**Network Morphology[[1]](#endnote-1)**

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*Abstract*

Network Morphology belongs to the family of inferential-realizational theoretical frameworks. This means that paradigms, more specifically the functions which construct them, play an important role. A major feature of Network Morphology is that it is based on defaults and allows for varying degrees of inheritance – from complete to partial – of paradigmatic structures. Network Morphology embraces computational implementation and has been applied to a range of typologically diverse languages. Computational fragments exist for languages belonging to a number of families, including Afro-Asiatic, Austronesian, Chukotko-Kamchatkan, Eskimo-Aleut, Gunwinyguan, Indo-European, Nakh-Daghestanian, Nilotic, and Nuclear Torricelli. It has also been used to model diachronic change.

Keywords: defaults, default inheritance, regularity, override.

**1. Introduction**

Network Morphology belongs to the set of frameworks that are characterized as inferential-realizational in the well-known typology set out by Stump in (2001). It therefore has much in common with Stump’s Paradigm Function Morphology. Network Morphology is **inferential** (as opposed to lexical) because it treats morphology as a matter of the application of rules to lexemes, rather than assuming that there are pieces of words (i.e. morphemes) that have their own lexical entries and attach to lexical roots (Brown and Hippisley 2012: 12). Network Morphology is **realizational** (as opposed to incremental), because morphology is licensed by the requirements of the appropriate morphosyntactic features, rather than features being incrementally acquired through the addition of exponents. In virtue of having these properties it allows for the separation of morphological form from the morphosyntactic features that are being expressed, and the lexeme is central to all of this because it belongs to, or inherits from, a specific set of rules that determine the forms required for its paradigm.

To characterize Network Morphology as inferential-realizational is insufficient, of course, to describe the framework in its entirety. It is also **inheritance-based**. Ever since its original inception in work reported by Corbett and Fraser (1993) Network Morphology has treated the lexicon as an inheritance network where generalizations about sets of words are located at nodes in the network. Higher-level nodes make generalizations that can potentially apply across the lexicon, while lower-level nodes may represent smaller classes, with information being inherited by the terminal nodes in the hierarchy that are the lexical entries. These lexical entries are not the word forms required for a particular cell in a lexeme’s paradigm. Instead they are lexemes (generalizations over paradigms). In virtue of the inheritance mechanism, it is possible to infer the full paradigm for any given entry. This means that Network Morphology can minimize the size of the lexical entry, in contrast with ‘full entry’ theories, such as the Construction Morphology approach (Booij 2010: 27; Masini & Audring, this volume; Jackendoff & Audring, this volume). Furthermore, because Network Morphology is inferential (i.e. morphology arises from the application of rules), what is inherited are sets of rules defining the lexeme’s paradigm. Each node in the network can be a source of several rules defining part of a lexeme’s paradigm. Not only is Network Morphology inheritance-based, it uses a particular type of inheritance, namely **default inheritance**. Furthermore, as we will see in §2 at its core Network Morphology uses the mechanism of **default inference** to achieve this. This is based on a kind of Pāṇinian determinism (Stump 2001: 22-25) that is quite strict, because it imposes an ordering on morphosyntactic features, and it also means that the way inheritance works in Network Morphology is naturally associated with a key idea in morphology. It allows information from inheritance sources to be overridden. It makes sense to use default inheritance to model the morphology of languages, because morphology can be subject to many exceptions and irregularities. Allowing for overrides lets us observe what the core parts of the morphological system are. If we also distinguish between two different notions of default, the **normal case default** and the **exceptional case default**, we can also see that much irregularity is often not about resorting to something that is totally outside the general rule system, but instead involves reverting back to a more general rule. We discuss this in §3.1. Being able to allow for overrides has a number of other advantages in terms of modelling morphology. For instance, as we see in the case study dealing with the morphological complexity of Nuer in §3.2 it is possible to quantify how well the lexicon performs in accounting for generalizations, by counting the number of overrides required in the lexical entries. In §3.3 we discuss briefly the application of Network Morphology to the study of diachrony.

We first turn in §2 to the representation of morphological information in Network Morphology.

**2. The Network Morphology Framework**

In this section we make a distinction between the full morphological model*,* which is a structured representation of the facts to be explained,and the analysis that leads to that model. We define the full morphological model in general terms in (1).

(1)

*Full morphological model*

Complete set of forms of lexemes and associated features relevant for syntax.

(based on Brown and Hippisley 2012: 45)

To illustrate some of the key ideas we look at the Chukotko-Kamchatkan language Koryak. This will show the role of defaults in capturing similarities between declensions and allowing for differences. We will also consider the relationship between the features of number and case, for which Koryak poses a particular challenge. Table 1 represents what the full morphological model would say about the two major types of noun in Koryak. These are represented in DATR notation (Evans and Gazdar 1996). DATR is the knowledge representation language used to represent Network Morphology theories, because it can be used to implement default inheritance hierarchies.

Table 1: Koryak noun declensions, based on Žukova (1972)[[2]](#endnote-2)

|  |  |
| --- | --- |
| Declension I ‘father’ | Declension II ‘papa’ |
| En'pič:  <gloss> = father.  <mor sg abs> = e n'p i \_č.  <mor sg loc> = e n'p i \_č i \_k.  <mor sg erg> = e n'p i \_č i \_te.  <mor sg abl> = a n'p e \_č e \_ŋqo.  <mor sg trans> = a n'p e \_č e \_jpəŋ.  <mor sg dat> = a n'p e \_č e \_ŋ.  <mor sg adit> = a n'p e \_č e \_jtəŋ.  <mor sg des> = e n'p i \_č i \_n u.  <mor sg narr-caus> = e n'p i \_č i \_kj i \_t.  <mor sg cont> = e n'p i \_č i \_j i \_t e.  <mor pl abs> = e n'p i \_č i \_w.  <mor pl loc> = e n'p i \_č i \_k.  <mor pl erg> = e n'p i \_č i \_te.  <mor pl abl> = a n'p e \_č e \_ŋqo.  <mor pl trans> = a n'p e \_č e \_jpəŋ.  <mor pl dat> = a n'p e \_č e \_ŋ.  <mor pl adit> = a n'p e \_č e \_jtəŋ.  <mor pl des> = e n'p i \_č i \_n u.  <mor pl narr-caus> = e n'p i \_č i \_kj i \_t.  <mor pl cont> = e n'p i \_č i \_j i \_t e.  <mor du abs> = e n'p i \_č i \_t.  <mor du loc> = e n'p i \_č i \_k.  <mor du erg> = e n'p i \_č i \_te.  <mor du abl> = a n'p e \_č e \_ŋqo.  <mor du trans> = a n'p e \_č e \_jpəŋ.  <mor du dat> = a n'p e \_č e \_ŋ.  <mor du adit> = a n'p e \_č e \_jtəŋ.  <mor du des> = e n'p i \_č i \_n u.  <mor du narr-caus> = e n'p i \_č i \_kj i \_t.  <mor du cont> = e n'p i \_č i \_j i \_t e. | Appa:  <gloss> = papa.  <mor sg abs> = appa.  <mor sg loc> = appa \_na \_k.  <mor sg erg> = appa \_na \_k.  <mor sg abl> = appa \_na \_ŋqo.  <mor sg trans> = appa \_na \_jpəŋ.  <mor sg dat> = appa \_na \_ŋ.  <mor sg adit> = appa \_na \_jtəŋ.  <mor sg des> = appa \_na \_n o.  <mor sg narr-caus> = appa \_na \_kj e \_t.  <mor sg cont> = appa \_j e \_t a.  <mor pl abs> = appa \_w.  <mor pl loc> = appa \_jə \_k.  <mor pl erg> = appa \_jə \_k.  <mor pl abl> = appa \_jə \_ka \_ŋqo.  <mor pl trans> = appa \_jə \_ka \_jpəŋ.  <mor pl dat> = appa \_jə \_kə \_ŋ.  <mor pl adit> = appa \_jə \_ka \_jtəŋ.  <mor pl des> = appa \_jə \_čge \_n o.  <mor pl narr-caus> = appa \_jə \_kj e \_t.  <mor pl cont> = appa \_jə \_ka \_j e \_t a.  <mor du abs> = appa \_nte.  <mor du loc> = appa \_jə \_k.  <mor du erg> = appa \_jə \_k.  <mor du abl> = appa \_jə \_ka \_ŋqo.  <mor du trans> = appa \_jə \_ka \_jpəŋ.  <mor du dat> = appa \_jə \_kə \_ŋ.  <mor du adit> = appa \_jə \_ka \_jtəŋ.  <mor du des> = appa \_jə \_čge \_n o.  <mor du narr-caus> = appa \_jə \_kj e \_t.  <mor du cont> = appa \_jə \_ka \_j e \_t a. |

