructions, prominently the word *sharp* and the [$_V$ [A] *-en*] suffix schema. These connections between constructions are central to the theory and will be discussed in more detail in Section 4.2.2.

While a constructionist approach is useful for understanding morphology, morphology in turn informs the theory as well. The primary aim of our chapter is not to show how morphological phenomena can be modeled in a constructionist way. The reader is referred to Booij (2010, 2018), Jackendoff and Audring (2020, chapters 4–6), and Hoffmann (2022, chapter 3), where this is done in greater breadth and detail.[2] This chapter highlights specific issues that arise in morphology and discusses their implications for construction-based theorizing. Special emphasis will be placed on three central topics: idiomaticity and non-compositionality (Section 4.3), productivity (Section 4.4), and paradigmaticity (Section 4.5). First, however, we introduce the two main theories of construction-based morphology currently on the market: Construction Morphology and Relational Morphology.

4.2 Construction Morphology and Relational Morphology

4.2.1 Representing Morphological Constructions

In recent years, two closely related constructionist approaches to morphology have been developed: Construction Morphology (CxM: Booij 2010, 2018; Masini & Audring 2019) and Relational Morphology (RM: Jackendoff & Audring 2019, 2020).[3] Earlier work along constructionist lines includes Jackendoff (1975), Rhodes (1992), Bochner (1993), Orgun (1996), Riehemann (1998, 2001), and Gurevich (2006); related approaches are Bybee's Network Model (Bybee 2010, 2013), Word-Based Morphology or Word and Paradigm Morphology (e.g., Blevins 2006, 2016; Blevins et al. 2019), and Word Grammar (Hudson 2007; Gisborne 2019). The framework

[2] These works are largely based on Germanic, in particular English, Dutch, and German, but Booij (2018) contains contributions on a wider range of languages. See also Audring (2022) for a concise literature review.

[3] Since the authors of the present chapter are also the developers of Relational Morphology, most issues will be discussed from the perspective of this model. Not every construction morphologist will agree with every point. We will highlight potentially controversial points here and there.

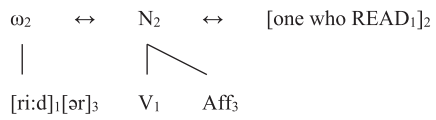
also shares many traits with Cognitive Grammar (see Langacker 2019 for an account of morphology in this framework).

The formalisms of RM and CxM are different but mostly intertranslatable; in turn, they both differ somewhat from more standard CxG formalisms, mostly as a matter of convenience. CxM uses the formalism illustrated in (1a), in which the word *reader* is a construction with a form side (phonology and morphosyntax) and a meaning side. The link between form and meaning is indicated by a double-headed arrow. The subscript coindices 1 and 2 specify which parts of form are related to which parts of meaning.

(1) a. $[[read]_{V1}\ er]_{N2} \leftrightarrow [\text{one who } [\text{READ}_1]]_2$

A more elaborate variant is (1b) (after Booij 2010: 8), which differentiates morphosyntactic and phonological properties. This requires a third coindex, 3, to connect the morphosyntax and the phonology of the suffix *-er*.[4]

(1) b.



RM uses the notation in (1c) for the same construction. It is built on the same principles as (1b). Each type of structure – semantics, morphosyntax, and phonology – is represented on its own tier. The semantic notation uses the principles of Conceptual Semantics (Jackendoff 1983, 1990).[5] In the first line in (1c), the verb READ is represented with its argument structure (agent α, patient Y). The word *reader* as a whole denotes a person and what follows after the semicolon provides information about this person. Coindex α links the person to the agent argument of READ.

(1) c. Semantics: $[\text{PERSON}^{\alpha}; [\text{READ } (\alpha, \text{Y})]_1]_2$
Morphosyntax: $[_{\text{N}} [\text{V}]_1\ \text{aff}_3]_2$
Phonology: $/\text{ri:d}_1\ \text{ər}_3/_2$

(1b) and (1c) are more informative than (1a), but still simplified. (1d) expands (1c), adding an orthographic tier.

(1) d. Semantics: $[\text{PERSON}^{\alpha}; [\text{READ } (\alpha, \text{Y})]_1]_2$
Morphosyntax: $[_{\text{N}} [\text{V}]_1\ \text{aff}_3]_2$
Phonology: $/\text{ri:d}_1\ \text{ər}_3/_2$
Orthography: $<\text{read}_1\ \text{er}_3>_2$

The representation could be expanded further, for example by adding tiers for phonetic/articulatory or pragmatic properties. It could also be enriched by splitting the phonological tier into segmental, syllabic, and prosodic structure, for example, to capture the fact that a certain construction is typically bisyllabic and trochaic, or by mapping sound to spelling in more detail. The

[4] Coindex 3 is not shown in the semantics, as affix semantics is a property of the affix plus its base, not of the affix in isolation (see Booij 2010: 15; Jackendoff & Audring 2020: 129 for discussion). Index 2 takes care of this connection.

[5] Readers should feel free to substitute their own favored formalism.

specificity of a written representation can be adjusted to the purpose of the exposition. In the mind, of course, all types of structure are potentially present, as they encode what speakers know about a word.

4.2.2 Relations within and between Constructions

The configurations in (1) reflect the principles of the Parallel Architecture (Jackendoff 1997, 2002): Linguistic knowledge is organized according to types of structure ('tiers' in [1c–d]), plus specifications of the way these structures are mapped onto one another. The mappings constitute the interfaces between tiers.[6] Accordingly, subscripts 1, 2, and 3 in (1) express 'interface links' between the individual tiers (Jackendoff & Audring 2020: 10). Interface links encode 'associated structure': The phonological string /ri:dər/ calls up the meaning 'person who reads' and the written form <reader> by association, and vice versa.

Interface links not only run between form and meaning, as in a Saussurean sign, but between all levels of structure. This means that the model includes form–form links as well as form–meaning links. For example, the connection between the phonology and the orthography tier in (1d) constitutes a form–form link: Certain strings of sounds are mapped onto certain strings of letters. Not all construction-grammatical models explicitly acknowledge such links; overall, the literature strongly prioritizes form–meaning links.

The noun *reader* is of course related to the verb *read* and the notation makes this explicit. Example (2) shows the verb in RM notation. Crucially, the representation for *reader* (1a–d) and for *read* (2) share coindex 1. Thus, the coindexation marks not only interface links within lexical items, but also 'relational links' between them (Jackendoff & Audring 2020: 13).

(2)

Semantics:	$[\text{READ } (\alpha, Y)]_1$
Morphosyntax:	V_1
Phonology:	$/ri:d/_1$
Orthography:	$<read>_1$

The relational links between *read* and *reader* encode the fact that the two words share parts of their structure. Therefore, relational links connect segments that have the *same structure*, in contrast to interface links, which create *associations between structures* on different tiers. 'Same structure' implies that the structures are identical and of the same type, say phonology, while associated structures are of different types (e.g., phonology and semantics).

A second type of relational link is needed to complete the typology of relations. This type encodes the hierarchical relations between a construction and its 'mother' and 'daughter' constructions, higher and lower in the network. The example word *reader* is a 'daughter' of the English $[_N\ [V]\ \textit{-er}]$ schema for

[6] Note that in this approach there is no such thing as an 'interface tier' or 'interface level', separate from the tiers that are being linked.

person nouns shown in (3).[7] This schema has the same format as the word in (1c), except that it contains a variable (also called an 'open slot' or 'schematic slot' in the literature) in the place where *reader* has a specific verbal stem. Variables and the interface links between them are notated by alphabetic instead of numerical coindices. Schema (3) sports two such variable indices: *x* for the interface links of the stem variable and *y* for connecting the tiers of the schema as a whole. The semantics can be glossed informally as 'Person who X-s'.

