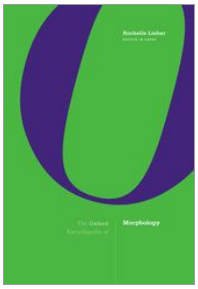

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Network Morphology

1. Inheritance

The notion of inheritance is widely used in linguistics to capture the sharing of the same information by different linguistic objects. These objects may inhabit different levels of description. For example, in Head-Driven Phrase Structure Grammar, the sharing that takes place among syntactic elements can be expressed as inheritance; and a verb lexical item whose semantics include the situation *s1* heads and a VP whose semantics is also about *s1*, as is the entire sentence. A VP is viewed as *inheriting* some of its feature values from its head daughter, including the value of the semantic feature INDEX, which for a verb is the situation *s*, and a sentence inherits these same features from the VP because the VP serves as the sentence's head daughter. The sharing of the index with reference to the head constituent is stated as a constraint based on *inheritance* of information.

(1)

The Semantic Inheritance Principle

In any headed phrase, the mother's MODE and INDEX values are identical to those of the head daughter. (Sag, Wasow, & Bender, 2004, p. 144.)

Without the principle in (1), the value *s1* for INDEX would have to be stipulated to be true for V, VP, and S. The principle allows us instead to state the value once and thereby reduce redundancy. It also gives us a means of stating an important generalization: a specified subset of the properties of verb lexical entries determines a subset of the properties of a subset of phrases, which includes the sentence itself. These properties are *head* properties (headedness).

Redundancy also lurks in a language's morphological system. Network Morphology is a morphological framework that addresses such redundancy through inheritance-based fact-sharing, leading to generalizations that ultimately address the question: what is a possible morphological word?

To illustrate, consider the paradigms in (2)–(4) of three nouns in Lower Sorbian, a West Slavonic language spoken in Germany in the surrounding areas of Cottbus, Brandenburg (see, e.g., Stone, 1993). Each noun in (2)–(4) is representative of an inflectional class that can be represented as a node in an inheritance hierarchy (Starosta, 1999, pp. 23, 27).

(2)

dub 'oak tree', node I

	SINGULAR	DUAL	PLURAL
NOMINATIVE	dub	duba	duby
GENITIVE	duba	dubowu	dubow
DATIVE	duboju	duboma	dubam
ACCUSATIVE	dub	duba	duby
INSTRUMENTAL	dubom	duboma	dubami
LOCATIVE	dubje	duboma	dubach

(3)

lipa 'lime tree', node II

	SINGULAR	DUAL	PLURAL
NOMINATIVE	lipa	lipje	lipy
GENITIVE	lipy	lipowu	lipow
DATIVE	lipje	lipoma	lipam
ACCUSATIVE	lipu	lipje	lipy
INSTRUMENTAL	lipu	lipoma	lipami
LOCATIVE	lipje	lipoma	lipach

(4)

wokno 'window', node III (Starosta, 1999, p. 28)

	SINGULAR	DUAL	PLURAL
NOMINATIVE	wokno	woknje	wokna
GENITIVE	wokna	woknowu	woknow
DATIVE	woknoju	woknoma	woknam
ACCUSATIVE	wokno	woknje	wokna
INSTRUMENTAL	woknom	woknoma	woknami
LOCATIVE	woknje	woknoma	woknach

Among the three classes there is multiple sharing of exponents in two ways. Classes may share an exponent for a given morphosyntactic feature set. For example, Classes I and III share the suffix *-om* for instrumental singular. And a single class may share an exponent for *different* morphosyntactic feature sets. For example, in Class II both accusative singular and instrumental singular share the suffix *-u*.

Inheritance-based fact-sharing can be represented graphically as in Figure 1.

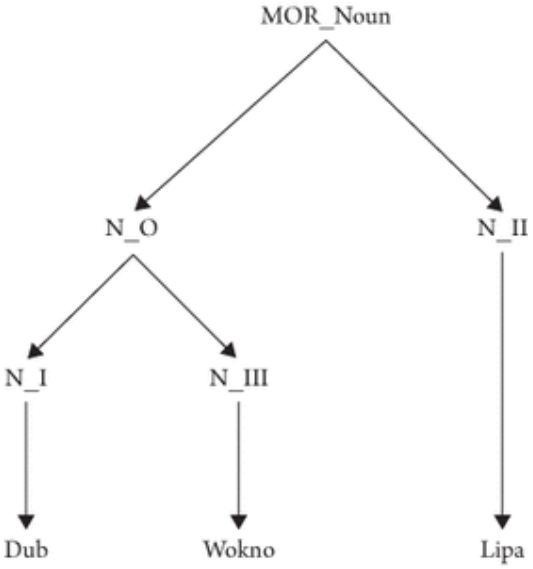

Figure 1. Inheritance hierarchy for Lower Sorbian nouns.

Each node in the hierarchy is placeholder for a set of morphological facts, that is, the pairing of a set of morphosyntactic feature values and its formal expression. For example, N_I could hold the pairing {CASE: INSTRUMENTAL, NUMBER: SINGULAR} ⇔ /*stem* + *om*/. The leaf nodes represent lexical entries that inherit morphological facts from respective class nodes. For example, the lexical entry for *dub* would inherit the instrumental singular fact from node N_I if that is where this fact were located, along with many other similarly patterning nouns. The pairings inferred from the paradigms in (2) to (4) can be mapped onto the appropriate nodes in the hierarchy in Figure 1: (2) onto N_I including {CASE: INSTRUMENTAL, NUMBER: SINGULAR} ⇔ /*stem* + *om*/, (3) onto N_II, and (4) onto N_III. But this would minimize the role that inheritance plays to capture identity *between* classes. For example, both N_I and N_III will contain the identical fact about instrumental singular: Class I *dubom* and Class II *woknom*. Inheritance can capture the identity with the introduction of an abstraction node N_O which serves as a placeholder for all facts that N_I and N_III share, including the instrumental singular, since the node is a source of inheritance for N_I and N_III. Example (5) provides some other facts that can be placed at N_O.

