

## **Inflectional Morphology in Word Grammar**

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### Abstract

The treatment of morphology in Word Grammar has received less attention than syntax and semantics, but the general principles are equally applicable to morphology. We outline a theory of inflectional morphology which uses ideas familiar from the Word-and-Paradigm tradition - Inflection, Lexeme and Stem - in combination with the logic of default inheritance. We apply this theory to a range of different morphological data: agglutinative (Swahili) and fusional, with and without syncretism (English, Welsh). We show that it is possible to analyse each of these types in a natural way without forcing it into an unsuitable mould, and in a discussion of Cree we show how dialect variation can be accommodated. We compare the WG theory with other approaches which are currently popular, especially a-morphous morphology, distributed morphology and network morphology.

Key words: morphology, default inheritance, inflection

## 1. Introduction

Our purpose in this paper<sup>1</sup> is to extend slightly the existing formalism for the treatment of inflectional morphology in Word Grammar (Hudson, 1990) in an attempt to facilitate a unified treatment of inflection in the languages of the world. We illustrate the extension by applying it to a number of different inflectional types in several languages, but obviously make no claims at this preliminary stage that it is universally applicable. We do, however, argue that this treatment is superior to existing treatments of inflection. We begin with a few simple points concerning existing approaches.

## 2. Two approaches to morphology

There has been a great deal of work on morphology within the generative tradition. Particularly influential has been the work of Matthews (1972, 1974, 1991) which has been attended to very closely in other recent and also influential work (Anderson, 1992; Aronoff, 1976, 1994). Central to this work has been the demonstration that, at least in certain instances, morphemes participate in many-to-many relations with meanings. This finding conflicts with

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the tradition stemming from Bloomfield in which morphemes are associated with a 'constant and definite unit of meaning' (Bloomfield 1933:162). One of the most telling examples Matthews gives is a detailed analysis of the Ancient Greek form, *elélykete* 'you had unfastened' (1974:141-45) in Figure 1. A similar example is given in Anderson (1992:55) for Icelandic *hafðir* 'you (sg.) had', in Figure 2.

[Figure 1 here]

[Figure 2 here]

Aronoff was a little more tentative than Matthews when he concluded:

- (1) The hypothesis that morphemes are the 'minimal meaningful elements of language' cannot be maintained...In many cases this role of the minimal sign must be moved one level up, to the level of the word. The sign gravitates to the word.

Note that we have not abandoned the concept of the morpheme. It still remains, but not always as a sign (Aronoff 1976:14).

Aronoff's best known argument, from a consideration of English derivational morphology, is what might be called the '\*vomission' argument. He notes the existence of a set of Latinate verbs with bound stems and unstressed prefixes for which neither the prefix nor the stem has any fixed meaning (1976:12). The relevant data are shown in Table 1.

[Table 1 here]

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These data provide strong support for the view of the word as the hook to which meaning is attached, but they also provide support for a notion of the morpheme as a unit of sound form. The element *-mit* exhibits a set of phonological variants (permit, permission, permissive; remit, remission, remissory; etc.) which are not, in general, characteristic of the phonological string *mit* as found, e.g., in the word *vomit*. Thus, *\*vomission*, *\*vomissive*. Aronoff provides a similar argument via the consideration of the meanings of the forms *understand* and *withstand*: although *stand* has no single meaning in these two words and, 'in *understand* at least', no semantics related to the 'free verb *stand*', we can be sure that there is a single morpheme *stand* in all three words because of the existence of *understood*, *withstood* and *stood* (Aronoff 1976:14).

The outcome of these observations is a view of the morpheme expressed in Beard (1995) and also in Rosta (1997) in which the morpheme is a unit pointed in the direction of word structure alone. Aronoff's own view is very similar to this: he views morphology as a level at which units of form devoid of meaning, but meaningful as formal elements, interact. *Morphology by Itself*, the title of Aronoff (1994), itself displays this focus, which in modern times was first seriously discussed in Robins (1959) where following Hockett (1954) it was termed Word and Paradigm (WP).

Although it is possible, by a careful choice of language (Matthews -- Ancient Greek and Latin, Aronoff -- Latin, Hudson -- English, Anderson -- Icelandic) to present a compelling case for a treatment of morphology in which

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there is no direct link to grammatical function, such a treatment fails miserably to account for the nature of some morpheme-function relations found in agglutinative languages. A simple example from a well-known language, Swahili, will suffice to demonstrate this. The Swahili verb has a number of prefix-positions among which are located a subject prefix and an object prefix. Confining our attention to human participants, the relevant forms are displayed in Table 2.