(3)
Semantics: $[\text{PERSON}^{\alpha}; [\text{X } (\alpha)]_x]_y$
Morphosyntax: $[_N [\text{V}]_x \text{ aff}_3]_y$
Phonology: $/ \ldots _x \text{ər}_3/_y$

Conceptually, the relation between the word *reader* and the [$_N$ [V] *-er*] schema is one of 'instantiation': The word instantiates the schema. From the opposite perspective, the relation is one of 'generalization': The schema generalizes over the word and other words like it. The relevant links run between coindex 1 in *reader* and coindex *x* in [$_N$ [V] *-er*], and between coindex 2 in *reader* and coindex *y* in [$_N$ [V] *-er*]. These structures are not the same since 1 and 2 mark substantive parts of the construction, while *x* and *y* mark variables. Instead, they are 'equivalent structures': The part marked 1 in *reader* is equivalent to the part marked *x* in the [$_N$ [V] *-er*] schema. Formally, the notation leaves equivalent structures implicit.

Figure 4.1 illustrates the difference between relational links involving the same structure and relational links involving equivalent structures. The verb *read* and the stem of *reader* are related because they contain the same structure, while *read* and the variable V in the schema are connected by virtue of equivalence.

An important design feature of the model is that words and schemas have essentially the same format. In particular, they are of the same size, because the representation of affixes includes variable slots for their bases, resulting in word-sized structures. The only difference between words and schemas is that a word is fully filled out,[8] while a schema contains one or more variables. This allows them to be situated in the same network, connected by relational links. Hence,

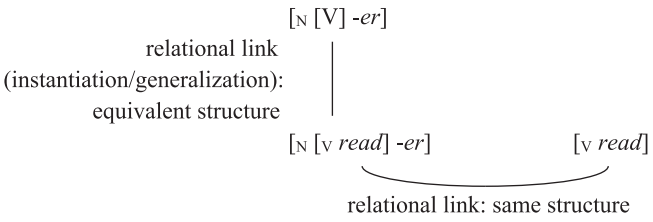


Figure 4.1 Two types of relational links between constructions

[7] Shorthand notations such as [$_N$ [V] *-er*] will be used throughout the text; they should be understood as simplifications. Note also that [$_N$ [V] *-er*] in English can have other meanings, for example instrument (*amplifier*, *opener*), which are not considered here.

[8] Even this is not entirely true, as words that take arguments also contain variables for these arguments.

[$_N$ [*read*] *-er*] and [$_N$ [V] *-er*] are linked by the same principles as, say, [$_N$ [*read*] *-er*] and [$_N$ [*sell*] *-er*]. This understanding of the network architecture is shared with CxG, although different flavors of CxG assume different links between constructions (compare, e.g., Goldberg 1995: 73–81; Diessel 2019: 22).

Note also that the model outlined here is constructed in such a way that all information is encoded in the nodes (i.e., in the constructions themselves). An alternative would be to express information in the links between nodes (cf. Hudson 2007 for a model of this type, and see Hilpert 2021: 72 for discussion). RM assumes three different types of links – interface links and the two kinds of relational links – but their type follows from what they link. The information 'associated with', 'same as', and 'equivalent to' does not need to be encoded explicitly. These architectural choices keep the model lean and avoid extra machinery.

4.2.3 Missing Structures and Missing Links

A crucial advantage of independent, parallel tiers of structure is the ability to accommodate non-one-to-one correspondences between the structures. These manifest themselves as missing structures or missing links and usually a combination of both. We will illustrate the situation for three phenomena: zero marking, idiomaticity, and complex words with non-lexical bases. The latter two are addressed in greater detail in Section 4.3.

A common type of missing structure is zero marking. Consider the word *sheep*, shown as a stem in (4a) and as a plural noun in (4b).

(4)

a.	b.
SHEEP$_4$	[PLURAL (SHEEP$_4$)]$_5$
N$_4$	[$_N$ N$_4$; PL]$_5$
/ʃi:p/$_4$	/ʃi:p/$_{4,5}$

Both words contain coindex 4, which serves as an interface link for the stems and as a relational link marking the stems as the same. The morphosyntax of (4b) contains the number value plural, which is needed for agreement (*those sheep are* . . .). However, (4b) lacks an overt plural marker, which means that the same phonology expresses both the nominal stem and the plural wordform (and, of course, also the singular). (4b) captures this situation by means of double coindexation on the phonological tier: The structures marked as 4 and 5 map onto the same string of sounds.[9] Note that this also entails a missing link: The property PL is not connected to any piece of phonology; compare (4b) with (5b) below, which has such a link, marked by coindex 7.

Consider next the noun *premises*, an interestingly complex case. It can be analyzed in two ways. One is as the plural of *premise*, with an idiomatic meaning, roughly 'a building (and its grounds)'. (5a) shows the singular noun *premise* and (5b) the idiomatic *premises*. Coindex 6 expresses the interface links within each word as well as the relational links between them.

[9] Strictly speaking, a similar configuration is necessary for all singular nouns since English has no overt marker for the singular. We omit the property singular in examples for the sake of readability.

Coindex 7 in (5b) links *premises* to the plural schema (not shown). The 'outer' coindex 8 keeps the word *premises* together.

(5)

a.	b.
$[\text{PREMISE}]_6$	$[\text{BUILDING}]_8$
$[\text{N}]_6$	$[_{\text{N}}\ \text{N}_6\ \text{PL}_7]_8$
/prɛməs/$_6$	/prɛməs$_6$ əz$_7$/$_8$

The relevant observation for our purposes is that the idiomatic meaning BUILDING in (5b) has no index 6 and is therefore not linked to the nominal stem that we see in the morphosyntax and in the phonology. The semantic tier interfaces with the other tiers only through the 'outer' link 8. This type of missing link occurs in all idiomatic words or phrases; it captures the fact that idiomatic meanings are dissociated from the compositional structure a word otherwise possesses.[10] In addition, (5b) also shows missing structure: The plurality does not extend into the semantics, as the idiomatic noun *premises* typically refers to a singular, though perhaps collective, entity. Note, however, that the morphosyntactic plurality remains: The word *premises* usually takes plural agreement.

But *premises* has an alternative analysis: It can be understood as a *plurale tantum* noun with a non-lexical base (i.e., a base that does not occur independently), which just happens to sound like the singular word *premise*. This is not entirely implausible; while *premises* and *premise* are etymologically related, the semantic idiosyncrasy of *premises* is radical enough that speakers probably do not make the connection. This alternative analysis differs from (5b) in two respects. First, it does not specify a syntactic category N for the base, as non-lexical bases never occur in isolation and hence cannot be classified for syntactic category, at least not on distributional grounds (Jackendoff & Audring 2020: 38).[11] Second, if the base of *premises* is disconnected from *premise*, they are no longer linked by coindex 6. The result is the representation in (6).