(5)

N_0

{CASE: DATIVE, NUMBER: SINGULAR} ⇔ /stem + oju/	*duboju, woknoju*
{CASE: GENITIVE, NUMBER: SINGULAR} ⇔ /stem + a/	*duba, wokna*
{CASE: LOCATIVE, NUMBER: SINGULAR} ⇔ /stem + je	*/ dubje, woknje*

The last fact about the locative is sharable among all classes. It can therefore be held at the root node MOR_NOUN where it is maximally inheritable. Other facts that could be placed at MOR_Noun include all plural and dual forms, with the exception of the nominative and accusative plural which is *-y* for Classes I and II (*duby, lipy*) and *-a* for Class III (*wokna*), and the nominative and accusative dual which is *-je* for Classes II and III (*lipje, woknje*) and *-a* for Class I (*duba*). The common facts about the direct cases in the dual and plural would then populate the class nodes N_I, N_II, and N_III. The node N_III contains the unique facts listed in (6), far fewer than what is shown in (4) since most of the facts in (4) are sharable (i.e., inheritable).

(6)

N_III

{CASE: NOMINATIVE, NUMBER: SINGULAR} ⇔ /stem + o/	*wokno*
{CASE: ACCUSATIVE, NUMBER: SINGULAR} ⇔ /stem + o/	*wokno*
{CASE: NOMINATIVE, NUMBER: PLURAL} ⇔ /stem + a/	*wokna*
{CASE: ACCUSATIVE, NUMBER: PLURAL} ⇔ /stem + a/	*wokna*
{CASE: NOMINATIVE, NUMBER: DUAL} ⇔ /stem + je/	*woknje*
{CASE: ACCUSATIVE, NUMBER: DUAL} ⇔ /stem + je/	*woknje*

Finally, lexical entries themselves are highly parsimonious since their paradigms constitute much inheritable information. The lexical entry for *wokno* could contain the facts in (7).

(7)

Wokno

class	⟵	N_III
stem =		*wokn*
gloss =		window
common =		+
count =		+

The first fact crucially expresses how the lexical entry plugs into the hierarchy, namely, via the node N_III. The last two facts have greater relevance for syntax than morphology especially for agreement with plural adjectives, plural demonstratives, plural verbs, and other number-marking elements that form a dependency with it.

Thinking of morphology as an *inheritance* system therefore allows us to wring out redundancy on the one hand, to the point where lexical entries are slimmed down to the unpredictable, and to capture important generalizations which suggest the system at a higher level. For example, despite all the allomorphy that Lower Sorbian exhibits there is an 'essential' locative case and essential plural and dual that stand out from the complexity of inflectional classes and tell us something about the organization of the language as a whole that we would miss if our view was restricted to the particular, either at the lower level of classes or the even lower level of lexical entries.

2. Lexical Knowledge Representation

Network Morphology provides for a straightforward computer implementation of all theories that are built in it, adhering to the principle that claims about the morphological facts of a language should be testable, providing robust external validity (Brown & Hippisley, 2012, pp. 287–288). For this purpose, Network Morphology makes use of the computable lexical knowledge representation language DATR, due to Roger Evans and Gerald Gazdar (see Evans & Gazdar, 1996, and references therein). (8) and (9) show the DATR representation of N_III and the inheriting lexical entry for *wokno*, with an explanation following.

(8)

N_III:

<> == N_0

<sg nom> == "<stem>" o

<sg acc> == "<stem>" o

<pl nom> == "<stem>" a

<pl acc> == "<stem>" a

<dual nom> == "<stem>" je

<dual acc> == "<stem>" je

(9)

Wokno:

<> == N_III

<stem> == wokn

<gloss> == window

<common> == +

<count> == +

The first line in (8) names the node and the second line indicates what node it inherits from, here N_0. The other lines express the mapping of an ordered set of morphosyntactic feature values (left-hand side) to their formal realization. We use the notation to express that Network Morphology is an inferential-realizational framework, where the formal expression of morphosyntactic meaning is realized by modification of the stem, here the addition of a suffix (Stump, 2001). The stem that is modified is represented as an attribute path seeking its own value. That value comes from the value of <stem> at the node representing the lexical entry being queried. In other words, the right-hand side is an instruction to concatenate an exponent to a lexeme's stem. (9) represents such a lexeme as a node. Its first line states its inheritance from N_III. The second line provides the value for the attribute path <stem>. For completeness, in (10) we give the DATR representation of N_O presented in (5), the abstraction of classes I and III.

(10)

N_0:

<> == MOR_Noun

<sg gen> == “<stem>” a

<sg dat> == “<stem>” oju

<sg ins> == “<stem>” om

<sg loc> == “<stem>” je

To evaluate the singular genitive you take the stem, whatever that might be, and concatenate a. The quote marks express global inheritance: the value of the path <stem> will be found non-locally, not at this node but at the node that represents the lexical entry that is being queried. For (9) this would be *wokn*.

3. Inheritance by Default

A maximally economic organization of the Lower Sorbian facts as presented in (2) to (4) would lack duplication. The node N_III shown in (8) contains not only unique but also repeated facts, namely, the nominative and accusative dual since they will also appear at N_II. The approach that Network Morphology adopts is to interpret inheritance of shared facts as inheritance *by default*: inheritance of facts can be overridden. This is an important decision. If inheritance were mandatory, then the analysis would be all or nothing. If it is by default, the analysis is ‘all things being equal’, or what happens for the most part. This seems to better capture natural phenomena including language, particularly morphology. When we think of the past tense in English, we think of the general situation and provide for exceptions (*sang, rang, found*, etc.) In child language there is an overgeneralization stage, then a reckoning with the realities of the language: allowing for the exceptional while keeping the notion of the general. Getting back to Lower Sorbian, the dual facts are shared by two classes but not all three. So with default inheritance they can be stated once at the root node MOR_Noun, and inherited by N_III and N_II. And, crucially, N_I would override the inheritance of these facts in favor of its own alternatives.