We can make the following generalizations about the two declensions:

* In both Declension I and Declension II the absolutive case distinguishes three different numbers (singular, dual and plural)
* Declension I has its own ergative case marker, while in Declension II ergative is syncretic with locative throughout
* In Declension I number is not distinguished at all outside of the absolutive
* In Declension II, outside of the absolutive, different forms of the stem distinguish singular (*appana-*) and plural (*appajə-*, *appajəka-*, *appajəkə-* or *appajəčge-*)
* In Declension II, outside of the absolutive, the dual has the same forms as the plural

Our task is to account for the different behaviours in these two types of noun and explain how we arrive at the complete set of forms for these nouns in such a way that we can generalize what they share and capture what is specific to each type. This is the role of morphological analysis.

(2)

*Morphological analysis*

A sufficiently minimal and optimal description of a language’s morphological system such that, by applying the appropriate rules of inference, a full morphological model can be obtained.

(Brown and Hippisley 2012: 45)

From the morphological analysis we can infer a complete morphological model. We can speak of each of the lines in Table 1 as *equations* or *facts*, or *rules* (see Brown and Hippisley 2012: 49). For instance, the equation (3) tells us that the singular ergative form of the lexeme *appa* is *appanak*.

(3) <mor sg erg> = appa \_na \_k.

Equations in the morphological model are represented using a single equals sign (=), as in (3), while those in the morphological analysis are represented using a double equals sign (==), which we will see shortly in (15).[[3]](#endnote-3) Each equation consists of a left-hand side (LHS) and a right-hand side (RHS). From a morphological analysis we can obtain a morphological model in which the sets of forms of lexemes are described using equations where the morphosyntax is provided in the LHS (e.g. <mor sg erg>) and the associated form in the RHS (e.g. appa \_na \_k), as is the case for the two lexemes in Table 1. In a morphological analysis the RHS either specifies a form directly or provides a path representing an inheritance source for a form. Every LHS consists of a *path*, represented by angle brackets. A path contains *attributes*. Attributes can be used to represent morphosyntactic features, such as sg or erg, as well as other types of information, illustrated in Table 1 by mor, which represents the linguistic component (morphology), or by gloss, which provides a translation for the Koryak lexeme.

Paths in Network Morphology representations require the attributes to be ordered. This ordering is important, and where attributes represent certain morphosyntactic features Network Morphology imposes an interpretation of the ordering as a kind of implicit typing. An alternative representation of the information in (3) would type the features as in (4).

(4) {module:mor num:sg case:erg} = appa \_na \_k.

In (4) module:mor contrasts the information with that for, say, syntax, which would be syn. Here the other types are number (num) and case (case). The use of ordering defines a particular shape to the paradigm, so that number is treated as the first level of differentiation, for instance. That is, instead of using the explicit typing in (4), Network Morphology uses the ordering within the paths to express constraints on the behaviour of morphosyntactic features with regard to phenomena such as syncretism and splits in the paradigm, as discussed in Brown and Hippisley (2012: 64-68). (See Corbett (2015) for a complete typology of paradigm splits.)

The ordering of attributes in a path is important when we come to consider the relationship between the full morphological model and the morphological analysis. We can think of the morphological model as a full-entry lexicon. In contrast, the morphological analysis is an inheritance network that is a compact representation from which the full-entry lexicon can be generated by applying rules of inference. (The rules of inference are those provided by the DATR language.) One way in which the morphological analysis can be compact is through underspecification of attributes in paths. This means that paths in the morphological analysis vary in the number of attributes. (Throughout this chapter we take ‘underspecification’ to mean the partial representation in the morphological analysis of the featural information required in the full morphological model.) While the path in (3) contains the attributes mor, sg and erg, some of the rules in the morphological analysis from which the singular ergative form can be inferred contain less attributes than this. For instance, as we shall see for (15) later there is an equation that is involved in the inference of the singular ergative that refers just to the singular without being specific about case.

In order to understand the role of attribute ordering we require the concept of *path* *extension*. In (5a) we see the empty path. This is the path that contains zero attributes. All paths are extensions of the empty path. The path in (5c) is an extension of the path in (5b). The path in (5d) is an extension of (5c) and also of (5b).

(5)

a. <>

b. <mor>

c. <mor sg>

d. <mor sg erg>

An important feature of morphological analyses in Network Morphology is the application of **default inference**. This is a fairly constrained form of Pāṇinian determinism (Stump 2001: 23) in that, in the absence of the exact path we require, we default to the most specific matching path. For example, if the syntax required the singular ergative form, in the morphological analysis we would look for an equation that has the LHS in (5d). In the absence of a rule with (5d) as an LHS, we will resort to (5c) (i.e. <mor sg>) as the most specific matching path for <mor sg erg>.

As we have noted, Network Morphology assumes a particular ordering of the attributes that represent morphosyntactic features. Here we only discuss the ordering of case and number.[[4]](#endnote-4) Note that the case feature erg in (5d) extends the path containing the number feature in (5c). Brown and Hippisley (2012: 61) argue for this ordering of case and number, articulated in (6), as a constraint on the attributes that applies to the full morphological model, such as the full paradigm in Table 1. It naturally follows that the morphological analysis must also obey these constraints, and this therefore determines how default inference can be applied.

(6)

*Number and case*

In paths containing case and number attributes, case attributes will extend number attributes. (e.g. <mor sg nom>).

(Brown and Hippisley 2012: 61)

This ordering of attributes is taken as reflecting cross-linguistically general patterns for morphosyntactic feature structure. It can account for the simplest types of syncretism. Syncretism is the situation where different feature combinations share the same form (Baerman, Brown and Corbett 2005: 2). Syncretism also has different causes. One of the simpler kinds, based on neutralization, reflects loss of distinctions that are syntactically relevant. In Russian, for instance, in the plural gender distinctions are neutralized on all agreement targets, as is often true of other languages with gender. By treating gender as an extension of number (i.e. ordering gender after number in paths) this falls out naturally, as the gender information need not be specified in the rules describing the plural form of agreement targets, such as adjectives.