(6)

Semantics:	$[\text{BUILDING}]_8$
Morphosyntax:	$[_{\text{N}}\ \text{ø}\ \text{PL}_7]_8$
Phonology:	/prɛməs əz$_7$/$_8$

The structure in (6) has various missing links. The phonological string /prɛməs/ has no interface link to anything. As in (5), the meaning BUILDING is not connected to any part of the word, only to the word form as a whole. In addition, the base of the word has no relational links to parts of other words.[12] The only recognizable segment is the plural suffix in the phonology and the morphosyntax, indicated by coindex 7, which identifies the word as a daughter of the plural schema.

[10] Of course, idiomatic semantics can be mixed in with, and piggyback on, compositional semantics, for example, in *feverish* 'having a fever', which also has the idiomatic meaning 'frenzied, as in a fever'. In such cases, parts of the semantics have interface links, while other parts do not.

[11] The plural schema tells us to expect a noun, which is why forms like *odds* and *greens* are interpreted as containing nouns, although *odd* and *green* in isolation are usually adjectives.

[12] The word as a whole does have relational links to other words within the same semantic field, as well as to listed expressions such as *licensed premises*. However, these links do not influence the perceived internal structure of the word.

This brief introduction illustrates the way in which complex words are understood in constructional terms. It also gives an indication of the way non-straightforward cases are handled: in terms of missing structures and/or missing links. The following sections build further on this general outline and look in more detail at idiomaticity and non-compositionality.

4.3 Idiomaticity and Non-compositionality

4.3.1 Idiomaticity

Idiomaticity, that is, unpredictable meaning, came to be a major concern of the 'constructionist turn' in syntax in the 1980s, after earlier (generative) approaches had considered it peripheral. In morphology, idiomaticity has always been a major part of the research agenda. While many morphologists have embraced the generative ideal of accounting for the *possible* words of a language in terms of productive word-formation rules,[13] the quirks of *existing* complex words, including their idiomatic meaning, has been too ubiquitous to be disregarded. This section provides a taste of the complexities. We draw examples from English, Dutch, and German.

Section 4.2.3 briefly addressed idiomaticity with the help of the English noun *premises*. This example is interesting because *premises* is an inflected word, and inflection is normally expected to yield forms with a transparent, predictable meaning. However, especially within the domain of inherent inflection (Booij 1993, 1996),[14] idiomatic meanings are surprisingly frequent. English plurals, for example, provide a rich source of cases, witness the examples in (7), selected from a sizable list in Bauer et al. (2013: 124).

(7) arms, arts, balls, bangs, bowels, brains, clothes, customs, directions, dregs, goods, grounds, guts, humanities, looks, manners, minutes, news, odds, regards, remains, smarts, spirits, thanks, trappings, troops, wits, woods

In word-formation, partial or full idiomaticity is found at every turn. Consider the Dutch examples in (8). All are diminutives that combine formal regularity with unpredictable semantics. (However, as for the English plurals in (7), the 'regular' meaning is also available in appropriate contexts; this is easier for some of the words than for others.)

[13] As Aronoff (1976: 17–18) put it, "the simplest task of a morphology, the least we demand of it, is the enumeration of the class of possible words of a language."

[14] Inherent inflection involves properties that belong to the word on which they are expressed. Examples of inherent inflection are grammatical number on nouns and tense on verbs. The alternative is 'contextual inflection', which depends on other words in the utterance; examples are number on verbs (dependent on the subject and/or object) and case on nouns (dependent on governing words such as prepositions). Inherent and contextual inflection differ in various respects, among them their propensity to develop idiomatic meanings.

(8) *telefoon* 'telephone' > *telefoontje* 'phone call'
oor 'ear' > *oortjes* 'ear buds'
spion 'spy' > *spionnetje* 'spy hole (in a door)'
brood 'bread' > *broodje* 'bun, roll'

From the viewpoint of what a speaker has to know, both the base form (*telefoon*, *oor*, etc.) and the idiomatic diminutive (*telefoontje*, *oortjes*, etc.) need to be listed in memory, with relational links between them. Example (9) illustrates the configuration for *telefoontje* (semantics simplified and diminutive allomorphy not considered).

(9) a. $[\text{TELEPHONE}]_9$
$[\text{N}]_9$
/teləfo:n/$_9$
b. $[\text{SMALL } (X_x)]_y$
$[_N\ [\text{N}]_x\ \text{aff}_{10}]_y$
/ . . . $_x$ t^{j}ə$_{10}$/$_y$
c. $[\text{CALL BY } (\text{TELEPHONE}_9)]_{11}$
$[_N\ [\text{N}]_9\ \text{aff}_{10}]_{11}$
/teləfo:n$_9$ t^{j}ə$_{10}$/$_{11}$

Coindex 9 in (9a,c) expresses the relational link between *telefoontje* and its base *telefoon*. Moreover, *telefoontje* is connected to the diminutive schema (9b) via the affix (coindex 10), and the instantiation/generalization link between 11 and *y*, implicit in the representation. What makes *telefoontje* idiomatic is that the diminutive meaning is not represented in the semantics of (9c) – although there is some spillover from the schema, as speakers tend to associate the word with a brief rather than an extended call. Most importantly, however, the meaning CALL is an idiosyncratic addition that cannot be attributed to either (9a) or (9b). It has no interface links to any part of the word.

Within a network of constructions, such idiosyncratic additions and modifications vis-à-vis the schema are unproblematic, as *telefoontje* has its own lexical entry and hence can accrue properties of its own. The consequences this has for its relation to other lexical items will be discussed in Section 4.4.3. In addition, an important advantage of this approach is that idiomaticity does not imply absence of internal structure.[15] The meaning of *telefoontje* contains the meaning of *telefoon* and the word looks formally like a perfectly normal diminutive noun. Idiomaticity just means that the segmentation does not extend to the semantics of the word. (9c) shows its predictable and unpredictable properties, both represented in individual detail.

Idiomaticity is vastly more common than is typically acknowledged. The common polysemy of affixes requires the listing of specific meanings conventionally attached to words, such as the fact that *meeting* denotes an event, *dwelling* a place, *drawing* an object, and *stuffing* a substance. For compounds, it is well known that the specific meaning relation between left- and right-hand constituents is largely unpredictable and a matter for pragmatics. These

[15] Actually, idiomaticity always goes with internal structure. A simplex word is never considered idiomatic, as it has no predictable meaning which the actual meaning could contradict. Alternatively, one might consider all simplex words idiomatic; this is just a matter of terminology.

and countless other cases show that the idiomaticity normally discussed in linguistic theory is only the tip of an iceberg of lexical idiosyncrasies. The advantage of a constructionist network architecture is that it freely permits the listing of whatever information a speaker possesses about an individual word. At the same time, systematic information is encoded wherever it manifests itself in relationships with other words and with more general patterns (i.e., schemas).

In the light of the account described here, semantic idiomaticity is one phenomenon among many that can be understood in terms of missing links within and across lexical items. Section 4.3.2 reviews other types of compromised linkage.