[Table 2 here]

Here are two examples:

- (2) a      wa-na-ni-lipa  
              They are paying me.
- b      u-me-ni-shinda  
              You have defeated me.

In the table, by looking across the columns on a given row, it can be seen that each subject prefix has a constant form relative to the object prefixes. Looking down the columns, it can be seen that each object prefix has a constant form relative to the subject prefixes. To deny that these elements of words independently signal subject and object person and number is very close to denying that night follows day, yet this is the essence of the 'word as minimal sign' approach. In this approach, morphemes are related to syntactic and semantic facts only indirectly, via 'realisation rules' and features (e.g Anderson

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1992:102-179, Aronoff 1994:22-24, Matthews 1991: 168-184). This allows any degree of mismatch between them and their function, and yet in a data-set such as this there is no such mismatch. To treat Swahili in terms of the same machinery as Greek implies that the difference between them is merely a matter of degree of complexity, but we believe this would be misleading. But if Swahili and Greek illustrate two radically different grammatical types, as they seem to, we prefer to assume that they opt for radically different grammatical machinery. In short, the Word and Paradigm approach allows too much machinery, with too much power, to explain the facts of Swahili. What is needed is a much simpler model which relates morphemes directly to the grammatical characteristics of the words concerned.

To sum up, we can point to the existence of a paradox here in that there appears to be evidence both in favour of and against a WP approach to morphology. One way to view our work is to see it as providing a single framework in which to take account of the criticisms of both morpheme-based and word-based approaches to morphology.

### **3. Word Grammar (WG): an introduction**

Word Grammar belongs to the family of generative grammars but it differs from (and improves upon) many current generative theories in a variety of ways. The most relevant facts for present purposes are the following, with the key concepts highlighted.

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It is **monostratal** -- there is only one structure per sentence and there are no transformations. More controversially, it uses word-word **dependencies** rather than phrase structure -- e.g. a noun is the subject of a verb. ('Word strings' are recognised for various purposes including quotations and coordination, but they are not equivalent to phrases.) Thus the **word** is the key unit for syntax, as it is for morphology -- hence the theory's name.

Consider the following simple example:

(3) Small birds started singing.

The phrase-hood of *small birds* is shown as a dependency between *small* and *birds*, so there is no need to duplicate this information by an 'NP' node; and in general, the sentence's syntactic structure consists entirely of dependencies between individual words. Freeing dependencies from phrase structure also allows them to be much richer, which allows *birds* to depend, as subject, not only on *started* but also on *singing*; this allows a monostratal analysis to incorporate both 'deep' and 'surface' information in a single structure. (It is simply a notational convenience to draw some links below the words - see Hudson, 1994; Rosta, 1994.) We see no justification for two separate syntactic nodes for *started*, one for *start-* and the other for *-ed*. This division should be shown in the morphology, not in the syntax. The WG analysis for the syntax of this sentence is shown in Figure 3.

[Figure 3 here]



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One particularly important question for morphology is how words are classified to show syntactic and semantic similarities. WG classifies words primarily in terms of **atomic word-types** -- e.g. 'noun', 'reflexive pronoun' -- which are related in an **inheritance hierarchy** beneath 'word'. More precisely, they form two hierarchies, headed respectively by '**lexeme**' and '**inflection**', which we shall explain below; by convention lexemes are written in upper-case and inflections are preceded by a colon. Thus as shown in Figure 4 *started* is classified as [START: past], the intersection of the two higher categories 'START' and 'past', plus the word class 'verb'. Unlike most other theories, WG does not classify words in terms of intersecting 'features', and in general morpho-syntactic features are replaced by the hierarchy of inflections. (The only role left for features is in agreement, which we shall illustrate in later sections.) Thus there is no attribute 'tense' for which this word has the value 'past'.

[Figure 4 here]

The main characteristic of this analysis is the hierarchical relationships among categories which allow generalisations to spread by means of **default inheritance**, thereby capturing the contrast between 'basic' or 'underlying' patterns and 'exceptions' or 'transformations'. Particular cases 'inherit' the default pattern unless it is explicitly overridden by a contradictory rule; for example, by default English words follow the word they depend on, but

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exceptionally subjects precede it. The use of default inheritance in syntax is controversial, in contrast with morphology where many theories invoke it. We make use of it repeatedly below.