Over-differentiation is another phenomenon that can be accounted for by orderings, such as that in (6). This is where an extra distinction is made in one part of the paradigm for a small number of items. For instance, Russian has over-differentiation in the singular (i.e. extra case values appearing in the singular), in that there are two additional cases for a small number of items, the second locative and the second genitive (Brown and Hippisley 2012: 57-59).[[5]](#endnote-5) The Russian second locative is an extra case which is relevant for syntax, because the prepositions *v* ‘in’ and *na* ‘on’ have to be assign it. This type of extension or ordering reflects feature structure distinctions that are relevant for syntax.

The feature ordering, however, accounts only for the simple instances where behaviour in the morphology correlates to some extent with what we expect from the syntax. In the Russian over-differentiation examples, we know that, while the extra cases are relevant for assignment by prepositions, there are no extra distinctions in the plural. The ordering in (6) brings with it the expectation that while we might expect extra cases for a particular number, the opposite (extra numbers in a particular case) is not so likely. However, because morphology can have a life of its own, it is possible to observe both patterns that fit with the ordering and those which do not. Koryak presents a challenge for the ordering in (6), because the absolutive case distinguishes dual number, while the other cases do not.

There is some evidence for the cross-linguistic tendency associated with the attribute orderings when one considers languages with syncretism. Baerman, Brown and Corbett (2005) looked at the cross-linguistic prevalence for syncretism among different features. They used the data from the Surrey Syncretisms Database to do this. The database aimed to be an exhaustive description of syncretism in 30 genealogically diverse languages. Syncretisms are represented as pairs of morphosyntactic descriptions. Consider the boxed syncretism in (7).

(7) Locative/dative syncretism in a-stem nouns Slovene (Baerman, Brown and Corbett 2005: 116)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | ‘grove’ | |
|  | nom sg | dobrava | |
| acc sg | dobravo |
| gen sg | dobrave |
| loc sg | dobravi |
| dat sg | dobravi |
| ins sg | dobravo |

We can represent the syncretism in (7) as a pair of morphosyntactic descriptions, as in (8).

(8) Feature interaction (number and case)

|  |  |
| --- | --- |
| Number | Case |
| sg | dat |
| sg | loc |

Baerman, Brown and Corbett (2005) investigated syncretism in the Surrey Syncretisms Database by transforming the pairs that represent syncretisms into characterisations in terms of the notions ‘Context’ and ‘Syncretic’. Where the feature values were the same they were characterised as ‘Context’. Where the feature values differed they were characterised as ‘Syncretic’. (The latter is, of course, the reason why the syncretism was included in the database.) The corresponding transformation of (8) yields (9).

(9) Feature interaction (number and case)

|  |  |
| --- | --- |
| Number | Case |
| Context | Syncretic |

While it is possible for number to be syncretic in the context of case, Baerman, Brown and Corbett (2005) noted that the tendency represented by (9) is the more frequent. Baerman, Brown and Corbett (2005) also make the following generalization (10).

(10)

“For a word class domain *D* in language *L*

If values from the feature case serve as *context* for a syncretism in *D*, then values from the feature case must be *syncretic* elsewhere in *D.”*

Baerman, Brown and Corbett (2005: 119)

This means that (11) is also possible, but only if (9) is also found.

(11) Feature interaction (number and case)

|  |  |
| --- | --- |
| Number | Case |
| Syncretic | Context |

This is a generalization that holds of the features case and number as a whole, rather than individual values of those features. Of course, syncretisms with the structure of (11) show that feature ordering is insufficient to describe all syncretisms, and our Koryak example in Table 1 cannot readily be described in terms of attribute ordering in (6) alone. But the Koryak paradigm in Table 1 does obey the generalization (10), because there is also ergative and locative syncretism (*appanak*). We repeat the equations from Table 1 that show this:

(12)

<mor sg loc> = appa \_na \_k.

<mor sg erg> = appa \_na \_k.

The syncretism of ergative and locative in Declension II also occurs across numbers; The dual locative also has the same form as the dual ergative (*appajək*):

(13)

<mor du loc> = appa \_jə \_k.

<mor du erg> = appa \_jə \_k.

The plural locative has the same form as the plural ergative (*appajək*):

(14)

<mor pl loc> = appa \_jə \_k.

<mor pl erg> = appa \_jə \_k.

The pair in (12) can be reduced to a characterisation of the form represented in (9). (13) and (14) as individual pairs of syncretisms will also reduce to the form represented in (9), but the dual-plural syncretism between the forms in (13) and (14) also means that syncretism pairs of the form (11) exist. [[6]](#endnote-6) Koryak exhibits syncretisms of the form (11) and (9). This still accords with (10), because Koryak does not exhibit syncretisms only of the form (11).

How are these different types of syncretism accounted for in Network Morphology? In §2.1 we will show that the syncretism of ergative and locative results from under-specification of case in line with (6), while the number syncretism is the result of **generalized referral** (Brown and Hippisley 2012: 170-175).

Morphological analyses in Network Morphology are grounded in default inheritance networks. There are two types of representation of any Network Morphology theory: an informal pictorial representation and the implementation in the DATR language that can be tested to determine whether it generates the correct forms. A simple default inheritance hierarchy for Koryak nouns is represented pictorially in Figure 1.