4.3.2 Other Types of Non-compositionality

Complex words can be non-compositional for other reasons beside semantics. In one common situation, words are morphologically segmentable but one or several of the building blocks are not available independently. We saw a relevant case in the second of the two possible analyses for *premises* (example [6] in Section 4.2.3). This situation is altogether the norm in inflection, which often uses stems that never occur in isolation. For example, the German verb *sprechen* 'to speak' has the stem *sprech-*, which, unless it appears in a derivation such as *Sprech-er* 'speaker' or a compound such as *Sprech-stimme* 'speaking voice', needs an inflectional suffix to form a full word. But non-lexical bases are also widespread in word-formation. In English, the most common source of such forms is borrowed words that have recognizable affixes but whose stems were not borrowed independently and hence do not occur as free words in the borrowing language. Two examples are *ambit-ious* and *hilar-ity*, which contain the derivational suffixes *-ious* and *-ity*, but lack a lexical stem. Some such stems are in fact unique, for example the underlined parts of *petri-fy* or *ranc-id*. A similar situation occurs in so-called cranberry morphs: compound members that do not (or no longer) exist as free words. Examples are *mulberry*, *werewolf*, *mermaid*, *twilight*, *Tuesday*, *cobweb*, *lukewarm*, and *iceberg*.

Complex words with unique stems pose a challenge for morphological theory. The two most common analyses both come with drawbacks. One of these treats such words as unsegmentable, which means disregarding whatever recognizable parts they do contain, such as *-ous* in *gorgeous* or *warm* in *lukewarm*. Another option is to list the unique parts as separate lexical entries. However, this requires a specification of the complex words they help create (e.g., thinking of *luke* as a word that can only be used in the compound *lukewarm*). The most satisfying option is simply to list the relevant complex word, with relational anchors for the parts that do recur as free items or as parts of other words.

From a constructionist, relational point of view, what is special about such words is only their connectivity. Consider *iceberg* in (11).

(11) a. [FLOATING MOUNTAIN OF $(ICE_{12})]_{13}$
$[_N\ N_{12}\ ø]_{13}$
$/aɪs_{12}\ bərg>_{13}$

b. ICE_{12}
$[N]_{12}$
$/aɪs/_{12}$

The segment *ice* is fully connected, both interfacially and relationally: Coindex 12 appears on all tiers of (11a) and (11b), and is shared between the two lexical entries. The segment *berg*, by contrast, is only a piece of phonology. It has no morphosyntactic category – it could in principle even be an affix, albeit a unique one (for unique affixes, see below).[16] Furthermore, there is no semantic structure associated with this element. However, (11a) differs from an ordinary compound such as *icebox* only in its missing links and in the gap in the morphosyntax. The analysis is entirely parallel to that of idiomatic words in Section 4.3.1.

Note that what is related to what can depend on an individual's lexicon. A speaker of German will recognize *berg* as the German word for 'mountain', filling in the missing structure and the missing link. Similarly, borrowed words such as *deodorant* or *helicopter* are transparent for speakers trained in Latin and Greek, but opaque for others. Speakers of German might segment *Deodorant* as *Deo-dorant*, thinking of the common short form *Deo* 'deodorant' rather than the Latin segments *de-*, *odor*, and *-ant* (unlike English, German does not have the word *odor*). Similarly, speakers of English are likely to assume that the structure of *helicopter* is *heli-copter* (see also words like *heli-skiing* and *gyro-copter*) rather than the etymologically correct *helico-pter*, which is also odd for phonotactic reasons. Others might (mis)interpret *helicopter* as an *-er* formation, parallel to *glider* or *carrier*.

Such examples reveal the important fact that the recognition of morphological structure amounts to the recognition of lexical relations. We perceive *cucumber*, *orchestra*, and *mahogany* as simplex words because none of their potential segments reappear in other words, in the same position and with a similar function. Hence, analyzing complex words in terms of interface and relational links is not only a notational or theoretical convenience, it also reflects what appears to be happening in the mind.

In this context, it is relevant to point out that a constructionist network permits multiple parentage and, hence, multiple parallel structural analyses. Figure 4.2 illustrates the competing analyses of German *Deodorant*.

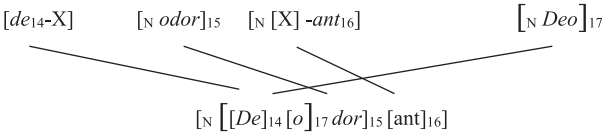


Figure 4.2 Multiple parentage and competing analyses for German *Deodorant*

[16] It is an open question whether the salience of NN compounding in English boosts the expectation that *berg* is a noun (see note 11 for a related case). Note also that we are disregarding etymology here, assuming a monolingual speaker who is not a philologist.

The coindices specify the relational links between words and schemas in the lexicon and the respective segments of the complex word. (The bracketing suggested by *Deo* is given in a larger font to improve readability.)

Speakers may entertain one analysis or both (or indeed none, or any part of one), depending on the structure of their mental lexicon and the perceived relations between individual entries. This fluidity matches the experimental observation that morphological complexity is a matter of degree (Hay 2001; Hay & Baayen 2002). The factor of relative frequency, shown to be decisive in these experiments, naturally fits the account presented here: More frequent words are more salient as relational neighbors and are therefore more likely to influence the segmentation of the word.

To round off the section on non-compositionality, let us briefly look at unique affixes – affixes that appear in only one word. This is a rarer phenomenon than unique stems but it does exist. (12) lists some examples (partially from Jackendoff & Audring 2020: 91). The English words on the right-hand side all contain a (near-)unique suffix. The symbol ≈ is used to indicate a paradigmatic relationship, which will be discussed in more detail in Section 5. (The forms *-ter* and *-red* each occur in one additional word, namely in *slaughter* and *kindred*, but in both cases the relation is less evident.)

(12)

bishop	≈	bishopric
bomb	≈	bombard
compare	≈	comparison
expert	≈	expertise
happen	≈	happenstance
hate	≈	hatred
hero	≈	heroine
know	≈	knowledge
laugh	≈	laughter

Since these suffixal segments are singletons, they do not give rise to a schema. Within the individual words, they might or might not have interface connections in the expected way. Comparing *laughter* (13) with *crying* (14), we see in essence the same configuration. However, there is no schema for $[_N\ [V]\ \textit{-ter}]$, as there is for $[_N\ [V]\ \textit{-ing}]$. This means that the suffix has no relational links of the instantiation/generalization type (recall Figure 4.1).

(13) $[\text{ACT/SOUND OF } (\text{LAUGH}_{18})]_{20}$
$[_N\ [V]_{18}\ \text{aff}_{19}]_{20}$
$<\text{læf}_{18}\ \text{tər}_{19}>_{20}$

(14) $[\text{ACT/SOUND OF } (\text{CRY}_{21})]_{23}$
$[_N\ [V]_{21}\ \text{aff}_{22}]_{23}$
$<\text{kraɪ}_{21}\ \text{ɪŋ}_{22}>_{23}$

Again, a conceptualization in terms of missing links is helpful in characterizing the phenomena that we observe.

4.4 (Limited) Productivity

We now shift our attention to a highly contested notion in morphological theory: productivity. Mainstream generative theory, especially in syntax, is built around the expectation that grammatical patterns are by default productive. Morphology poses a central challenge to this assumption: Many morphological patterns are unproductive, that is, unavailable to the language user for the active creation of new words or word forms.[17] For example, speakers of German do not produce new instrumental nouns in *-el* (as in *Hebel* 'lever', *Deckel* 'lid', or *Zügel* 'rein'); English has no new verbs in *-ish* (to go with *vanish*, *cherish*, *publish*); and Dutch does not extend the class of nouns in *-te* (*kalmte* 'calmness', *lengte* 'length', *stilte* 'silence'). These observations are neither incidental nor marginal. Spencer (2013: 3) states that "much of the derivational morphology discussed in the literature is . . . of the occasional, accidental kind," concluding that it may therefore be of greater interest to "lexicographers, historians, psycholinguists, language teachers" than to "grammar writers." From a constructionist perspective, however, limited productivity is a fact of grammar just like any other, so the theory needs to make room for this fact. The aim of the current section is to outline a few aspects about productivity which inform constructionist theory, or on which constructionist theory provides a specific angle.