The final characteristic of WG that we should like to highlight is that it presents language as a network of knowledge which links concepts about words, their meanings, etc. -- e.g. *dog* is linked to the meaning 'dog', to the form /dog/, to the word-class 'noun', etc. The most relevant fact about this network is that there is no clear boundary in it between the 'lexicon' and the 'rules of grammar'. This view is again widely shared (see for example Bates and Goodman, 1997 for a psycholinguistic defense), though it is controversial. In morphology this means that a default pattern has the same formal properties as its exceptions, contrary to the view that 'rules' are formally and psychologically different from exceptions (e.g. Pinker and Prince, 1988). However it is important to stress that we are agnostic as to the merits of a connectionist implementation of the network; at present we assume that information is represented locally rather than in a distributed fashion, and that even if connections are in fact weighted, we can ignore this fact in discussions such as this.

WG facts can be expressed formally either as links in a network diagram or as propositions. All statements in the grammar can be stated in the form of propositions consisting of a predicate 'is', 'has' or 'precedes/follows' and two

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arguments. Thus the fact that the verb *like* has an object and the fact that this object is a noun are expressed as follows (Hudson, 1990:15):<sup>2</sup>

- (4) a. has(LIKE/v, object).  
b. object(LIKE/v, noun).

Equivalent prose statements in ordinary English are often used:

- (5) a. LIKE/v has an object.  
b. The object of LIKE/v is a noun.

We shall use ordinary English in this paper.

The standard 'full' treatment of WG is Hudson (1990, referred to hereafter as **EWG**). However, there have been many changes in the theory since the publication of that work, including some changes in the theory of morphology. Short discussions of many of these may be found in Hudson (1997), but those that are relevant will be mentioned below. Two implementations of EWG have been made (Hudson, 1989; Poch, 1992). The former is written in Prolog and the latter in DATR. Poch is particularly relevant because it includes a complete working implementation of the EWG treatment of English verbal inflection.

## 4. Morphology in WG

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<sup>2</sup> In a general way, the propositional notation is similar to the attribute-value notation of Lexical-Functional Grammar (Kaplan and Bresnan 1982:181, Kaplan 1995).

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As already mentioned, the word is taken as the basic unit in EWG, and the same is still true. The word has syntactic and semantic properties as well as a morphological structure, and is therefore available as the interface of these different patterns. The notion of morpheme is used, but only as an element of form: 'Feature values are assigned to words on the basis of their internal structure' (EWG:85). Thus there is no need to assume that morphemes have constant syntactic or semantic properties, because the mapping between the two is mediated by the word<sup>3</sup>. This will allow us to handle 'Word-and-Paradigm' type languages efficiently. On the other hand, there is also nothing in the theory to prevent us from linking morphemes directly to higher-level categories, which will turn out below to allow an efficient analysis of 'Item-and-Arrangement' languages like Swahili.

As in EWG, we still believe that morphological relationships can be handled efficiently as part of the network of relationships mentioned in section 3. Thus just as the verb *like* has an object and subject, it also has a meaning (more precisely, a sense and a referent) and a **stem**; and by default the stem is also the full form, which we call the **whole** (EWG:88). These concepts will be

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<sup>3</sup> Despite a statement early in the book that 'the analysis of a word includes a morphological analysis, in which its internal structure...may be related to a set of morpho-syntactic features' (1990: 13), features are not directly associated with elements of words.

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explained more fully in the next section. Regular facts are inherited from a much more general default, which is shown below as d.)

- (6) a The sense of LIKE/v is 'like'.
- b The stem of LIKE/v is *like*.
- c The whole of LIKE/v is *like*.
- d The whole of a word is its stem.

In contrast, the past tense of LIKE/v has a whole which consists of its stem plus *-d*, so the morphological part of the total network must provide a general proposition from which this fact may be inherited.

- (7) a The whole of [LIKE/v: past] is *like < d*.
- b The whole of a [verb: past] is its stem < *d*.

Seen in this light, the task of inflectional morphology is to define the relationship between a word's stem and its whole.

One consequence of the network view which will play an important part in our analyses is the possibility of recognising ad-hoc relationships as needed. For languages which allow complex morphological structure this means that we can give the 'slots' names such as 'prefix-1' and 'suffix' which can then be referred to in the rules that define possible structures. The advantage of naming the parts of a structure is that, just as in syntax, their various characteristics can be defined by means of different kinds of rules: some rules fix their order, others decide whether they are present or absent, and others again determine their identity (in terms of morphemes). Thus the rule for past-tense verbs given above may be factored into a number of rules:

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- (8)
- a A [verb: past] has a suffix.
  - b A word's whole is its stem < its suffix.
  - c The suffix of a [verb: past] is *d*.
  - d An inflection has no suffix.