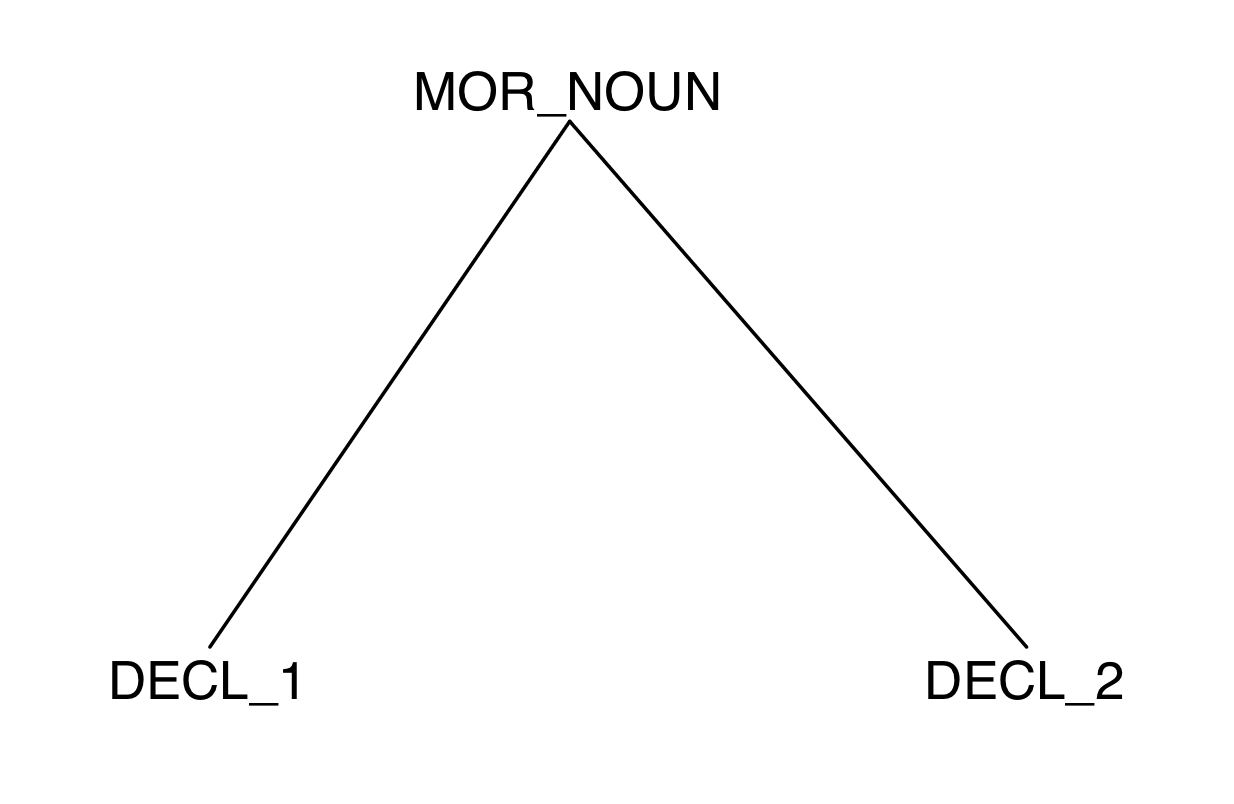


Figure 1: a default inheritance hierarchy for Koryak nouns

Figure 1 consists of three nodes: MOR\_NOUN, DECL\_1 and DECL\_2. The nodes can be understood as locations for rules about different morphological classes. So MOR\_NOUN is a source of generalizations about the morphology of nouns, while DECL\_1 is a source of information about first declension nouns and DECL\_2 is a source of information about second declension nouns. The lines in Figure 1 represent inheritance, which can be thought of as flowing downwards. Rules about the morphology of Koryak nouns may be inherited from MOR\_NOUN by DECL\_1 and DECL\_2.

The DATR representation of the hierarchy in Figure 1, including some of the rules housed at each of three nodes, is given in (15). (Where rules have been omitted, this is marked by ellipses.)

(15)

MOR\_NOUN:

<mor> ==

<mor sg> == "<stem 3>" "<mor suffix>"

<mor pl> == "<stem 4>" "<mor suffix>"

<mor du> == "<mor pl>"

<mor sg abs> == "<stem 1>"

<mor pl abs> == "<stem 2>" \_w

<mor suffix> == \_k

…

DECL\_1:

<> == MOR\_NOUN

<mor du abs> == "<stem 2>" \_t

<mor suffix erg> == \_te.

DECL\_2:

<> == MOR\_NOUN

<mor du abs> == "<stem 2>" \_nte

…

In a morphological analysis equations may have paths in their RHS, or forms, or a combination of these. Equations may also specify nodes as inheritance sources. In (15) at both DECL\_1 and DECL\_2 there is the equation <> == MOR\_NOUN, with a node (MOR\_NOUN) in its RHS. This equation corresponds to the inheritance lines in Figure 1. Recall from our discussion of (5) that default inference determines the application of the equations. For instance, consider the inference of the singular absolutive form (<mor sg abs>) of a noun that inherited from DECL\_1. At DECL\_1, for which all equations are given in (15), the singular absolutive form is not specified. We therefore need to use the most specific path at DECL\_1 of which <mor sg abs> is an extension. The most specific matching path of which <mor sg abs> is an extension is <>. This means that the equation <> == MOR\_NOUN applies, and we look for the value for <mor sg abs> at the node MOR\_NOUN. At MOR\_NOUN there is an equation that matches with this query exactly. So the specification of singular absolutive is inherited from MOR\_NOUN by DECL\_1. In contrast, the dual absolutive is specified directly at DECL\_1 and not inherited from MOR\_NOUN. Furthermore, if we wished to know about the dual form for, say, the ergative, this would also require inheritance from MOR\_NOUN because, <> is the most specific match at DECL\_1 for a query about the dual ergative. At the node MOR\_NOUN the most specific match for this query is underspecified for case and says that extensions of the dual are referred to extensions of the plural.

The hierarchy in Figure 1 is a default inheritance hierarchy, because rules at MOR\_NOUN may be overridden by DECL\_1 and DECL\_2. As we have noted, the default inheritance relations between nodes are based on the default inference mechanism. Any generalization made at MOR\_NOUN will be inherited by DECL\_1 and DECL\_2, unless there is a specific equation given at DECL\_1 or DECL\_2 that matches with the query and therefore overrides what is given at MOR\_NOUN. Most of the case suffixes are given at MOR\_NOUN, and these will in turn be inherited by nouns of the two declension classes. For Koryak we also need to stipulate information about the stems involved.

In (15) all of the paths that occur in the RHS are enclosed in quotes. This is **global inheritance**. In (15) there is an equation at MOR\_NOUN that says that the singular absolutive is by default stem 1 (<mor sg abs> == "<stem 1>"). Because it is specified for global inheritance, this means that the value for "<stem 1>" will be determined by the lexeme which is being queried. If used without quotes, RHS paths refer to their own node for the value referred to. This is known as **local inheritance**. For instance, if <stem 1> appears without quotes, this means that the value associated with it should be found locally at MOR\_NOUN. But this would mean that <stem 1> would be limited to one form, as opposed to referring to all possible stems. Global inheritance is therefore a way of making systematic generalizations about forms, such as stems, that are very dependent on what is specified for, or inherited by, individual lexemes.

The default inheritance analysis in (15) can account for our earlier generalizations about the noun system of Koryak.

*In Declension I and Declension II the absolutive case distinguishes three different numbers*

The analysis says that the singular absolutive of all nouns is *stem 1*. The plural absolutive is *stem 2* plus the ending *–w*. These generalizations are inherited by both declension classes. Both Declension I and Declension II override the default statement that the dual is the same as the plural, by specifying their own dual absolutive forms. This override takes place because the path <mor du abs> is more specific than the path <mor du>.

*Declension I has its own ergative case marker, while in Declension II ergative is syncretic with locative throughout*

At the node MOR\_NOUN there is an equation that says that the singular consists of stem 3 plus a suffix. This is repeated as (16).

(16)

<mor sg> == "<stem 3>" "<mor suffix>"

This means that the singular will be realized by a particular stem, stem 3, and a suffix. The rules for forming the different stems are specified in a separate component of the fragment for Koryak, not given here. The stem 3 form for *enpič* ‘father’ is *enpiči-*.[[7]](#endnote-7) The morphological model in Table 1 specifies a form for <mor sg erg>.[[8]](#endnote-8) In order to obtain this form the morphological analysis represented by the hierarchy in (15) is queried for this path. There is, however, no LHS path <mor sg erg> in the morphological analysis in (15). Instead the form is provided by default inference. As exemplified in (5), the path <mor sg erg> is an extension of <mor sg>. So, by default inference, the rule in (16), specified at the node MOR\_NOUN, will provide the realization for <mor sg erg>.

The next part of the equation in (16) specifies the suffix <mor suffix>. Again, this is global inheritance (i.e. quoted), because the value associated with this path may not be available locally, but it is dependent on what is inherited by the lexeme. As we shall see in our discussion of generalized referral in §2.1, the rules of inference that Network Morphology makes use of require that if we are looking for an extension of an LHS path this will also extend any RHS path referred to. Because we are inferring the form of <mor sg erg> using the equation with the LHS path <mor sg>, the attribute erg extends the RHS paths in (16) and will therefore extend <mor suffix> as <mor suffix erg>. The attribute erg also extends the path <stem 3>, but as the theory never specifies extensions for <stem 1>, <stem 2>, <stem 3> or <stem 4>, this has no additional effect on the choice of stem. In contrast there is an equation with the LHS path <mor suffix erg> to be found at the node DECL\_1, repeated in (17).