(11)

N_I:

<> == N_0

<dual nom> == “<stem>” a

<dual acc> == “<stem>” a

<sg nom> == “<stem>”

<sg acc> == “<stem>”

In similar fashion, the sharing of the nominative and accusative plural by classes N_I and N_II can be captured by locating them at the root node and specifying overrides at N_III.

Overriding inheritance is also used in Network Morphology to capture irregularity. Lower Sorbian *słowo* 'word' patterns are like any other Class III noun, except that instead of the expected genitive plural *słowow* it has *słow* in its paradigm. The lexical entry for *słowo* can be represented as in (12).

(12)

Słowo:

<> == N_III

<stem> == słow

<gloss> == word

<gen pl> == <stem>

<common> == +

<count> == +

Compared to the node for *wokno*, there is an additional fact whose mention overrides a morphosyntactic fact inheritable from N_III, namely, that for the genitive plural, just the stem is used rather than the stem plus ending.

Similarly *polo* 'field' is to all intents and purposes a Class III noun, with the exception that the locative singular is in *-u* (*na polu* 'in the field') and the nominative and accusative dual are in *-i*, *poli* (Stone, 1993, p. 618). Along with *poli*, Starosta (1999, p. 28) lists *koljeni* 'knees' and *łopjeni* 'leaves' as having exceptional nominative and accusative dual forms. An abstraction node situated underneath N_III could be posited to draw such items together to express a subclass that gathers the common exceptional facts as overrides.

(13)

N_III_Exception:

<> == N_0

<dual nom> == "<stem>" i

<dual acc> == "<stem>" i

Lexical entries for *polo*, *koljeno*, and *łopjeno* would inherit from this class instead of stating the same overrides regarding the dual. (Of course, *polo* would still have to override the locative singular.) The hierarchy that is built and the list of overrides in this way represent the nature and degree of the (ir)regularity: regular, semiregular, barely regular, exceptional.

4. Further Reducing Redundancy: Syncretism as a Rule of Referral

The paradigm for *lipa* presented in (3) shows that in this class a feature set may share an exponent with another feature set. Both dative singular and locative singular are formed in *-je* (*lipje*), and *-u* is shared between the accusative singular and instrumental singular (*lipu*). To account for directional syncretism as a rule of referral (see Stump, 1993, 2001, pp. 212–241; Zwicky, 1985), Network Morphology provides for intra-node path referrals as shown in the partial representation of the node N_II in (14).

(14)

N_II:

<> == MOR_Noun

<sg ins> == <sg acc>

<sg acc> == "<stem>" u

<sg dat> == <mor sg loc>

…

The goal of the directional syncretism is the left-hand side of the equation, and the target is an attribute path on the right-hand side, whose value is available within the node. So the (goal) path <sg ins> finds its value by referring to another (target) path <sg acc> whose value is made available within the node. Dative singular as the goal whose target is locative singular is treated in the same way. Recall from Section 1 that the actual value of locative singular is inheritable information, from the root node MOR_Noun.

The specification of a directional syncretism may itself be sharable across nodes. For example, all classes share the fact that the dual dative, instrumental, and locative converge on the same exponent, *-oma: duboma, lipoma, woknoma* are all ambiguous in three ways. The generalizability of the syncretism can be captured by locating it at the topmost node MOR_Noun from which all class nodes inherit.

(15)

MOR_Noun:

<dual ins> == <dual dat>

<dual dat> == <dual loc>

<dual loc> == "<stem>" oma

…

The choice of which feature set serves as the goal and which as the target in the referral might appear arbitrary. Network Morphology requires a system-based motivation for the directionality. Elsewhere in the Lower Sorbian system, we see that the dative refers to the locative: in Class II, we have just seen that the dative singular shares the exponent that is available for all nouns in the locative. We also see that for all classes, the instrumental plural (e.g., *dubami*) is realized by taking the exponent of the dative plural and adding i.

(16)

MOR_Noun:

<dual ins> == <dat dual>

<dual dat> == <loc dual>

<dual loc> == "<stem>" oma

<pl dat> == "<stem>" am

<pl ins> == <pl dat> i

…

We have seen similarly repeated information in several other places, notably due to a nominative/accusative syncretism. The representation of node N_I was given in (11), where two sets of equations share the same value to capture a lexical entry like *dub* having the nominative and accusative dual *duba*, and the same nominative and accusative singular *dub*. Class III has the same syncretism, where nominative and accusative converge on the exponent *-o* for the singular (*wokno*), and *-je* for the dual. This is represented as the duplicate equations at N_III, shown in (8). Finally, in the plural we also find nominative/accusative syncretism for all classes, except that the exponents used differ: *-a* in Class IV and *-y* in Classes I and II. We therefore have a *generalized* syncretism, over class and across number. While the exponents themselves may differ, the feature sets of the goal and target are the same in every case. The statement we are looking for is "no matter what the class or the exponent, by default find the accusative by referring to the nominative." To capture this, we introduce at the root node the specification of a goal and target that is inherited by all nodes by default.

(17)

MOR_Noun:

<sg acc> == "<sg nom>"

<dual acc> == "<dual nom>"

<pl acc> == "<pl nom>"

…

This generalization will cover even the exceptional class in (9), capturing the fact that though the dual exponent is exceptional, the sharing between nominative and accusative is not: it is part of the system that is Lower Sorbian noun inflection. However, the accusative does exist as a separate formal feature given the *lipa* inflectional class: *lipa* versus *lipu*.