This factorisation has the advantage of allowing generalisations across word types; for example, rule d) says that a typical (default) inflection has no suffix, in contrast with languages where virtually every inflection has an affix, and has to be overridden by rules like a). Similarly, the ordering rule b) applies to all suffixes, and not just to those of past-tense verbs<sup>4</sup>.

Another of the EWG claims that we still maintain is the need to recognise recurrent morphological patterns independently of their links to higher-level categories. For example, we believe that English nouns and verbs share a pattern which we call 's-form', consisting of the stem followed by *-s* although an 's-form' verb is clearly very different in syntax and semantics from an 's-form' noun. This notion of '**X-form**' is important for the analysis of systematic syncretism, as we shall show below. This concept is new to WG<sup>5</sup>. X-forms

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<sup>4</sup> By convention, a rule of the form 'X of Y is A < B < ...' fixes the order of elements (A, B, ..) without determining their presence or absence. In simple cases such a proposition is equivalent to a proposition containing 'precedes', but more complex cases require a formula which fixes the order of a chain of elements.

<sup>5</sup> The nearest equivalent in EWG is the notion 'word-form' (EWG:90-2) which is used to classify words, so it corresponds roughly to the 'inflection' of

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mediate between the stem and the whole. In languages like French we can allow one X-form to build on another: for example, it is possible to analyse *finirai*, '(I) shall finish' as follows. Its unique description is [FINIR: future, 1sg], for which the morphology gives the following analysis:

- (9) a the stem of [FINIR: future, 1sg] = *fini* (finish)  
b the r-form of [FINIR: future, 1sg] = *finir* (also used as the whole of the infinitive)  
c the whole of [FINIR: future, 1sg] = *finirai*

The 'r-form' relationship allows us to express the traditional generalisation that (with a handful of exceptions) the future endings are added to 'the infinitive', however much that may vary from verb to verb.

Possibly the most important change since EWG is the downgrading of morphosyntactic features. These provided the classification of inflected forms (EWG:92-3) that was needed for syntax and semantics (in contrast with the strictly morphological classification in terms of X-forms); for example, the s-form of a verb had the feature description [agreement: singular-subject]. It turned out to be very difficult to integrate such descriptions into the rest of a WG analysis

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the present paper except that it is more closely based on form rather than function; for example, we would now say that the verb *cuts* and the noun *cats* both **contain** the s-form of their respective lexemes, whereas EWG would say they both **are** the s-form of these lexemes.

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(EWG:92, 177), so we have replaced it by the simple hierarchy of 'inflections' mentioned above.

To summarise, if the internal structure of a word consists of a stem and an affixal morpheme, this is explained by a rule which refers to the 'inflection' of which the word is an example and links this inflection to a morphological pattern. This may be defined directly in terms of stem and whole, or this link may be mediated by an X-form. There may also be a rule which links the inflection to the value of some feature, but this is generally not the case. Both possibilities are illustrated in the following (EWG:90,93):

- (10) a The whole of a [noun: plural] is its s-form.
- b The s-form of a word is its stem < /s/.
- c The number of a [noun: plural] is plural.

Note how the feature is not assigned to the morpheme, /s/, but to the inflection; but as pointed out earlier, there is no theoretical constraint on networks which would prevent a direct link between features (or meanings) and morphemes. This will allow us to have the best of both worlds in the choice between the word-and-paradigm approach (Matthews, 1991) and approaches such as distributed morphology (Halle and Marantz, 1993) where morphemes do carry features.

### **5. Multiple inheritance applied to morphology in WG**

A further change since EWG is the use of multiple inheritance. Following Hudson (1997), we allow inflected words to inherit from two higher categories,



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or 'models': one for the lexeme and the other for the inflection. To the extent that these models are disjoint, this is an instance of orthogonal multiple inheritance (Touretzky, 1986; Evans and Gazdar, 1996; Evans, Gazdar & Keller, 1997), and no conflicts will arise. The lexeme is responsible for the stem (and in some cases for the selection of characteristics which determine aspects of the inflected form) and the inflection provides the details of the whole of the inflected word. Each model has an associated relation. For the lexeme, this relation is 'stem', which we can now define as a relation between a lexeme (possibly further specified for some inflectional category), and a (phonological or orthographical) form. For the inflection, the relation is 'whole', a relation between a complete grammatical classification of a word and a (phonological or orthographical) form; for example, *dog* is the stem of [DOG: plural], while *dogs* is its whole. In the absence of inflectional material, a word's stem and its whole will be the same, so the role of inflectional morphology is to define the possible differences between the two.