(17)

<mor suffix erg> == \_te

The ergative singular form of the Declension I noun *enpič ‘*father’ is therefore *enpičite*. The non-absolutive forms of the dual and plural work in a similar way.

The syncretism of locative and ergative in Declension II is accounted for by equations at MOR\_NOUN, repeated here as (18).

(18)

<mor sg> == "<stem 3>" "<mor suffix>"

<mor pl> == "<stem 4>" "<mor suffix>"

<mor du> == "<mor pl>"

<mor suffix> == \_k

The singular and plural differ in terms of their stems, but as there is no ergative suffix specified at either DECL\_2 or MOR\_NOUN, Declension II nouns use the default suffix *–k*, which lacks a specification for case. (To pre-empt the terminology we use in §3.1 *­–k* is the ‘normal case default’ for ergative in Declension II, while *–te* is the ‘normal case default’ for ergative in Declension I.) As there is no locative case suffix specified anywhere, the suffix *–k* will also be used for the locative in the singular. For both declensions the suffix *–k* will also be used to express locative case in the plural. (That is, *–k* is also the ‘normal case default’ for locative.) It will also be used to express the locative case in the dual, because this refers to the plural.

*In Declension I number is not distinguished at all outside of the absolutive*

The lack of number marking outside the absolutive in declension I results from the identity of stem 3 and stem 4 (while Declension II distinguishes these), and the fact that the dual refers to the plural. (Stem 1 and stem 2 are reserved for use with the absolutive forms.)

*In Declension II, outside of the absolutive, different forms of the stem distinguish singular and plural*

Declension II nouns have different stem 3 and stem 4 forms.

*In Declension II, outside of the absolutive, the dual has the same forms as the plural*

This is accounted for by the generalized referral we discuss in §2.1 The equation at MOR\_NOUN, repeated here as (19), says that extensions of the dual are the same as extensions of the plural.

(19)

<mor du> == "<mor pl>"

This equation is overridden by the dual absolutive forms specified for both types of noun, because the case information extends the number information. Koryak is interesting in this regard, because although it does not show the typical instances of case and number syncretism suggested by (6) it does exhibit morphological patterns for which the feature structure required by (6) has a role. That is, it obeys the generalization in (10), and the feature ordering on which (19) relies, as we discuss in the next section, involves the simultaneous use of an underspecified structure in conformity with (6), combined with a referral.

**2.1 Generalized Referral**

As noted, Koryak presents a serious challenge if we assume that syncretisms can only be accounted for in terms of the feature structure that typically reflects syntactic relevance, in this instance the ordering of case and number attributes in (6).[[9]](#endnote-9) Another way of accounting for identities of form is to use **referrals** (Zwicky 1985, Stump 1993, Stump 2001: 218-222). The idea here is that a particular form is directly associated with a certain feature combination and that another feature combination refers to that combination for its realization. For instance, in Table 2, the realization *–um* is associated with the accusative singular for the Latin noun *servus* ‘slave’ and the realization *–us* is associated with the nominative singular for the same noun. The distribution of these forms for *servus* suggests the morphosyntax with which they are primarily associated. For the noun *bellum* ‘war’ the nominative singular can be analyzed as referring to the accusative singular for its realization, while for the noun *vulgus* ‘crowd’ the accusative singular can be analyzed as referring to the nominative singular for its realization. So we see here that ­*–um* and *‑us* are taken as primarily exponents of accusative singular and nominative singular respectively. There is a clear directionality to the syncretism. This is an example of ‘divergent bidirectional syncretism’ (Baerman, Brown and Corbett 2005: 139-144), where the syncretism goes in both directions. It is a straightforward matter to use rules of referral to account for both patterns, while symmetrical approaches (i.e. those not based on referrals) are forced to treat aspects of the pattern as accidental. (See Baerman, Brown and Corbett (2005: 133-145) for further discussion of the arguments for rules of referral.)

Table 2. Latin second declension nouns (discussed in Baerman et al. 2005: 140)

|  |  |  |  |
| --- | --- | --- | --- |
|  | *bellum* ‘war’ | *servus* ‘slave’ | *vulgus* ‘crowd’ |
|  |  |  |  |
| nom sg | bell-um | serv-us | vulg-us |
| acc sg | bell-um | serv-um | vulg-us |
| gen sg | bell-ī | serv-ī | vulg-ī |
| dat sg | bell-ō | serv-ō | vulg-ō |
| abl sg | bell-ō | serv-ō | vulg-ō |

As we saw with the Koryak example, in Network Morphology referrals are modelled as pairings of LHS paths and RHS paths, as illustrated in (20) for Latin nouns of the *bellum* type (20 a), and nouns of the *vulgus* type (20 b). (Note that we have indicated in brackets which type each rule applies to, but this is not part of the rule notation.)

(20)

1. <mor sg nom> == "<mor sg acc>" (*bellum* type)
2. <mor sg acc> == "<mor sg nom>" (*vulgus* type)

The fact that referrals in Network Morphology take the form of an LHS path paired with an RHS path also means that extensions of the LHS path will also be extensions of the RHS path. In the Latin example this property is not relevant, because beyond the case and number combinations there are no other morphosyntactic features associated with nouns in their paradigm. Network Morphology can combine referrals with the mechanism of default extension to yield **generalized referrals**. A significant advantage of these is that they can express generalizations about whole sets of paradigm cells, rather than merely state relationships between single paradigm cells.

(21)

**Generalized Referral**

1. One feature specification (the goal) may refer to another feature specification (the source) for its realization.
2. As with other realization rules, referrals may be underspecified.
3. Extensions of the goal will be realized by extensions of the source.

In order to deal with the syncretism of the dual and plural that occurs outside of the absolutive case in Koryak, the equation in (19), repeated as (22), is sufficient.

(22)

<mor du> == "<mor pl>"

The underspecified equation (22) states that by default, if we need the dual form we can use the plural form. Because of (21 c), if we require any extension of the dual, this will be the same as the corresponding extension of the plural. This means that it is possible to refer not just to a single paradigm cell, but to whole portions of the paradigm, requiring identity of exponence between those cells, determined according to the case extension of the number, and this follows from stipulation of case after number in (6). For instance, to infer the form of the dative dual it is sufficient to know the form of the dative plural. The RHS path involves global inheritance, because it will depend on the form of the plural for the given lexical item. The specification in (22) is sufficient to cover all forms of the dual for both types of Koryak noun.

A key feature of this system is that generalized referrals are a simultaneous combination of both default inference and referral, and the challenging data of Koryak shows that we need to use these mechanisms together. Consider, for instance, the syncretic locative plural and ergative plural form of *appajək* of the noun lexeme *appa*. The dual is, of course, realized by the corresponding sets of plural forms, as (22) requires. The syncretism of the locative and ergative cases of *appa* arises in a similar way to the syncretism in the singular that we discussed earlier. The corresponding dual form therefore arises from both (22) combined with the default inference (underspecification-based) approach to the case syncretism. The generalized referral mechanism finds application across a diverse range of unrelated languages, including Dalabon and Slovene (see Brown and Hippisley 2012: 167-180).[[10]](#endnote-10)

**3. Case studies**

We have seen how rules, such as generalized referrals, could be located at different points in the simple inflectional hierarchy for Koryak nouns in Figure 1. At the top node in this hierarchy we located default information, including the generalized referral of the dual to the plural: this is true for Koryak Declension I where all number distinctions are collapsed outside of the absolutive, and it is true for Koryak Declension II where the dual is the same as the plural outside of the absolutive. In this section we consider three case studies. The first illustrates a finer distinction between two types of default, the second tackles a particularly challenging instance of syncretism, and the third shows how default inheritance systems may be restructured in a diachronic account.