4.4.1 Productivity as an Explanandum

A construction-based perspective offers a different vantage point from the generative approach in that it encodes grammatical patterns in terms of schemas rather than derivational rules. A schema arises in a speaker's knowledge of language as a product of generalizing over some number of observed instances that have been previously stored in the lexicon. Thus, every schema starts out as an unproductive schema, that is, it is related to a limited family of stored instances.

Allowing a schema to freely produce novel instances constitutes an additional (and optional) step (Booij 2010: 2; Jackendoff & Audring 2020: 45). This is a radical difference from (generative) theories where productivity is considered the default. It also shifts the burden of explanation. While a generative theory needs to explain unproductivity in terms of *limitations* to productivity, constructionist theory takes unproductivity as the baseline and

[17] Note that co-occurrence restrictions and collocational preferences are typical of syntactic constructions as well (Hilpert 2021: 18). See also Culicover (1999), Culicover & Jackendoff (2005: esp. section 1.5), Suttle & Goldberg (2011), and Kay (2013) for restricted productivity in syntax.

inquires after the reasons for productivity itself. What properties prompt speakers – especially child learners – to upgrade a schema from generalizing to generative? An important insight from existing research is that there is no simple answer to this question.

For example, consider the Dutch adjectival suffix *-(e)lijk*, a cognate of English *-ly* as in *lovely* (similar points are made in Bauer 2001 for the English nominal suffix *-ment*). The suffix is virtually unproductive (de Haas & Trommelen 1993: 294; Fehringer 2004: 287). This is striking, because the pattern meets most of the criteria for productivity proposed in the literature (e.g., Bauer 2001, 2005; Barðdal 2008). First, it has several hundred existing types, spread widely across the lexicon. Second, it is a native formative attaching to native (as well as non-native) bases, so the attested forms are transparent. Third, it is salient in having enough phonological weight to add at least one syllable (/lək/) and potentially two (/ələk/; see Fehringer 2004 on the distribution of the two allomorphs). Fourth, the suffix schema has a broadly tolerant variable: It occurs with verbal, nominal, and – to a lesser extent – adjectival bases, yielding a vast range of theoretical input forms. (15) shows a typical example for each type of base.

(15) *vaderlijk* 'fatherly' < *vader* 'father'
aantrekkelijk 'attractive' < *aantrek-* 'attract'
ziekelijk 'sickly' < *ziek* 'sick'

The only evident factor standing in the way of the suffix's productivity is a fairly large number of competing suffixes such as *-baar* (comparable to English *-able*) or *-achtig* (English *-like*); however, the advantages of one competitor over the other are not evident (cf. Kempf 2016 for a diachronic analysis of the German cognate suffix *-lich* and its competitors).

This example shows that even transparent, well-entrenched patterns with a broad base of potential inputs are not necessarily interpreted as productive by language users. Instead, the existing instances must be stored in speakers' mental lexicons. From a constructionist perspective, which explicitly envisages rich lexical storage, this is not an embarrassment. However, such cases show that the cognitive motivations for upgrading of a schema to productive need to be reconsidered carefully. Aside from the various linguistic factors mentioned briefly above, we may expect sociolinguistic influences to play a role, for example, age, literacy, and register (e.g., Plag et al. 1999), as well as individual differences between speakers (e.g., De Smet 2020). In addition, certain patterns may be productive for particular groups of speakers, for example, in technical vocabularies. These issues cannot be addressed in any depth or detail here but they belong on the research agenda of any theoretical account.

An important point to add is that upgrading a schema from generalizing to productive does not change the fact that all schemas are relationally linked to a set of 'daughter' instances stored in memory. For example, in (7) we saw listed instances of the productive English plural schema, such as *clothes*, *goods*, and *manners*. The existence of daughter instances follows from the assumption that schemas start out as generalizations: Generalizations require a set of known

words to generalize over. Moreover, new instances can be entrenched in memory when they are frequent or newsworthy, or even without obvious reasons, extending the set of listed daughters. This needs to be borne in mind as we further explore constructional productivity.

4.4.2 The Locus of Productivity

A second question to address is how and where knowledge about productivity is encoded. The network architecture outlined in Section 4.2 suggests that this question has two sides. On the one hand, we need to ask how an individual schema is marked for productivity. This issue will be briefly discussed in Section 4.4.2.1. On the other hand, the question arises on what taxonomic level the productivity of constructions can be localized. Section 4.4.2.2 addresses this point.

Productivity in the Schema

From the perspective of CxG, novel words and phrases are created by unifying the variable of a schema with new lexical material. Hence, the variable is the natural place to encode productivity (Jackendoff & Audring 2020: 41). A productive variable is 'open' and permits unification; an obvious example is the noun variable in the English regular plural schema. In contrast, a 'closed' variable in a schema is relationally linked to a finite class of listed forms that instantiate it, and speakers normally reject unlisted instantiations. For instance, recall the [$_V$ [A]-*en*] schema mentioned in Section 4.1, in which the adjectival base is the variable. It is instantiated by listed forms such as *sharpen*, *flatten*, and *sweeten*. The putative forms **crispen* and **louden* also meet the criteria for this schema, but they are not in current use and speakers would probably be surprised to hear them.[18] Hence the variable in this schema is closed.

Some schemas have more than one variable. An advantage of locating productivity in the variable is that each can be marked for openness individually. For example, the construction [$_V$ [Prep] [V]] in English, with instantiations such as *outrun*, *overthink*, and *underrepresent*, occurs with only a limited set of prepositions, so the preposition is a closed variable in the schema.[19] However, the schema does allow for a potentially open-ended class of verbs and hence has an open variable V (see Kotowski 2020 on the high productivity of *out*-prefixation). Such differences can be notated by a single underline for closed and a double underline for open variables: [$_V$ [Prep] [V]] (Jackendoff & Audring 2020: 42).

Productivity is often described as a graded property. Therefore, an important question is whether the openness of a variable is also graded. In

[18] The Oxford English Dictionary lists these words, but sorts them under "terms which are not part of normal discourse and would be unknown to most people" (OED.com).

[19] See Anshen and Aronoff (1997) for historical instances with *of-*, *at-*, and *with-* (e.g., *withstand*), prepositions that no longer participate in the pattern in present-day English.

Jackendoff and Audring (2020), it is tentatively hypothesized to be binary. The main argument in favor of this choice is that gradedness can be attributed to a variety of other factors. Making the variable graded would add more uncertainty but not necessarily more explanatory power to the model. The most evident factors will be discussed in the following section, which addresses the second major issue regarding the locus of productivity: the anchoring of productivity in the hierarchical network of constructions.