4.1 Neutralization Syncretism and Attribute Ordering.

The syncretisms that we have been discussing have been captured as rules of referral, because they are *directional*: there is a goal feature set and target feature set. But not all syncretism needs to be thought of as goal oriented. For the dual dative, instrumental, and locative syncretism, instead of paths being directed to one another, they could be treated as three cases being neutralized in the context of dual number. In other words, these three cases are distinguished in Lower

Sorbian in the singular and plural but not in the dual. The neutralization of case in the context of number is typologically common (e.g., Greenberg, 1963, p. 103). Network Morphology captures feature neutralization through the ordering of the attributes in an attribute path and its interpretation as default inference. A path <dual dat> is inferred by the subpath <dual>, the shorter path containing only one attribute. This is because in the DATR language, subpaths, or shorter paths, imply their extension. And because <dual dat> is an extension of <dual>, whatever value you give for <dual> will be the same value that is given for <dual dat>, by default. Therefore, if <dual> == "<stem>" oma then it is also the case that <dual dat> == "<stem>" oma, since this is the inference by default. By default, inference (19) is equivalent to (18).

(18)

<dual> == "<stem>" oma

(19)

<dual dat> == "<stem>" oma

<dual ins> == "<stem>" oma

<dual loc> == "<stem>" oma

The inference can be overridden by associating the extended path with another value. So stating as a fact that <dual nom> == "<stem>" je is overriding the inference that any extension of <dual> will be oma ((18)). Case neutralization is therefore captured by ordering the case attribute after the number, so that the number attribute specifies the shorter path. The shorter (number) path is then the path that gets used for the syncretized value. So *-oma* is represented as the syncretic value for the dual. Sometimes that doesn't hold when certain cases are in place, namely, the accusative, nominative, and genitive, all of which have their own distinct dual ending.

(20)

MOR_Noun:

<dual> == "<stem>" oma

<dual acc> == "<dual nom>"

<dual nom> == "<stem>" je

<dual gen> == "<stem>" ow

<pl acc> == "<pl nom>"

…

The ordering of attributes in Network Morphology is a decision based on a maximally parsimonious analysis of the system, and makes a claim about paradigmatic *shape*: how the paradigm is split. We see that for Lower Sorbian nouns, the split is based on number. Turning to adjectives, we see a third feature, gender. In order to capture neutralization syncretism for adjectives, we adopt the following feature order.

(21)

number → case → gender

The facts about Lower Sorbian adjectives are given in (22).

(22)

Dobry 'good' (Starosta, 1998, p. 35)

	SINGULAR			DUAL	PLURAL
	M	F	N		
NOM	dobry	dobra	dobre	dobrej	dobre
GEN	dobrego	dobreje	dobrego	dobreju	dobrych
DAT	dobremu	dobrej	dobremu	dobryma	dobrym
ACC	dobry	dobru	dobre	dobrej	dobre
ACC/ ANIM/ M	dobrego	-	-	dobreju	-[1]
INSTR	dobrym	dobreju	dobrym	dobryma	dobrymi
LOC	dobrem	dobrej	dobrem	dobryma	dobrych

1

Adjectives agree with their head noun in gender, number, and case, and in (highly restricted contexts) animacy. Number values are singular, dual, and plural. Gender values are masculine, feminine, and neuter. A root node MOR_Adj is given partial representation in (23), showing the ordering of features through the attribute ordering in a path.

(23)

MOR_Adj:

<sg nom fem> == "<stem>" a

<sg gen fem> == "<stem>" eje

<sg acc fem> == "<stem>" u

<sg ins fem> == "<stem>" eju

<sg dat fem> == <sg loc fem>

<sg loc fem> == "<stem>" ej

…

It should be noted that just as with nouns, there may be instances of referral-based syncretism, captured here in (23) as a path referral from the dative to the locative.

In the singular, there is widespread syncretism between the masculine and neuter. This is where our ordering of gender after case plays a crucial role. Facts about the masculine and neuter agreement forms for the singular are added to the adjective node in (24).

(24)

MOR_Adj:

<sg gen> == "<stem>" ego

<sg ins> == "<stem>" ym

<sg dat> == "<stem>" emu

<sg loc> == "<stem>" em

<sg nom neuter> == "<stem>" e

<sg nom masc> == "<stem>" y

<sg acc> == "<sg nom>"

…

In the first four equations, extended paths such as <sg dat neuter> and <sg dat masc> are inferred, capturing neutralization of gender in the context of case. And this inference is overridden by extended paths such as <sg ins fem> in (23). The last equation in (24) mixes a neutralization with a referral syncretism, expressing that the value for the

singular accusative of any gender, unless specified, is the same as the value of the singular accusative of the same gender. This serves to generalize a referral syncretism over masculine and neuter contexts. But this is a generalization. For feminine contexts there is a unique form, creating a distinction between feminine and non-feminine agreement. This is captured by overriding the gender neutralization through an explicitly extended path in (23): <sg acc fem>.

Turning now to the dual and plural, we can use even shorter subpaths to capture complete neutralization of gender as well as a subset of cases (dative, instrumental, locative).

(25)

MOR_Adj:

<dual> == "<stem>" yma

<dual gen> == "<stem>" eju

<dual nom> == "<stem>" ej

<dual acc> == <dual nom>

…

The choice of attribute ordering means that it is possible to reduce the entire dual subparadigm to just four facts. Note that the last equation expresses a mix of neutralization syncretism (gender) with a referral (case). For completeness, (26) represents the plural subparadigm.

(26)

MOR_Adj:

<pl nom> == "<stem>" e

<pl acc> == "<pl nom>"

<pl gen> == "<stem>" ych

<pl dat> == "<stem>" ym

<pl ins> == "<stem>" ymi

<pl loc> == "<stem>" ych

…

Lower Sorbian has an additional animacy feature. This can be viewed as a subgender, following Corbett (2006, p. 20) for Russian. In terms of feature ordering, we say that animacy extends gender:

(27)

number → case → gender → animacy

In Lower Sorbian, animacy is overtly expressed in the masculine accusative singular and dual only (Stone, 1993, p. 615). To capture animacy in these contexts, we use the full path: <sg acc masc animate>, <dual acc masc animate>. Note that the value for this path is syncretic with the genitive, so it is expressed as a path referral overriding the normal accusative/nominative syncretism.