**3.1 The normal case default and the exceptional case default**

When a default realization is overridden in a lexical entry it is typically the case that a lexeme resorts back to a more general rule. A lexical item can specify an inheritance link that goes back to the highest default rule, rather than inheriting the value associated with its class.[[11]](#endnote-11) In fact, we need to distinguish between two different types of default, the **exceptional case default** and the **normal case** default. This distinction was first introduced by Fraser and Corbett (1997) in their treatment of the noun class and gender system of Arapesh, drawing on Fortune’s (1942) grammar and associated work by Aronoff (1992; 1994: 89-114). The distinction between exceptional case and normal case default can be explained using the following non-linguistic analogy from Evans et al. (2002: 119)

*Mary and John both work for a firm based in London. Mary is the personnel manager and works in the office in London. Occasionally, she goes to Paris on a training course. By default, then, Mary works in the office in London. John is a salesman. He normally spends Mondays in the south of England, Tuesdays in the west, and Wednesdays and Thursdays in the north. If, however, a client cancels an appointment, or he has a problem with his car, or there is a department meeting, he goes to the office in London. On Fridays he often plays golf, but if it rains he goes to the office. By default, then, John also works in the office in London. Intuitively the two cases are rather different. Mary is 'normally' at the office, John is not. And yet at a higher level of abstraction the office is the default workplace for both. It is these two types of default, both reasonable uses of the term, that have led to differences in usage in the literature, and to confusion. This is why we make the distinction: for Mary, working at the office in London is the normal case default, while for John, working in London is the exceptional case default.*

As an example, let us consider the realization of the nominative plural for Russian nouns. The normal case default for Russian nouns is to have a nominative plural form in *–i*. Of the four major declensions in Russians, this is the form associated with three of them, including the largest declension, declension I. However, for the subset of nouns belonging to declension I that have ending stress in the plural and stem stress in the singular (a less common stress pattern) the nominative plural exponent is *–a*. For this class of nouns *–a* is the normal case default. However, for some nouns with this stress pattern the nominative plural form in *–i* is used. Their exceptional case default is what is the normal case default for other nouns, namely *–i*.

|  |  |  |
| --- | --- | --- |
| Table 3. Normal case and exceptional case defaults for the nominative plural of nouns with stem/ending stress pattern | | |
|  | normal case default  nominative plural | exceptional case default  nominative plural |
| *tórmoz* ‘brakes’ | *tormoz–á* |  |
| *ókorok* ‘ham’ | *okorok–á* |  |
| *snég* ‘snow’ | *sneg-á* |  |
| *lesosád* ‘country park’ |  | *lesosad-í* |
| *dólg* ‘debt’ |  | *dolg-í* |
| *grób* ‘coffin’ |  | *grob-í* |
| *Source*: Brown & Hippisley (2012: 89) | | |

Brown & Hippisley’s analysis is based on a computational implementation for the first 1500 most frequent Russian nouns based on Zasorina’s (1977) frequency dictionary. There are 77 nouns in the lexicon of 1500 most frequent nouns that belong to the appropriate stress pattern and belong to declension I. Of these 47 follow the normal case default for the group (i.e. like *sneg* ‘snow’), while 30 use the exceptional case default (i.e. like *grob* ‘coffin’). It should be noted that it is possible for new items with the required stress pattern, especially for specialist terminology, to follow the normal case default *-á*. Hence, this is an important distinction that constitutes substantive linguistic knowledge. Total irregularity (i.e. the introduction of a completely new form) is extremely rare. In most cases, what we observe is that a lexical item is resorting back to a very general pattern, even though the rules associated with the class with which it fits most closely would predict another realization. In terms of the formal representation we can identify the exceptional case default, because it will be specified in the lexical entry. However, the specification does not involve direct stipulation of the realization. Instead it involves a link back to a rule located high in the inheritance structure.

**3.2 Morphological complexity in Nuer**

In this section we discuss Baerman’s (2012) analysis of the nominal system of Nuer based on Network Morphology’s use of default inheritance. Nuer is particularly challenging as the extent of the case syncretism means that it is hard to identify a consistent meaning for a given suffix, and the different possible combinations of affixes mean that there are a large number of inflection classes. Nuer is a Western Nilotic language of South Sudan, as well as parts of Ethiopia, and Baerman, who takes his data from Frank (1999), presents an analysis of implicational relations between elements of the paradigm, so as to identify potential principal parts. Principal parts are those combinations of cells that serve to predict other parts of the paradigm. Stump & Finkel (2013), who present a comprehensive typology of principal parts, note that a canonical principal part is highly predictive, but highly unpredictable (2013: 16-17). (For more on principal parts see Blevins & Ackermann, this volume.) The analysis that Baerman presents shows that there is an identifiable system and his implemented analysis allows him to quantify exceptions in such a way that we can determine how well it works.

The inventory of suffixes for Nuer nouns is actually not that large (Table 4).

|  |  |
| --- | --- |
| nom sg | *Ø* |
| gen sg / loc sg | *Ø, kä, ä* |
| pl | *Ø, ni* |

Table 4. Inventory of Nuer noun suffixes (Baerman 2012: 468)

The case syncretism in Table 4 is in itself not that surprising, but the number of inflectional classes which arise when we consider the different combinations of suffixes is quite remarkable. Table 5 illustrates some of the possibilities.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ‘milk’ | ‘kind of tree’ | ‘bump’ | ‘rank’ | ‘potato’ | ‘fat’ | ‘hair’ | ‘ring’ |
| nom sg | *cak* | *kɛ̈c* | *pony* | *gatɔt* | *tac* | *liɛth* | *nhim* | *nyaŋyɛt* |
| gen sg | *caak* | *kɛ̈c-kä* | *pony-kä* | *gatɔt-kä* | *tac-kä* | *liɛth-kä* | *nhim* | *nyaŋyɛt* |
| loc sg | *caak* | *kɛ̈c-kä* | *pony-kä* | *gatɔt-kä* | *tac* | *liɛth* | *nhim-kä* | *nyaŋyɛt-kä* |
| nom pl | *cak* | *kɛɛc* | *poony* | *gatuut-ni* | *tac-ni* | *lith* | *nhiäm* | *nyaŋyɛt-ni* |
| gen pl | *cak* | *kɛɛc-ni* | *poony-ni* | *gatuut-ni* | *tac-ni* | *lith-ni* | *nhiäm-ni* | *nyaŋyɛt-ni* |
| loc pl | *cak-ni* | *kɛɛc* | *poony-ni* | *gatuut-ni* | *tac-ni* | *lith-ni* | *nhiäm-ni* | *nyaŋyɛt-ni* |
|  |  |  |  |  |  |  |  |  |

Table 5. Nuer inflectional classes (Baerman 2012: 468)

Baerman uses his Network Morphology analysis of the kinds of distributions observed in Table 5 to discuss the two different approaches required to account for such variable distributions. These are ‘blocking’ and rules of referral.[[12]](#endnote-12) Blocking and related notions, of course, are important and familiar mechanisms in morphology (Anderson 1969; Kiparsky 1973; Aronoff 1976; Anderson 1986: 4; Stump 2001). We saw in our analysis of the case syncretism in Koryak in §2 that Pāṇinian determinism has an important place in Network Morphology in terms of the specificity of paths, which are also constrained by the ordering in (6). Indeed, Network Morphology exploits the rule-based nature of inferential-realizational approaches to the full by integrating the rules into an inheritance network.