Productivity in the Hierarchical Network

An important observation in the constructionist literature is that, in a hierarchy of schemas, it is not always the top schema that is productive (Booij 2010: chapter 3). For example, Kapatsinski and Vakareliyska (2013) discuss [$_N$ [N][N]] compounds in Russian. This pattern is not typical of Slavic, but it can be found in names of business establishments such as *Nogti-Servis* 'Nail Service' (a manicure salon). Such compounds are "generally meant to convey a Western, cosmopolitan, urban cachet" (Kapatsinski & Vakareliyska 2013: 74) and typically contain an English loanword like *-bar*, *-klub*, or *-servis*, plus another, usually native, noun. The authors conclude that the pattern is partially lexically specific in that the second nominal slot recruits its fillers from a particular set of nouns. Hence, the productivity of this pattern needs to be stated on a lower level than [$_N$ [N][N]]; at the very least, the slots need to be typed as [$N_{English}$] for the head and [$N_{Russian}$] for the modifier.

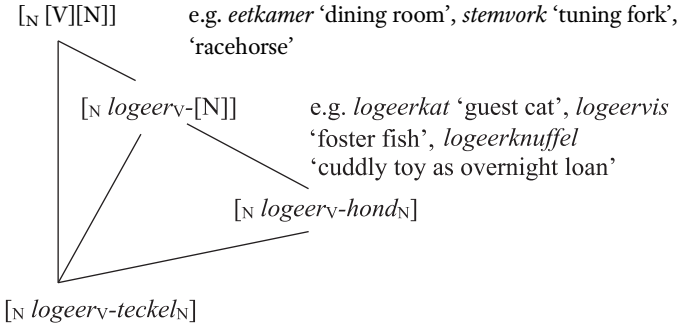
Even when productivity can be established both for a higher- and a lower-level schema, new instances can be attributed to lower-level schemas rather than to their higher-level mothers. For example, Gaeta and Angster (2019) describe German adjectives of the form [$_A$ [A][N] *-ig*]. Some of them cluster around particular nouns (e.g., *Herz* 'heart' in *großherzig* 'generous', *gutherzig* 'kind-hearted', *kaltherzig* 'cold-hearted', etc.) and around particular adjectives (e.g., *hoch* 'high' as in *hochgradig* 'high-grade', *hochwertig* 'high-quality', *hochrangig* 'high-ranked', etc.). The constructionist network architecture permits the listing of relevant subschemas such as [$_A$ [A][$_N$ *herz*] *-ig*], with an open variable.

Additionally, new formations can be modeled on listed entries, a procedure often called analogy. In this situation, a novel form can be created or judged as acceptable based on its similarity to one or more 'sister' forms stored in memory. This can overrule the effect of a closed variable: Even if the schema fails to license a daughter form, it can be sponsored by a sister. For schemas with open variables, a novel form may be accepted with greater confidence if it also resembles one or more sister forms.

Note that the existence of lower-level subschemas ties in well with this understanding of analogical influences: Subschemas may arise from repeated recognition of sister resemblances between novel and existing words. If novel words were only checked against higher-level schemas, more specific resemblances would go undetected.

As a consequence, we arrive at a continuum between word(form) creation based on a general schema, on a more specific schema, or on analogy to a specific word: All three cases involve the use of an existing construction for the creation of a new one. In fact, there is often no way of knowing which word or schema has given rise to a novel form. As an example, consider the spontaneously innovated Dutch compound *logeerteckel*, used for a dachshund (*teckel*) staying temporarily (*logeren*) at somebody's home. This word could arise from any of the three constructions listed in (16) and indeed any number of intermediate patterns:[20] a general schema for VN compounds, a compound schema with the verbal stem *logeer-* as lexically specified left-hand element, or the word *logeerhond* 'guest dog', which is used with some frequency, especially on social media.[21]

(16)



The considerations in favor of one or the other source construction are theoretically interesting. A more general schema on a higher level of the hierarchy has the advantage of numbers: The schema $[_N\,[V][N]]$ is supported by vastly more instantiations than any of its lower-level daughters. On the other hand, the lower the level of the schema, the closer the relation with the target word. *Logeerteckel* matches the mid-level schema in referring to a temporary pet and in the subtle fun of using a verb normally reserved for human guests. The match with *logeerhond* is, of course, even tighter, as both share the specific meaning 'dog'. Conversely, *logeerteckel* matches only a subset of the $[_N\,[V][N]]$ compounds in semantic terms, as not all of them show an agentive relation between N and V (*eetkamer* and *stemwork*, for example, have a locative and an instrumental meaning, respectively). Hence, higher-level schemas, which may be favored by linguistic theory as broader generalizations, have disadvantages in actual use.

Such disadvantages extend to more general considerations related to productivity, as one may wonder what it means to say that, for example, $[_N\,[V][N]]$ is a productive schema in Dutch. If most or all novel instances are produced by lower-level schemas or lexical analogues, the productivity of the higher-level schema may be impossible to assess. Even if we cut the knot by stipulating the

[20] See Pijpops et al. (2021) for an insightful study on establishing the appropriate hierarchical level for a linguistic generalization.

[21] The nlTenTen14 webcorpus, available via sketchengine.eu, yields sixty instances of *logeerhond(je)(s)* (i.e., including plural and diminutive variants).

productivity of a schema as the summed productivity of its subschemas, the notion becomes less informative as we move higher up the taxonomy. From a certain level upward, it may make little sense to speak of productivity at all. However, this is unproblematic in a construction-based architecture, where lower-level schemas can have their own productive potential and hence encode all relevant information. In fact, it makes sense for productivity to be in sharper focus for lower-level schemas, as the set of potential bases as well as that of existing forms is smaller and easier to assess.

Returning to the issue of graded productivity, we see that there is a principled uncertainty about the exact source construction – word, subschema, or higher-level schema – involved in the creation or acceptance of a novel form. Hence, as linguists we do not know how to evaluate a novel form. By what road did it arise? Which schema's productivity does it indicate?[22] Importantly, the same question also arises for the speaker. If the productivity of a schema is established by interpreting observed language use, then the interpretations may differ from speaker to speaker. In fact, speakers may update their interpretations over the course of time, leading to shifts in the perceived productivity of a pattern. Thus, we arrive at three principled factors that make productivity a graded property, plus a temporal dimension:

- Variability in lexical knowledge: Individual lexicons (native and L2+) differ in size and content.
- Variability in use: Which source construction is used to form a novel word?
- Variability in interpretation: Which source construction gets boosted in its perceived productivity by being credited with an observed novel form?
- Variability over time: Knowledge, use, and interpretation can change between one usage event and the next, and throughout the lifespan.

All of these factors help explain why patterns may appear to be productive to different degrees. In the model presented here, the issue is not so much a matter of gradedness, but of variation. Hence, assuming a binary distinction of open and closed variables constitutes a lighter choice, until evidence is found for graded openness.

4.4.3 The Function of Schemas

A consequence of the construction-based understanding of productivity as outlined here is that productive and unproductive schemas differ only in a single detail, that is, in the openness of the variable. This has the important advantage that both types of schema can 'live' in the same environment – the constructicon – and fulfill the same functions, except that open schemas can also generate new instances. But it raises the question what functions a schema might have, other than sponsoring new words and word forms.

[22] An interesting question in this regard is whether novel forms are attributed to a single source construction or to several constructions at once. We are not aware of any evidence regarding this issue.

From the perspective of Construction Morphology and Relational Morphology, the central function of schemas is to *motivate* their instances (e.g., Booij 2017; Booij & Audring 2018). Jackendoff and Audring (2020: section 2.6 and chapter 3) call this the "relational" role of schemas. This means that by codifying the similarities among its daughter words, the schema reduces the arbitrariness of the daughters: It marks certain parts of their structure as predictable. This contrast between arbitrariness and motivation is already found in de Saussure (1959 [1915]: 131, italics original): "Some signs are absolutely arbitrary; in others we note . . . degrees of arbitrariness: *the sign may be relatively motivated*."