(28)

MOR_Adj:

<sg gen> == "<stem>" ego

<sg acc masc animate> == <sg gen>

<sg acc> == "<sg nom>"

<dual gen> == "<stem>" eju

<dual acc masc animate> == <dual gen>

<dual acc> == <dual nom>

Only when we mention the attribute animate as the final extension of a subpath is its relevance expressed capturing the highly restricted role that animacy plays in Lower Sorbian.

4.2 Cross-linguistic Implications.

The specific order of attributes that is adopted to express a given morphosyntactic feature affects the parsimony of the account, and can be seen as a cross-linguistic claim. In a study of syncretism among 30 languages, the greatest tendency was for number to be the context for case syncretism, and for gender to be syncretized in the context of number or of case (Baerman, Brown, & Corbett, 2002; Brown & Hippisley, 2012, pp. 165–166; Brown, Tiberius, Chumakina, Corbett, & Krasovitsky, 2009). While neutralization syncretism expressed as attribute ordering captures cross-linguistic tendencies, directional syncretism as expressed by path referrals captures language or language family tendencies. A number of Slavonic languages other than Lower Sorbian display a nominative/accusative syncretism for inanimate and a genitive/accusative syncretism for animates (see, e.g., Comrie & Corbett, 1993, for a survey treatment), suggesting the tendency in a particular language family for a rule of referral syncretism with respect to the nominative and accusative.

5. A Separate Morphological Component

Network Morphology is strongly lexicalist, and assumes an autonomous level of morphology whose mapping to syntax may be many to many. This is nothing more than a recognition of the widespread existence of inflection classes and syncretism, as shown in our Lower Sorbian data. To capture the possibility, but not the necessity, of the lack of isomorphism between syntax and morphology, Network Morphology expresses isomorphism as the default fact shown in (29).

(29)

<syn> == "<mor>"

The syntactic level is characterized by attribute paths beginning with syn; these are related to attribute paths beginning with mor, expressing the morphological level. The equation says that by default, any extension of <syn> will have the same value as the same extension of <mor>. This provides for a separate set of purely morphological relations that provide the evaluation. In the situation of inflectional classes, the evaluation of <mor> will depend on the inflectional class of the noun being queried, and the referral and neutralization syncretisms that define the morphological level of evaluation, as just described. Figure 2 shows the distinction between syntactic and morphological representation as two related hierarchies from which a single lexical entry inherits.

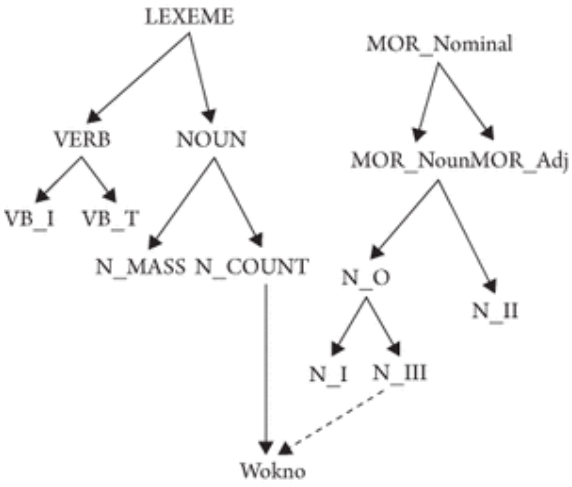

Figure 2. Inflection as multiple inheritance from the Lexeme and Morphological noun hierarchies.

The lexical entry for *wokno* is a leaf node multiply inheriting from a hierarchy of lexemes, which distinguishes lexemic categories such as verb and noun, and subcategories such as transitive verb and count noun, and a hierarchy of purely morphological facts regulated by declension class. Multiple inheritance in Network Morphology is specifically *orthogonal* multiple inheritance: the primary source of inheritance for *wokno* is the lexeme hierarchy, and the facts about it being a syntactic atom. The orthogonal source of inheritance is from the morphological hierarchy. The representation of the lexeme *wokno* given in (9) is revised in (30) as a node inheriting from two hierarchies.

(30)

Wokno:

<> == N_Count

<mor> == N_III

<stem> == wokn

<gloss> == window

~~<cat> == noun~~

~~<common> == +~~

~~<count> == +~~

Crossed out are facts now inheritable from the lexeme hierarchy, represented as paths that extend the leading subpath <syn>. From NOUN, the lexical entry Wokno will inherit <syn cat> == noun and <syn cat> == common (as a default), and from N_COUNT the path <syn count> == + which could be used as a constraint on plural agreement, for example. At NOUN we could also put as a default <syn animacy> == inanimate. All morphological facts for the lexical entry are expressed as <mor> paths that are inherited from the morphological hierarchy, namely, the node representing the Class III pattern of inflection. This is stated by the extra equation <mor> == N_III. Nodes in the morphological hierarchy must be revised so that left-hand side paths have the leading subpath <mor>.

(31)

N_III:

< > == N_0

<mor sg nom> == "<stem>" o

<mor pl nom> == "<stem>" a.

The equation in <syn> == "<mor>" in (29) will be located at the root node LEXEME in the lexemic hierarchy. This ensures that any lexical entry will map its <mor> values to equivalent <syn> values as a matter of course, in other words as a default. The <syn> values come from <mor> paths. We will see how this default mapping can in some instances be disrupted. For the moment, we have seen how Network Morphology handles lack of isomorphism between syntax and morphology due to inflectional classes by dispersing the morphological machinery to a separate hierarchy, subject to its own (morphological) generalizations that hold over many-to-many mappings—in terms of inflectional classes, referral, and neutralization syncretism. The morphological hierarchy has been expanded in Figure 2 to allow for generalization over noun and adjectival morphology, through the root node MOR_Nominal. Common to both kinds of morphology are the nominative/accusative syncretism. Furthermore, the exponents used for the plural dative, instrumental, and locative are the same for both nouns and adjectives except for a difference in theme vowel: *-y-* for adjectives and *-a-* for nouns.