Baerman argues that it is not possible to describe the Nuer patterns in terms of either blocking or rules of referral. Baerman illustrates why this is with patterns from four nouns, given in Table 6.

Table 6 Distributions illustrating the problem with blocking (underspecification) or referral-based approaches to Nuer noun morphology (Baerman 2012: 469)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | ‘stone’ | ‘umbilical cord’ | ‘peace’ | ‘sky’ |
| nom sg | *döl* | *caar* | *mal* | *puäär* |
| gen sg | *döl-kä* | *caar-ä* | *mal-ä* | *puäär-kä* |
| loc sg | *döl-kä* | *caar-ä* | *mal-kä* | *puär-ä* |
|  |  |  |  |  |

As table 6 illustrates, the exponent *–kä* can have a distribution in which it is syncretic between the genitive singular and the locative singular (see *döl* ‘stone’). The exponent *–ä* can also be syncretic between the genitive singular and the locative singular. But in other paradigms, such as those for *mal* ‘peace’ and *puäär* ‘sky’, there is no syncretism. If we tried to analyze the paradigms for ‘peace’ and ‘sky’ in terms of underspecification, however, there would be a problem. This requires us to allow a morphosyntactically more specific form to fill one of the paradigm cells. But it is not possible to identify a narrower morphosyntactic specification for either *–ä* or *–kä*. For example, in order for *–ä* to block*–kä*’s occurrence in the appropriate part of the paradigm of *mal* ‘peace’ it would need to be specified genitive singular. But this would fall foul of -*ä*’s distribution in *puäär* where it is locative singular. Likewise an analysis using rules of referral would also be problematic, because, given the inability to identify the primary meaning of any exponent, it is unclear what is being extended into what.

Given the problems which arise for underspecification and referrals in analyzing the Nuer noun paradigm, Baerman raises the possibility that the distribution is the product of accidental homophony and that, for instance, there would be distinct affixes *–ä1* , *-ä2 , -kä1* , *-kä2* in the genitive and locative singular of the respective paradigms, with syncretism arising from the occurrence of the two accidentally identical affixes in the same paradigm. However, as Baerman argues, this would fail to account for the fact that the suffixes do have a coherent maximal distribution, namely genitive and locative singular combined, as shown by the forms in table 6. The exponents *-kä* and –*ä* are maximally genitive and locative singular, for instance, and the exponent *–ni*, for which the same problems with underspecification and referral-based analyses arise, has a maximal distribution as plural. As Baerman notes, while accidental homophony is a real phenomenon in natural languages, one would be required to make the assumption that each of the realizations in table 6 was the subject of accidental homophony. But this is not a plausible assumption, as the homophony would be so consistent as to hardly be considered accidental.

Baerman notes that Nuer presents serious problems for concepts such as Paradigm Economy and No Blur (Carstairs 1983 and Carstairs-McCarthy 1994), because the number of classes drastically exceeds what would be expected given the set of suffixes (violating Paradigm Economy) and it is hard to identify a single default (contra No Blur). As it can account for large numbers of classes in terms of an inheritance network, with different levels of default, Network Morphology is able to address the challenges Nuer poses. Given the possible combinations of affixes Baerman identifies 24 possible inflectional classes based on Frank’s (1999) corpus.[[13]](#endnote-13) Nuer also has stem alternation patterns. Baerman presents data to show that the stem alternation is not typically predictable from the suffixation. Stem alternations include vowel length, diphthongization, vowel quality and phonation type. They are also reversible so that, for instance, it is possible to have long vowels in the singular opposing short vowels in the plural, or long vowels in the plural opposing short vowels in the singular. What is important is the positioning of the stem alternation within the paradigm.

Baerman (2012: 479) notes the following generalizations: i) where a stem does not alternate for number, there will be *-ni* suffixation (with two exceptions); ii) zero suffixation is possible only when there is a stem alternation; iii) there is a weaker association between stem alternations for case and suffixation with non-alternating stems preferring suffixation for genitive and locative (72%), while alternating stems prefer zero suffixation for both genitive and locative (66%). Using a defaults-based approach Baerman shows that Nuer need not be seen as that aberrant. A key observation is that the default must be sensitive to morphological context. Frank (1999) originally identified a default class of suffixation pattern (*-kä* in genitive/locative singular and *–ni* throughout the plural). Frank’s default class excludes 82% of the lexicon. However, if the lexicon is modelled so that the sensitivity to stem alternation is taken into account only 57% of the lexical items are excluded from the default class. This actually puts Nuer on a par with a language like Russian where the default inflectional class for nouns accounts for about 47% of the lexicon (Brown et al. 1996: 57, Zaliznjak 1977). Baerman’s analysis shows that the Nuer case-number suffix system is the product of a system of rules, where much of the patterning in the affixes can be predicted by what is happening in the stems. The formal Network Morphology implementation using defaults has the virtue of allowing us to quantify how successfully the analysis accounts for the Nuer system.

We turn now to a Network Morphology account of diachronic change in the Greek nominal system.

**3.3 Diachrony**

Collier (2013) examines changes in the Greek nominal system from the classical language to modern Greek. It is reasonable to assume that the inheritance network that represents the inflectional structure of the language is not passed down from one generation to the next. Instead, each generation acquires its own inheritance structure on the basis of the observable patterns of inflection (Collier 2013: 107).[[14]](#endnote-14)

Collier proposes a typology of incremental alterations to the inheritance-representation in order to capture changes over time. The typology he creates contains different mechanisms for historical change. These can be divided into changes associated with rules and those associated with nodes.

*Changes related to rules*

1. rule change
2. redundancy deletion
3. rule insertion
4. rule relegation
5. rule deletion
6. rule promotion

*Changes related to nodes*

1. node insertion
2. node division
3. node merger
4. node realignment

**Rule change** involves essentially the same inheritance structure and nodes but with a particular rule altered to effect a change in the exponent used. **Redundancy deletion** is reserved for the situation where certain morphosyntactic values are lost (e.g. the loss of a case distinction). The rules associated with these morphosyntactic values are simply deleted. As Collier (2013: 44) notes, however, redundancy deletion may not always be straightforward. If, for example, realization of the lost morphosyntactic values was the only thing that distinguished two inflectional classes, then merger of nodes may be required (see ‘node merger’). Where one of two inflectional classes that share a mother (a macro-class) innovate a new form and increase differentiation between them, this could be analyzed as **rule insertion**, involving overriding the original default inherited by both classes from the macro-class. If there is no longer any evidence to assume that the original default rule remains a default, because it is associated only with one class, then this rule is subject to **rule relegation** and is associated directly with the class that still maintains it, rather than being inherited by that class. **Rule deletion** is one way of modelling generalizing or analogical processes and is probably quite important in historical change. Originally node A (the daughter) inherits from node B (the mother) but overrides one of the rules from node B. When rule deletion occurs node A no longer overrides this rule and so, all other things being equal, the class described by node A is more like the one described by node B (Collier 2013: 48). **Rule promotion**, as its name suggests, involves the promotion of a rule from a daughter node to the mother. Collier (2013: 150) notes that, all other things being equal, we should expect rule deletion to be more prevalent than rule promotion, since rule deletion corresponds to the replacement of a minor pattern with a major one, while rule promotion is typically the opposite.