In testing these extensions of the EWG model, we consider three kinds of lexeme-inflection relationships. We illustrate these with facts from three different languages, but it is important to recognise that, in general, these three relationships are characteristics of inflected words, not of languages, and it is possible for a single language to display all three types. In the first, exemplified by Swahili, there is typically an invariant stem and a sometimes direct relationship between the analytical categories of inflection and the morphemic constituents of words. This relationship led Lyons (1977:72) to postulate a

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fundamental bifurcation into languages of this type, where the lexeme is a redundant notion (except for the phenomenon of homonymy) and where morphemes rather than words are the basic grammatical units, and languages of the inflectional type, where this one-to-one correspondence is missing and there is a need for an abstract form, lexeme. Our approach avoids the need for this dichotomy.

In the second type, exemplified by Welsh, there is also an invariant stem, but it is impossible, in general, to break the elements of inflection into distinct morphemes. In other words, there is a relationship between a bundle of inflectional categories and a morpheme (i.e. affixal morphemes are portmanteau morphemes). However, it is generally the case that each bunch of inflectional categories is signalled distinctively, i.e. there is little syncretism. Finally, in the case of English, there is in addition multiple use of the elements which signal inflectional category combination, i.e. syncretism is present. In order to emphasise that these three cases are fundamentally to be associated with words, not languages, we observe that there is in fact a small amount of syncretism to be seen in Swahili in Table 2 where *wa* is associated with third personal plural subject and both second and third personal plural object. Similarly, both noun class 9 and noun class 11, discussed in the following section, are associated with the same plural (class 10).

## 6. Swahili

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In Swahili, an agglutinative language, the morphemic constituents of words are typically monofunctional. However, there are a variety of inflectional word-types. The following set of forms omits relative and negative forms, but is illustrative of both the basic elements of verbal inflection in the language and the variety of word-types (Contini-Morava, 1989). We assume the following classification of verb inflections: imperative, subjunctive, infinitive and indicative; imperative has a special sub-type 'object-imperative' which we discuss below.

- |      |    |              |                         |                  |
|------|----|--------------|-------------------------|------------------|
| (11) | a. | lip-a        | 'pay!'                  | (imperative)     |
|      | b. | m-lip-e      | 'pay him/her!'          | (obj-imperative) |
| (12) | a. | a-lip-e      | 'may s/he pay'          | (subjunctive)    |
|      | b. | a-m-lip-e    | 'may s/he pay him/her'  | (subjunctive)    |
| (13) | a. | ku-lip-a     | 'to pay'                | (infinitive)     |
|      | b. | ku-m-lip-a   | 'to pay him/her'        | (infinitive)     |
| (14) | a. | a-ta-lip-a   | 's/he will pay'         | (indicative)     |
|      | b. | a-ta-m-lip-a | 's/he will pay him/her' | (indicative)     |

Even these simple examples present some interesting challenges for a morphological analysis developed mainly on the basis of English data. The word structures are much more complicated, but also much more transparent. A second challenge is to allow the subject and object prefixes to have overlapping membership,<sup>6</sup> while still distinguishing them in terms of their functions. And

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<sup>6</sup> Referring to Table 2, it may be determined that three of the six

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thirdly, as the pairing of the examples shows, an object prefix is an optional extra in every case, but its presence in an imperative -- example (11b) -- triggers a change to the final vowel. What is needed is a grammar which reveals the basic simplicity of the patterns while still allowing such complexities to be handled accurately.

As explained in section 4, one of the benefits of Word Grammar is its propositional basis which distinguishes between different kinds of proposition -- for example, between those responsible for ordering elements and those responsible for the presence of these elements. We shall exploit this fact in the following analysis, which will consist of three types of proposition: to do with order, presence/absence and identity. However, another theoretical tenet is that relationships are defined in terms of labelled functions which may be created as needed, so the same will be true of the relationships between words and their constituent morphemes (as indeed they are in the traditional terminology of stems, roots and affixes). Thus instead of talking about the distribution of the morpheme /a/, 'he/she', we shall say which verbs have a 'prefix-1' (presence/absence), whereabouts in the verb's structure its prefix-1 occurs (order), and which morphemes can be its prefix-1 (identity). These aspects of morphological structure will be handled by means of different propositions.

We start then with the structure of words, defined in terms of the morpheme's function within the word. Apart from the stem, we shall recognise

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person/number elements are identical as subject prefixes and object prefixes.