(32)

MOR_Nominal:

<mor sg acc> == "<sg nom>"

<mor dual acc> == "<dual nom>"

<mor pl acc> == "<pl nom>"

<mor pl dat> == "<stem>" "<theme>" m

<mor pl ins> == "<stem>" "<theme>" mi

<mor pl loc> == "<stem>" "<theme>" ch

The equations <theme> == y and <theme> == a will be located at the MOR_Noun and MOR_Adj nodes, respectively. Due to path attribute ordering, the gender feature will be implied for all adjectives that inherit from this node since it is the last attribute. This means that syntactically, gender will be a relevant feature even when it is morphologically neutralized. Given a syntactic constraint on the agreement between modifier and head, if the head is {gender:feminine, number:plural}, then the appropriate word form will need to specify correct gender and number values. Given <syn> == "<mor>", the adjective will have a value for the <syn plural ins fem>.

The facts about Lower Sorbian, and many languages, call for occasions where morphology needs to be viewed separately from syntax. Inflectional classes and syncretism are more naturally accounted for with this view. By default, morphology cooperates with syntax. Now and again it does its own thing. To allow for both situations, Network Morphology assumes an autonomous morphological component that 'matches' syntactic requirements as the generalization, but the generalization can be overridden. This is elegantly summarized as <syn> == "<mor>", that is, the value you need for any feature bundle used for syntax can be retrieved by referencing the same feature bundle specification in morphology *unless otherwise stated*.

otherwise stated.

6. Morphological Mismatch, Overriding <syn> == "<mor>"

Separating off a morphological hierarchy from a lexemic hierarchy is Network Morphology's way of handling syntax/morphology dissociations such as inflectional classes (morphological allomorphy) and syncretism. One particular dissociation is an actual *mismatch* between what the syntax requires and what the morphological machinery delivers. This is a line from the play *Miles Gloriosus* by the Roman comic playwright Plautus.

(33)

nam	ego	hanc	mechaer-am	mihi	consol-ari
CONJ	I.SG. NOM	this. ACC.SG	sword-ACC. SG	me.DAT. SG	console- PRS. INF.**PASS**
vol-o	ne	lament-etur			
wish-1SG. PRS.ACT	NEG	wail-3SG.PRS.SBJV.**PASS**			

'Verily I would comfort this blade of mine, lest he lament'[2]

2

If we compare the glossing with the translation, we see that something a bit funny is going on. The verb used for 'console' is glossed as passive but its service to the clause is undoubtedly active. The verb for 'wail' is also glossed passive but is not part of a passive construction. Both verbs belong to a special subclass of Latin verbs termed *deponent*. They are characterized by building word forms with passive morphology in contexts that have an active reading. The partial paradigms of regular *amō* 'love' and deponent *consolor* can be compared. Example (34) gives the active and passive imperfective, present, indicative forms as well as present infinitive.

(34)

	Conjugation 1 *amō* 'love'		Conjugation 1 *consolō* 'comfort'	
	ACTIVE	PASSIVE	ACTIVE	PASSIVE
SG				
1	amō	amor	consolor	--
2	amās	amāris	consolāris	--
3	amat	amātur	consolātur	--
PL				
1	amāmus	amāmur	consolāmur	--
2	amātis	amāmini	consolāmini	--
3	amant	amantur	consolantur	--
INIFINITIVE				
	amāre	amārī	consolārī	--

Both verbs belong to the same inflectional class. The rules that build the passive morphology of the regular verb also build the active morphology of the deponent verb. At the same time, the deponent lacks a passive paradigm. The generalization we can make is that there is not a mismatch between *all* the features relevant to the syntactic and what the morphology offers but only the single feature voice. When the syntax requires a word form which is {VOICE:ACTIVE, ASPECT:IMPERFECTIVE, TENSE:PRESENT, MOOD:INDICATIVE, NUMBER:PL, PERSON:1}, then for the deponent verb it gets back from the morphology the word form that normally expresses the feature set {VOICE:PASSIVE, ASPECT:IMPERFECTIVE, TENSE:PRESENT, MOOD:INDICATIVE, NUMBER:PL, PERSON:1}. The mismatch is restricted to the voice feature; all other features match. Such an irregularity can be captured in a disarmingly simple way in Network Morphology using <syn> == "<mor>" and having the right ordering of attributes. This is shown in (35).

(35)

LEXEME:

<syn> == "<mor>"

…

VERB:

<> == LEXEME

<syn cat> == verb

…

DEPONENT_VERB:

<> == VERB

<syn act> == <mor pass>

<syn pass> == undefined

Example (35) represents the partial lexemic hierarchy from which Latin verbs inherit. Lexical entries will inherit orthogonally from a morphological hierarchy specifying conjugational patterns of inflection and generalizations over them. While *amō* inherits from VERB, items like *consolor* and *lamentor* inherit from the lower node DEPONENT_VERB. The default for verbs is that whatever combination of features specifies a particular syntactic word, the same combination of features is referenced for morphological evaluation. At VERB, any extension of the path <syn> is the same extension of the path <mor>; (36a,b) are therefore equivalent.

(36)

a. <syn> == "<mor>"
b. <syn act impf prs ind pl 1> == "<mor act impf prs ind pl 1>"

This situation does not obtain at DEPONENT_VERB because the node overrides the default equivalence between the attribute that extends <syn> and the attribute that extends <mor>. Instead of <syn act> and any extensions implying <mor act> with the same extensions, <syn act> is specified as referencing <mor pass>. But the equivalency between extensions to <syn act> and <mor pass> remains undisturbed.