Motivation is effected through relational links, which mark parts of words and schemas as the same or as equivalent (recall Section 4.2.2). Therefore it is not actually limited to schemas and their daughter words. Any shared structure between two or more lexical items has a motivating effect. This section focuses on motivation as a function of schemas. Section 4.5 will address motivation between sister words and sister schemas.

Though partly by conjecture, it can be posited that motivatedness is beneficial

- for the organization of the mental lexicon;
- to lighten the cost of lexical storage;
- during processing; and
- in language acquisition.

That is, the relational function of schemas helps to keep order in the mental lexicon by encoding which words are related and in what way. Motivated information may be 'cheaper' in terms of independent information content (see Jackendoff & Audring 2020: 80 for discussion). Schemas – including unproductive schemas – may guide and thereby speed up production and comprehension of language and they may aid the learner (Jackendoff & Audring 2020: chapter 7). Hence, schemas can be considered to be of value and there is no reason to assume that the mind discards them if they turn out not to be productive.[23]

Of the many things that can be said about motivation, two points deserve to be highlighted briefly. First, since schemas in their relational role do not create their instances, and hence are not 'responsible' for all of their properties, motivation can be partial. An example of this effect can be seen in Section 4.3.1, the Dutch idiomatic diminutive *telefoontje* 'phone call'. Parts of the structure of this noun, especially its formal properties, are accounted for by the diminutive schema. The mismatching semantics does not prevent the word from being a daughter of this schema.

[23] Recall that from a constructionist perspective, schemas arise as unproductive schemas and are only promoted to productivity if the observed language use suggests so. Hence, there is no need to ask why unproductive schemas are formed. However, we have to ask whether they are retained. A possible answer is that using a schema in production or comprehension amounts to (re)activating it, which prevents it from fading from memory.

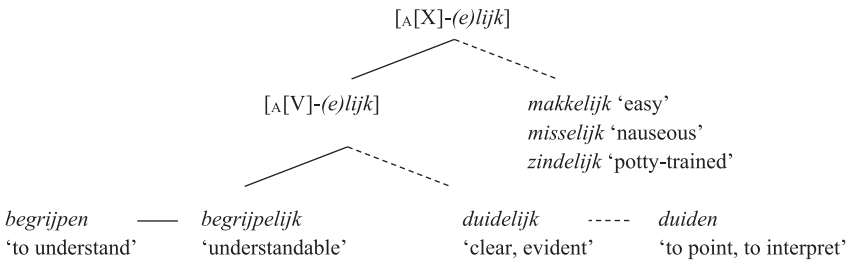


Figure 4.3 Degrees of motivation in Dutch adjectives in *-(e)lijk*

Motivation is thus a matter of degree, depending on the amount of structure that is relationally linked. Figure 4.3 illustrates this for Dutch [$_A$ [X] *-(e)lijk*] (mentioned in Section 4.4.1), in a simplified representation. Only a small portion of the network is shown. The two deverbal adjectives *begrijpelijk* and *duidelijk* both have lexical bases (the verbs *begrijpen* and *duiden*, respectively), but while *begrijpen* and *begrijpelijk* are clearly related in form and meaning, the link between *duidelijk* and *duiden* is probably opaque to most speakers. The semantic relation is recoverable but not obvious, and the complex adjective is vastly more common than the base verb, which discourages a compositional parse (Hay 2001; Hay & Baayen 2002). The dashed line indicates the looser connectivity. Turning to the right-hand side of Figure 4.3, *makkelijk*, *misselijk*, and *zindelijk* do not have a lexical base in present-day Dutch. They can only be daughters of the higher-level schema, which does not pose any restrictions on the category of the base. The schema motivates these words only partially: Their only non-arbitrary properties are the phonology and orthography of the suffix and the fact that they are adjectives.

This raises the question what the limits of 'daughterhood' are. Psycholinguistic evidence suggests that even 'look-alike' forms can be parsed out as stems or affixes, such as *broth-* in *brother* or *-er* in *corner* (e.g., Rastle et al. 2004). Other studies suggest that non-affixal segments can develop functional properties similar to the true affixes that they resemble in form (e.g., Weidhaas & Schmid 2015 on German verbal *-el*, Köpcke & Panther 2016 on German nominal *-er*, and Booij & Audring 2018 on Dutch *-er* and *-el*). Such observations relate to the point made in Section 4.3.2: The recognition of morphological structure equals the recognition of lexical relations. Recognition is a matter of interpretation. For the non-straightforward cases, it makes sense that interpretations can differ from one speaker to the next.

As a second central point, it is important to realize that the relational role of motivating listed instances is played by *all* schemas, including productive schemas. As was pointed out in Section 4.4.1, having a productive schema does not mean that there are no existing words stored in memory. Hence, even though the English plural schema is productive, speakers store frequent plurals such as *tears*, *pluralia tantum* such as *scissors*, and idiomatic plurals such as *clothes* (recall the list in [7], Section 4.3.1). These listed forms are motivated by the plural schema in the expected way.

4.5 Paradigmaticity

Another topic central to morphology and less so to syntax is paradigmaticity, a situation in which constructions form oppositional pairs or groups. A small selection of English examples is given in (18).

(18)
a. want ≈ want-s ≈ want-ed (inflection, regular)
rise ≈ rose, drive ≈ drove (inflection, ablaut)
am ≈ are ≈ is (inflection, irregular)
b. hard-ware ≈ soft-ware ≈ mal-ware (compounding)
down-load ≈ up-load
c. construct-ion ≈ construct-ive (derivation)
splend-id ≈ splend-or, ferv-id ≈ ferv-or (derivation, non-lexical bases)

While inflection is considered the heartland of paradigmaticity (18a), paradigmatic relations are also found in word-formation, for example when a compound pattern is analogically extended to new instances (18b), and in what is often called affix replacement (18c). What is common to these pairs or groups is that they have a part that is the same – often a stem – and a part that differs. In many cases, the parts that are not the same are nevertheless related, which strengthens the bond between the words involved. The most evident example in (18) is *download* ≈ *upload* (18b), where the diverging parts stand in semantic opposition; but the inflectional markers in (18a) are systematically opposed as well.

From a constructionist perspective, 'paradigmatic' does not contrast with 'syntagmatic' here, but with 'hierarchical'.[24] While hierarchical links run 'vertically' between more schematic constructions and more substantive constructions, paradigmatic links are 'horizontal' and involve constructions on the same level of schematicity. Using the family metaphor as above, the words in (18) are paradigmatic sisters (Audring 2019; Jackendoff & Audring 2020). Sister relations are often missing in representations of constructionist networks and they have received less attention in the (syntactic) constructionist literature, with notable exceptions such as Cappelle (2006), Van de Velde (2014), Diessel (2015), Norde & Morris (2018), and the contributions in Sommerer and Smirnova (2020); see also Kapatsinski (2022) for criticism. An important work in morphology is Booij and Masini (2015).

Paradigmatic relations can be modeled by means of relational 'same structure' links between the words involved. Thus, the verbs in (18a) share the same stem (*want-*), the same stem minus the vowel (*rise* ≈ *rose*), or the identity as the same verb (*am*, *are*, *is*), respectively. (18b–c) also involve the same stems. However, paradigmatic relations often go beyond relations among individual words. An example is the pattern from (18c), elaborated in (19) (Audring 2019: 288; Jackendoff & Audring 2020: 109).