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three prefixes (numbered 1-3) and one suffix; each of these is referred to functionally, as the verb's stem, its prefix-1, and so on. This will allow us later to relate the particular morphemes to the verb's own classification, but it means that the functional definition must be repeated for each morpheme in the ordering rule.

(15) The whole of a verb = its prefix-1 < its prefix-2 < its prefix-3 < its stem < its suffix.

Notice that this proposition says nothing about which of these parts are optional and which are obligatory.

The presence or absence of parts is handled by means of propositions about what a word 'has'. Most generally of all, every word has a stem:

(16) A word has a stem.

This applies by default to every word, including (of course) verbs. Another rule applies by default to every verb:

(17) A verb has a suffix.

Every verb has either -a or -e after its stem. The choice between these two morphemes will be fixed by a later rule. As noted earlier, object prefixes are always optional. A verb's object prefix is its prefix-3, as it always follows any subject and/or tense prefix, so a general rule is needed for every verb:

(18) A verb has an optional prefix-3.

Subject prefixes are more complicated, however, because they interact with the basic word classes. Most kinds of verb do have one, so we treat this as the default.

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(19) A verb has a prefix-1.

But imperatives and infinitives are exceptions, so the grammar must contain other propositions specific to them which will automatically override the general rule:

- (20) a. An imperative verb has no prefix-1.  
b. An infinitive verb has no prefix-1.

Similarly for the tense/mood prefix, prefix-2. Most verbs have one, but some do not:

- (21) a. A verb has a prefix-2.  
b. An imperative verb has no prefix-2.  
c. A subjunctive verb has no prefix-2.

These rules predict almost every verb's structure from its class, with the exception of imperatives (to which we return below).

The third kind of fact concerns the identities of the various morphemes. The identity of the stem is (of course) fixed by the lexeme, but those of the other morphemes are covered by more general rules. We start with the tense/mood prefix. The first fact to notice is that there is no need to postulate zero morphemes for imperatives and subjunctives, because the rules in (19) prevent such verbs from having any tense/mood prefix. Consequently we only need rules for those verbs that have overt prefixes:

- (22) a. The prefix-2 of an infinitive verb is /ku/.  
b. The prefix-2 of an indicative verb is /ta/.

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(A complete analysis will presumably subdivide 'indicative' into various tenses, so the last rule will be replaced by one that refers specifically to 'future verb'.)

The suffix is either /a/ or /e/, depending basically on the verb's mood.

Assuming that /a/ is the default, the choice of /e/ must be forced by more specific rules:

- (23) a. The suffix of a verb is /a/.
- b. The suffix of a subjunctive verb is /e/.

However, there is a complication. As we noted earlier, the presence of an object-prefix in an imperative verb affects the suffix vowel. In order to handle this detail, we have recognised such verbs as a distinct sub-class of imperatives, called 'object-imperatives', in order to allow us to distinguish between imperatives that do have an object prefix (object-imperatives) and those that do not (all others):

- (24) a. An imperative verb has no prefix-3.
- b. An object-imperative verb has a prefix-3.

The interaction between this contrast and the suffix vowel is handled by an identity rule:

- (25) The suffix of an object-imperative verb is /e/.<sup>7</sup>

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<sup>7</sup> An alternative which we do not consider in detail here would be to regard object-imperatives as subjunctives. Although this would account for the suffix /e/ rather than /a/, it would also complicate the grammar by requiring us first to prevent imperatives from having objects, and second to allow

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Most interesting of all, perhaps, is the fact that some of the prefixes look like incorporated or cliticised pronouns,<sup>8</sup> whose function as subject or object is distinguished only by their position in the verb. Our claim is that the identity of these prefixes need not be reflected in the classification of the whole verb, because of the possibility mentioned in section 4 of relating the prefixes directly to the verb's syntax and semantics. Take the verb *a-ta-m-lip-a*, 's/he will pay him/her'. The prefix /a/ indicates that the verb's subject belongs to Class 1, and

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subjunctives to have no subject prefix just in case they had an object. We believe the correct treatment of this anomaly should involve the morphology, and not the classification of the words. There may of course be a historical link between the /e/ of object imperatives and that of subjunctives, but we can only speculate about the nature of this link.

<sup>8</sup> See Bresnan and Mchombo (1987: 777-8) for evidence that these elements are prefixes and not clitics. Note also the contrast between (i) and (ii):

- (i) u-me-mw-ona nani  
you-PERF-her/him-see who  
  
'whom did you see?'
- (ii) \*u-me-mw-ona yeye nani?  
you-PERF-her/him see her/him who  
  
'\*whom did you see him?'