(37)

a. <syn act> == "<mor pass>"
b. <syn act impf prs ind pl 1> == "<mor pass impf prs ind pl 1>"

Example (37) allows us to capture aspects of regularity in a verb like *consolō*. Though it has the 'wrong' morphology in one sense, it has the right morphology in another sense: the passive morphology that is built for this word is exactly what

you would expect it to look like for any other Class I verb.

Capturing deponency as a misalignment of a single feature between syntactic and morphological specifications suggests an ordering of features that best describes the Latin verbal paradigm. Deponents suggest voice first. Semi-deponents, a smaller group of verbs which are only deponent in the perfect aspect, suggest that the next attribute must be aspect. Nodes that handle semi-deponency are situated under DEPONENT_VERB, partially overriding facts about deponency.

(38)

PERFECT_DEPONENT:

<> == DEPONENT

<syn act impf> == VERB

(39)

IMPF_DEPONENT:

<> == DEPONENT

<syn act perf> == VERB

A semideponent verb such as *audeō* 'dare' will inherit from PERFECT_DEPONENT whose imperfective paradigm is regular but whose perfective paradigm is deponent. The second equation in (38) explicitly pulls out a set of paths, all those that extend <syn act impf>, preventing them from receiving the deponent treatment <syn act impf> == <syn pass impf> inherited from DEPONENT. This subset of paths is instead referred back to the initial default at VERB that all <syn> paths are evaluated through equivalent <mor> paths. In (39), a different subset is pulled out to 'save' perfective paths from deponent treatment. An example of a perfective deponent is *revertor* 'return'.

7. Lexical Relatedness

Distinguishing a hierarchy that generalizes over lexemes from a hierarchy which generalizes morphological rules is the way that Network Morphology captures what regularity there is in morphology while providing for syntax-morphology dissociations. The unit mediating the two hierarchies is the lexeme itself, represented as a partially specified leaf node sitting between the two hierarchies (i.e., multiply inheriting from both). In Network Morphology, the minimal sign is the lexeme, a unity of syntactic, semantic, phonological, and morphological information. While semantic and phonological (i.e., stem) information is lexeme specific, syntactic and morphological information is inheritable. However, when two lexemes are associated by a derivational relationship, part of the semantics and part of the stem of one lexeme come from the other lexeme. Network Morphology handles derivational morphology as a kind of lexical relatedness (Spencer, 2013) where the deriving lexical entry inherits from its base lexical entry at specified levels of information.

To illustrate, we consider the association between the Russian verb *čitat´* 'read' and *čitatel´* 'reader, person who reads' as one of lexical relatedness.

(40)

ČITAT´		ČITATEL´
syntactic level		***syntactic level***
syn cat = V		syn cat = N
args = 2 (NP_NP)		args =
semantic level	>	***semantic level***
'read'		'person who reads',
READ(x, y)		PERSON (x) such that read(x, y)
phonological level		***phonological level***
stem 1 = /čit-/		-
stem 2 = /čita-/		/čita-tel´/
morphological level		***morphological level***
mor class = V_I		mor class = N_I

At the syntactic level, we essentially have a new item: we had a verb, we now have a noun. At the morphological level, we are also dealing with something new. However, the semantic level of the derivative includes the semantic level of the base lexeme, as is the case with the phonological level where the derivative's stem embeds the base lexeme's stem. In Network Morphology, sharing is expressed as inheritance. For lexical relatedness, we enrich the lexeme hierarchy by allowing lexemes to inherit from lexemes. This inheritance is, of course, by default, since some of the old lexeme's information must be overridden, as in our case here: syntactic and morphological levels. At the same time, we want to provide access to generalizations about derivational morphology. Affixing *-tel´* to the stem of a transitive verb to create a personal noun is a highly productive process in Russian. Through orthogonal multiple inheritance, a derived lexeme has access to its base lexeme and to morphological generalizations expressed as a hierarchy of word-formation rules. The two hierarchies constitute two sources of sharable information that characterize lexical relatedness as derivational relatedness.

In Figure 3, the node WFR_TEL´ will be used to generalize lexical relatedness for other verb-noun pairs such as those given in (41).

(41)

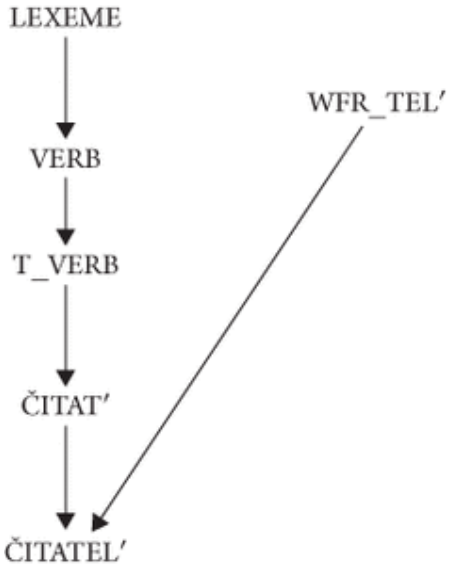

Figure 3. Derivation as multiple inheritance from the Lexeme and WFR hierarchies.

Base	*Gloss*	*Derivative*	*Gloss*
čitat´	'read'	*čitatel´*	'reader'
pisat´	'write'	*pisatel´*	'writer'
grabit´	'steal'	*grabitel´*	'thief'
xranit´	'guard'	*xranitel´*	'custodian'
terzat´	'torment'	*terzatel´*	'tormentor'
podžigat´	'set on fire'	*podžigatel´*	'arsonist'
zaušat´	'abuse'	*zaušatel´*	'abuser'

The node WFR_TEL´ holds the inheritable information that *-tel´* is affixed to the stem, more precisely the second stem of a verb, that there is a personal semantics, and that the derived lexeme will be a noun.