[24] Some constructionist models also include syntagmatic links between constructions that are likely to follow one another linearly (e.g., Diessel 2019). In morphological constructions such links appear to be unnecessary, as syntagmatic structure is an internal part of morphological constructions.

(19)

candid	≈	candor
fervid	≈	fervor
horrid	≈	horror
languid	≈	languor
pallid	≈	pallor
splendid	≈	splendor
squalid	≈	squalor
torpid	≈	torpor
stupid	≈	stupor
liquid	≈	liquor

The fact that these paired items form a group suggests that relational links between the individual words do not capture the full generalization. The paradigmatic relation can be upgraded to the level of the schema (20).

(20) $[_{A}$ ø *-id*$]$ ≈ $[_{N}$ ø *-or*$]$

Both schemas are unproductive; moreover, not all *-id* adjectives have an *-or* counterpart (e.g., *vivid* ≈ **vivor*), nor do all *-or* nouns have an *-id* counterpart (e.g., *vigor* ≈ **vigid*). The stem variable in both schemas is uncategorized, as none of the bases occurs as a free lexical item. Within this very limited frame, the relevant generalization is that when both forms exist, the stem variables of the $[_{A}$ ø *-id*$]$ and the $[_{N}$ ø *-or*$]$ schema are filled by the same material. Hence, the relational link indicates "same variable" (Jackendoff & Audring 2020: 109).

Paradigmatic relations between schemas have received particular attention in constructionist morphology. They are sometimes regarded as a special configuration called 'second-order schemas', because they are generalizations over generalizations (Booij & Masini 2015; the term is adopted from Nesset 2008: 18–21; Plag 2003 uses the term 'cross-formation'). The issue is of particular relevance when second-order schemas are used to represent inflectional paradigms (as suggested in Booij 2010: 256; van der Spuy 2017; Masini & Audring 2019: 384; Audring 2019). Here the question arises whether a paradigm is a special type of higher-order construction, a "hyperconstruction" (Diewald 2020), or a "metaconstruction" (Leino & Östman 2005). In the understanding outlined here, paradigmatic relations on higher levels in the constructicon are simply sister relations between schemas, entirely parallel to sister relations between words. The only difference is the type of element that is marked as the same. In words, these elements are substantive, in schemas they are variables.

A final issue to address briefly is the division of labor between sister relations and mother–daughter relations (see, e.g., Audring 2019; Sommerer & Baumann 2021 for discussion). In particular, it has been suggested that sister constructions are 'allostructions', that is, variants of a common mother (Cappelle 2006), much in the way that allophones are variants of a phoneme. This would make their direct horizontal connection less central and perhaps optional. Looking back at example (20), it is evident that a common mother is not always an attractive option. In this particular case, the mother schema would consist of nothing but variables: for the category, for the stem, and for

the suffix. Each of the variables requires a list of possible instantiations: The category is A or N, the participating stems are those shown in (19), and the suffixes are *-id* and *-or*. It is not even possible to generalize over the category of the bases except for the fact that they do not have a category. Hence, a putative mother schema adds no information: The paradigmatic links between the sisters encode all necessary information.[25]

A different situation arises when the variables of the mother schema express a necessary generalization that cannot be encoded in the sisters themselves. This happens when the parts of the sisters that are *not* the same are nevertheless related, for example, by being systematically opposed. The examples given above were *download* ≈ *upload* (18b) and inflectional markers in general (18a). Systematic oppositions cannot be expressed by relational links since they do not involve the same structure; *down-* and *up-* are not the same in form nor function, and neither are the suffixes *-s* and *-ed* in (18a). The fact that they form opposites requires stating the set in which the opposition holds. Mother schemas are useful in this situation as they can define the common semantic scale on which 'down' and 'up' are opposites, as well as the structure of the verbal paradigm to which *-s* and *-ed* belong.

This brief overview demonstrates that sister relations, especially between schemas, are a powerful modeling tool in constructionist accounts of morphology. They are attractively compatible with the view that generalizations are understood as being built 'bottom-up', which makes sisters ontologically primary to mothers (causing the metaphor to break down). Hence, they deserve closer consideration in future work.

4.6 Conclusions: Implications for Constructionist Theorizing

This chapter shows that a construction-based approach yields insightful modeling options for morphology. Both words and the patterns in which they participate can be understood as constructions, ranging from fully specified to entirely schematic. The extended lexicon, or constructicon, accommodates morphological and syntactic constructions with equal ease and according to the same architectural principles. A marked difference between syntax and morphology is that complex words typically show a rich interplay of idiosyncrasy and regularity: Unpredictable properties are the rule more than the exception in morphology. An important advantage of a construction-based approach is that there is no need to differentiate between regular words 'generated by the grammar' and irregular or idiomatic words 'listed in the lexicon'. The lexicon–grammar continuum with its broad tolerance for listed forms allows for predictable and unpredictable properties to be modeled in

[25] Cf. Höder (2019: 345, figure 2) for a roughly equivalent scenario from phonology but with a different solution involving a mother schema.

individual detail. The result is a memory-rich but well-structured network in which lexical and grammatical knowledge are integrated harmoniously.

The view of the constructicon presented here involves constructional nodes – words or schemas – and two types of links: interface links within each node and relational links across nodes. This yields a lean yet flexible architecture. Construction-internally, the basic principles of the Parallel Architecture allow for an easy handling of non-isomorphy such as in zero marking (e.g., the English plural form *sheep*), non-compositional meanings (the Dutch diminutive *telefoontje*), or non-lexical bases (English *ambitious*). The structural tiers, that is, semantics, morphosyntax, phonology, and orthography, are independently encoded and mapped onto each other. Interface links between the tiers can be one-to-one but also one-to-many or even many-to-many. In yet other cases we see segments that are not linked at all. Neither of these situations needs to be treated as exceptional or peripheral.

In Relational Morphology (but not only there), relations are central: The recognition of internal morphological structure rests on the recognition of similarities between words. This implies that inter-speaker differences can be expected in the morphological segmentation of complex words.

Observations from morphology suggest a number of refinements to the theoretical apparatus of Construction Grammar. One is that limited productivity can be encoded on each level of generality, from lower-level subschemas to more general schemas higher up in the hierarchical network. Within a construction, each variable slot can be marked as open or closed, depending whether its fillers come from a restricted or unrestricted set of lexical items. Full productivity is not as self-evident as a syntactic perspective might suggest. In fact, the premise that schemas arise as generalizations over stored exemplars means that they are not automatically committed to productivity: Productive extendibility constitutes an upgrade, requiring extra evidence from observed language use.

If a schema is unproductive, it can nevertheless be functional and useful. All schemas – productive or unproductive – are related to their instantiating words and phrases and motivate their structure. Motivation helps to keep order in the lexicon; it is expected to aid processing and support learning. Motivational relations are flexible in that they can account for a construction in full or in part. Hence, individual quirks of complex words do not disrupt their relation to their mother schemas.

Another refinement that Relational Morphology adds to CxG is a greater attention to paradigmatic relations within the constructicon. Sister constructions are not only relevant as alternating or competing expressions for the same meaning: They add further motivational texture to the network. In addition, they can express generalizations without the need of an overarching mother schema. The division of labor between mother schemas and sister relations is an important issue for future research.

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