If *-mw-* were pronominal, i.e. an argument, then (i) would be ungrammatical -- as its analogue in Chicheŵa is (Bresnan and Mchombo 1987: 760).



## Inflectional morphology in Word Grammar

the prefix /m/ shows that its object belongs to Class 1.<sup>9</sup> This connection can be handled very simply by giving these prefixes a 'noun-class' feature, just like the subject and object NPs:<sup>10</sup>

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<sup>9</sup> Swahili is a slightly atypical Bantu language in that nouns referring to animates are associated with classes 1 and 2 regardless of their own morphology. Thus (Maw 1969: 39-40):

- (i) ki-pofu a-me-fika  
cl.7-blind person cl.1-PERF-arrive  
'the blind man has arrived'
- (ii) \*ki-pofu ki-me-fika  
cl.7-blind person cl.7-PERF-arrive

This situation is easily handled in our analysis via the mechanism of default inheritance. The network for *ki-pofu* will assign it to class 1 but include a proposition which gives it an exceptional morpheme as its prefix, instead of the expected *a-*.

<sup>10</sup> Eleven of the traditional 16-18 Bantu noun classes are found in Swahili (Contini-Morava 1997: 600, 615-616), given here as class-name, noun-prefix, verb-prefix:

1	m-	a-/m-
2	wa-	wa-
3	m-	u-
4	mi-	i-
5	Ø/ji-	li-

### Inflectional morphology in Word Grammar

- (26) a. The noun-class of the subject of a verb is the noun-class of its prefix-1.
- b. The noun-class of the object of a verb is the noun-class of its prefix-3.

In other words, instead of saying that the whole verb agrees with its subject, we are saying that its prefix-1 does; and similarly for agreement with the object. Given this analysis, all the grammar need do is give each prefix a noun-class, and describe any formal differences between subject and object prefixes. This can be done by recognising a general class of pronoun-prefixes (a sub-class of morphemes), with 'object' and 'subject' subdivisions for use where the forms differ.

- (27) a. /tu/ is a pronoun-prefix.
- b. /a/ is a subject-pronoun-prefix.
- c. /m/ is an object-pronoun-prefix.

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6	ma-	ya-
7	ki-	ki-
8	vi-	vi-
9	Ø/n-	i-
10	u-	u-
11/14	u-	u-

Some analysts define the classes in terms of singular/plural pairs (1/2, 3/4, 5/6, 7/8, 9/10, 11/10, 14/10). See Contini-Morava (1997) for discussion.

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The classification of the prefixes is done separately:

- (28) a. The class of /tu/ is /tu/.<sup>11</sup>  
b. The class of /a/ is 1.  
c. The class of /m/ is 1.

This completes the analysis of the Swahili verbs that we presented at the beginning of this section. To recapitulate, the main points of this framework are:

- A functional description of each morpheme, which allows its position and identity to be related to the class of the verb that contains it,
- Distinct propositions for matters of order, presence/absence and identity, and
- A means for directly linking a verb's subject and object prefixes with the full words which are its subject and object dependents.

In the following two sections we shall utilise the first two aspects of this framework together with the notion 'X-form'.

## 7. Welsh

In Welsh (King, 1993), the typical situation is an unchanging stem and an unpredictable whole associated with a set of inflectional categories. However, there is almost no syncretism: each bundle of categories is signalled by

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<sup>11</sup> The first- and second-person prefixes and pronouns fall outside the traditional system of noun-classes, but our analysis can easily be accommodated to include them.

## Inflectional morphology in Word Grammar

distinctive inflectional material. Consider *clyw-och* 'you(pl) heard'. Here the stem is *clyw* and the categories of past, second person and plural are signalled by the suffix *-och*. (As in earlier examples, we write inflectional categories after a colon added to the word-class or lexeme; e.g. [verb: past] or [CLYW: past].) As is the case with Swahili, the stem is invariant, giving

- (29) a. The stem of CLYW is /clyw/  
b. so: The stem of [CLYW: past] is /clyw/

The whole can be given directly:

- (30) a. The whole of [V: past] is its stem < its suffix.  
b. The suffix of [V: past,2pl] is /och/

This model is inherited in the case of the whole of [CLYW: past, 2pl].

- (31) The whole of [CLYW: past, 2pl] is its stem(CLYW: past, 2pl) < its suffix (/och/).