(42)

WFR_PERSON:

<> == NOUN

<gloss> == λx [<sem feature> (x) & "<base gloss>" (x)]

<stem> == "<base stem 2>" tel´

Different derivational types, such as category-changing derivation, transposition, conversion, zero derivation, and so forth, are expressed in Network Morphology as nature and degree of inheritance from the base lexeme and the word-formation rule node. For a noun like *čitatel´*, a product of category-changing derivation, information from the base is restricted to the semantic and phonological levels. This can be compared to the lexical relatedness that obtains between the verb *upravit´* 'control' and its nominalization *upravelnie*, an example of verb-to-noun transposition. In this case, the semantic level is left largely intact; that is, it is inherited fully from the base without alteration from the word-formation rule (though a 'thing' semantics associated with nouns à là Jackendoff, 1990, may be introduced by virtue of change of category). In fact, some of the syntactic level may persist from the base. The government requirements of the verb *upravit´* are maintained in the transposed noun if we compare the two examples in (43) and (44).

(43)

Intelligentci-ja	*sumel-a*	*raskačat´*	*Rossi-ju*	*do*
Intelligentsia-NM.SG	manage.PST-F.SG	rock-INF	Russia-ACC	up to
kosmičesk-ogo	*vzryv-a,*	*da ne*	*sumel-a*	*upravi-t´.*
cosmic-GEN.SG	explosion-GEN.SG	but not	manage.PST.F	control-INF
eë oblomk-ami				
its fragment-**INS**.PL				

(44)

sozdani-e	*arxiv-ov*	*na*	*baz-e*
Creation-NOM.SG	archive-GEN.PL	on	base-LOC.SG
žëstk-ix	*disk-ov,*	*upravleni-e*	
hard-GEN.PL	disk-GEN.PL	managing-NOM.SG	
žiznenn-ym	*cikl-om*	*dann-yx,*	
life-**INST**.SG	cycle-**INST**.SG	data-GEN.PL	
xraneni-e	*statičesk-ix*	*dann-yx*	
storing-NOM.SG	static-GEN.PL	data-GEN.PL	

"creating hard-drive based archives for data life-cycle management and storing static data" (*Russian National Corpus*)

In (43), the verb governs the instrumental case; in (44), the transposed noun also governs the instrumental case.

Extreme inheritance from the base is represented by cases of category-preserving derivation, in many languages found in the domain of diminutives or expressive morphology. In Russian, an augmentative noun in *-šče* has the same semantics, syntactic class, and agreement properties as its base lexeme, the latter despite a shift to a morphological class normally associated with another gender. The masculine noun *dom* 'house' derives the noun *domišče* 'house' with an augmentative semantic feature, which takes on a pattern of inflection associated with neuters. The agreement is nevertheless masculine.

(45)

orgromn-yj	*nedostroenn-ij*	*dom-išč´-e,*	*možno*	*skazat´*
huge-SG.**M**	underbuilt-SG.**M**	house(**M**)-AUG-SG	possible	say.INF

'a half-finished mansion, if you like' (*Russian National Corpus*)

In Network Morphology, such lexical relatedness would be characterized as maximal inheritance from the base node and minimal inheritance from the word-formation node (Hippisley, 2017).

8. Levels of Information as Separate Hierarchies in the Same Network

In Network Morphology, levels of information—lexical, inflectional, derivational—are expressed as distinct hierarchies that stake out the space of a common network. The disassociations between what syntax uses and what morphology provides are regulated by the way the hierarchies are connected with one another. The connection is regulated by the default <syn> == "<mor>" and relies on the most parsimonious choice of attribute ordering, where attributes express morphosyntactic features. One exponent may be shared by more than one feature set, and this sharing can be captured as a function of attribute ordering where a subpath implies its extensions by default, capturing cases of feature neutralization. Exponent sharing can also be captured by referring one set of features to another, capturing cases of directional syncretism. The organization of the morphological hierarchy, and the distribution of facts across its nodes, are also used to capture shared information by means of inheritance with the option to override. Irregularity is viewed as semiregularity, where what is abnormal is how information is being accessed from the hierarchy, rather than the information itself. Latin deponents serve to illustrate this point well: they abnormally deliver passive morphology, but the passive morphology they deliver is highly regular. Separate hierarchies for the lexeme and the morphological processes used to derive new lexemes also express the autonomy of morphology in the grammar. While there is autonomy, there is still a relationship with the rest of the grammar: separate hierarchies share the same network, and information in one hierarchy may correspond to the same kind of information in another hierarchy by default.

Network Morphology tackles head on the so-called difficult morphology, where form and function don't align, and gathers the predictable, the less predictable, and the completely unexpected in one space, a network, where information is organized and communicated in a redundant-free fashion so that the general system emerges from layers of subsystems. The guiding principle is default inheritance, and the validation of the model is through a computable lexical knowledge representation language. In this way, Network Morphology has been used to capture syncretism, inflectional classes, deponency, defectiveness, and other kinds of 'difficult' morphology. It has also captured any generalizations in morphological word formation by viewing word formation as different degrees of lexical relatedness.

Bibliography

Further Reading

A bibliography of works that employ Network Morphology to account for morphosyntactic phenomena can be found online at http://www.smg.surrey.ac.uk/approaches/network-morphology/bibliography/.

A key seminal work is:

Corbett, G. G., & Fraser, N. M. (1993). Network morphology: A DATR account of Russian nominal inflection. *Journal of Linguistics*, *29*(1), 113–142.

Find this resource:

Works that have inspired a Network Morphology covering defaults, inflectional classes, the paradigm, deponency, syncretism, defectiveness, stems and morphomes, and lexical relatedness include:

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Notes:

1. Starosta gives *dobrych* as an alternative animate accusative plural, although Stone (1993, p. 630) states that animacy is not relevant in the plural except in highly restricted contexts.

2. Translation from Nixon (1924).