When inflectional classes split this could be analyzed as **node insertion** where a new daughter node is created that represents a new inflectional class, with the original class remaining the mother of that class. Alternatively, **node division**is another analysis where a virtual class node is created.[[15]](#endnote-15) Where inflectional classes merge this can be expressed by **node merger**. On the other hand, **node realignment** is where changes mean that a node may switch the class from which it inherits. This could be because phonological changes have led to it naturally being reanalyzed as a subtype of another class, rather than its original class.

Some of the change types outlined above play little or no role in Collier’s analysis of Greek, while others are much more prominent. To give one example, the position of the ā-stem class alters over time so that in the Attic period it is treated as inheriting from the o-stem class (Collier 2013: 119). The dative plural and nominative plural forms become more like those of the o-stem class and this is treated as a change brought about by rule deletion. That is, specific rules for the dative and nominative plural of the ā-stems (see (1) in Table 7) are deleted so that ā-stems inherit the relevant rules from the o-stems. The nominative plural rule has *–Vi* as the exponent and the dative plural rule has *–Vis* as the exponent (where V is the theme vowel for the class). This accounts for both the o-stem class and the innovated ā-stem (see (2) in Table 7).

Table 7 Change in the ā-stem class, so that (2) is more like the o-stem class (Collier 2012: 117)

|  |  |  |  |
| --- | --- | --- | --- |
|  | ā-stem class (1) | ā-stem class (2) | o-stem class |
| nom sg | *-ā* | *-ā* | *-os* |
| acc sg | *-ān* | *-ān* | *-on* |
| gen sg | *-ās* | *-ās* | *-ou* |
| dat sg | *-āi* | *-āi* | *-ōi* |
| nom pl | *-ās* | *-ai* | *-oi* |
| acc pl | *-ās* | *-ās* | *-ous* |
| gen pl | *-ōn* | *-ōn* | *-ōn* |
| dat pl | *-āsi* | *-ais* | *-ois* |
|  |  |  |  |
|  |  |  |  |

Collier (2013: 194) also notes the importance of node realignment and the alteration of hierarchical relationships to the overall analysis. As Network Morphology relies on implementation and explicit formal analysis, it is a good means for formulating clear analyses of historical change.

1. **Conclusion**

Network Morphology has default inheritance at its heart. Its use of defaults means that it is an ideal framework for dealing with different degrees of regularity, allowing us to see default or general properties that are associated with the core part of the morphological system. It embraces computational implementation to allow theoretical claims to be checked. This is an extremely important aspect of the theory, because often small changes to account for the pieces of theoretical interest may have unforeseen consequences. The ability to test out analyses by determining how often generalizations have to be overridden is a particularly useful means for validating theories empirically, as we saw with the case study for Nuer. Computational fragments exist for languages belonging to a wide range of families.

**Resources**

A bibliography of Network Morphology works is maintained at the following address:

http://www.surrey.ac.uk/englishandlanguages/research/smg/webresources/network\_morphology\_bibliography.htm

There is also a website associated with the book by Brown and Hippisley (2012), available at the following address:

http://networkmorphology.as.uky.edu/

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**Notes**

1. With thanks to the European Research Council (grant ERC-2008-AdG-230268 MORPHOLOGY). §3.1 is shared with Brown (in press). I would like to thank Greville Corbett, the editors and two anonymous reviewers for very helpful comments on earlier drafts. [↑](#endnote-ref-1)
2. We do not discuss here the differences in form that arise from vowel harmony. The designative suffix *–no/–nu* is the same suffix in both declensions, for instance. The Network Morphology analysis is available from http://networkmorphology.as.uky.edu/theory/ch2koryak.dtr. [↑](#endnote-ref-2)
3. This distinction follows from the use of DATR as the language for representing Network Morphology theories. In DATR = is used to represent extensional statements and == is used to represent definitional statements (Evans & Gazdar 1996: 170). This is an important distinction, because extensional statements are typically only implicit, as they can be inferred from definitional statements. [↑](#endnote-ref-3)
4. See Brown and Hippisley (2012: 60-64) and references there for an exposition of some of the other constraints, including discussion of problematic cases, as well as an explanation of how the ordering of number and gender relates to Greenberg’s (1963: 112) Universal 37. [↑](#endnote-ref-4)
5. More accurately, the Network Morphology treatment of case and number means that we allow for differential behaviour across the numbers. In constructions of the type *idti v soldaty* ‘become a soldier’ (lit. ‘go into the soldiers’) (Švedova 1980: §1129), where the complement of the preposition is an animate noun typically denoting a profession, the noun has a form which is the same as the nominative plural, rather than the usual accusative plural that is identical with the genitive plural. One analysis of this is that in this structure the preposition governs the nominative (plural). This would have to be a second nominative form that occurs in the plural only. However, in this case it would still be conditioned by number, as it does not occur in the singular. [↑](#endnote-ref-5)
6. Syncretism pairs such as plural locative and dual ergative can also be identified. These reduce to characterisations in which both number and case are ‘Syncretic’. See Baerman, Brown and Corbett (2005:117) for discussion. [↑](#endnote-ref-6)
7. The path <stem 3> consists of two attributes, stem and 3. Note that Table 1, which provides information of the type required in the morphological model, says nothing about stems, as this is concerned only with what is relevant for syntax. [↑](#endnote-ref-7)
8. The features and values used for the morphological analysis are those for which there is evidence in terms of form and distribution, such as in the method outlined by Comrie (1991). [↑](#endnote-ref-8)
9. For detailed discussion of the ways that syncretisms may, or may not, reflect syntactic relevance see Baerman, Brown and Corbett (2005: 27-35). [↑](#endnote-ref-9)
10. As they pick out whole sub-paradigms, generalized referrals are also good mechanism for treating deponency. Corbett (2007: 35) characterizes canonical deponency as affecting whole slabs of the paradigm. [↑](#endnote-ref-10)
11. Network Morphology is a framework that uses orthogonal multiple inheritance (Brown and Hippisley 2012:35-37). So it is possible to inherit from multiple sources. As multiple inheritance is orthogonal, the path specifications for inheritance cannot be the same. This means that contradictions do not arise. This property arises from the fact that default inference relies on different degrees of specificity for paths, as we saw in (5). [↑](#endnote-ref-11)
12. Baerman (2012) talks of a general class of rules that he terms ‘extension’. The term is used in the sense that one is extended to another part of the paradigm, through a mechanism such as rules of referral. We stick to rules of referral here so as not to confuse this notion with path extension introduced earlier. [↑](#endnote-ref-12)
13. Baerman (2012: 470) points out that there are actually 25 classes, because there is one aberrant occurrence of *–kä* in the plural. [↑](#endnote-ref-13)
14. The value of the Network Morphology approach is not to make direct claims about the nature of speakers’ cognitive structures. Rather it is to make generalizations that would appear to constitute substantive aspects of speakers’ knowledge of morphology. [↑](#endnote-ref-14)
15. A virtual class node is one that represents generalizations shared by more than one class, but which itself is never instantiated by an individual lexical item. [↑](#endnote-ref-15)