Therefore,

- (32) The whole of [CLYW: past, 2pl] is /clyw < och/

With the verb BOD 'to be', in non-present forms, stem suppletion is involved. Thus, although the stem of BOD is /bod/, the past tense stem is /bu/. In this case, although the affixes are regular and inheritance is straightforward for them, default inheritance is used to allow the default /bod/ to be overridden.

We analyse *bues* 'I was':

- (33) a. The stem of BOD is /bod/  
b. but: The stem of [BOD: past] is /bu/  
c. therefore: The stem of [BOD: past], 1sg is /bu/

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- d. The suffix of [verb: past, 1sg] is /es/
- e. therefore: The whole of [BOD: past, 1sg] is the stem of BOD: past, 1sg (/bu/) < its suffix (/es/)
- f. therefore: The whole of [BOD: past, 1sg] is /bu < es/

With the verb BOD 'to be' in the present, complete suppletion is involved and neither the stem nor the affix have regular properties. Neither the general stem rule nor the general whole rule are used. Thus for *mae* 's/he is':

(34) The whole of [BOD: pres, 3sg] is /mae/

The main interest of the Welsh data lies in the irregular stem allomorphy, which can be handled naturally by means of a variety of propositions that apply by default inheritance directly to the stem. The use of default inheritance removes the need for morphological processes. It could be objected that this treatment reduces all allomorphy to suppletion, but this would be to overlook the fact that the irregular stems are combined with completely regular affixes. Moreover, the theory of Word Grammar would allow us, in principle, to capture the similarities between the alternating forms - e.g. the fact that both /bod/ and /bu/ begin with /b/ - but this would require an excursion into phonology which would take us too far afield (cf. Hudson 1990:184-188).

## 8. English

The typical situation in the English verbal system is a many-to-one function from a number of diverse inflectional category combinations to a single form, i.e. massive syncretism. Inflected forms are typically analysable into a stem and an

## Inflectional morphology in Word Grammar

affix, but as with Welsh, there is no possibility of associating pieces of the affix with particular inflectional categories and typically, as in the following examples, the form of the affix is a function of the stem. Here is an analysis of *walk-ed* (non-finite, participle, passive), presented bit by bit:

- (35) a. The stem of WALK is *walk*.  
b. so: The stem of [WALK: passive] is *walk*.

The default suffix of the passive in English is /ed/, but since this form is also the default suffix of the past, we believe it is more explanatory to postulate a X-form which they share, the 'ed-form':

- (36) a. The whole of a [verb: passive] is its ed-form.  
b. The ed-form of a verb has a suffix.  
c. The suffix of the ed-form of a verb is *ed*.

Given this general rule, the passive of WALK will inherit and be specified fully:

- (37) a. The whole of [WALK: passive] is its ed-form.  
b. The suffix of the ed-form of [WALK: passive] is /ed/.  
c. (so:) The whole of [WALK: passive] is *walk-ed*.

However, the passive of TAKE is specified by the following proposition, which overrides the general one:

- (38) The suffix of the ed-form of [TAKE: passive] is *en*.<sup>12</sup>

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<sup>12</sup> The notion of base can also be used in a limited way in the analysis of the Swahili data in order to show the similarity between objective imperatives

## Inflectional morphology in Word Grammar

This exception automatically extends to all other inflections of TAKE which use its ed-form.

### 9. Cree

A different kind of challenge for a theory of morphology is to explain patterns of variation in time or space; we shall consider here a particularly interesting example which involves closely related dialects. Anderson (1992:130) discusses the inflection of non-third person participants in two dialects of Cree (Table 3). The dialects have the same forms except as shown, where 'X' indicates the verb's stem.

[Table 3 here]

The main point of the example is the dialect alternation in two cells between dialects 1 and 2, which have /-ina:n/ and /-ina:wa:w/ respectively in both cells. In each case the form found in this cell is also found in one other cell, and the challenge is to explain why these particular pairs of cells show syncretism. We can simplify the data to start with by focussing just on the

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and subjunctives in a slightly more explanatory way. By characterising a stem + /a/ as an 'a-base' and a stem + /e/ as an 'e-base', it is possible to specify the a-base as a general default but to require the e-form for subjunctives and object-imperatives.

## Inflectional morphology in Word Grammar

bottom left corner of the table, which deals with verbs which have a 2nd-person subject and a 1st-person object; the top right corner reverses this relationship by adding /-it-/ after the stem. To begin with, we can therefore ignore this suffix, as well as the other affixes that are found in all the verbs: /ki-/ and /-in-/. Table 4 gives the pattern for 2nd-person subjects and 1st-person objects, showing the effects on the last suffix of number contrasts for each person:

[Table 4 here]

In both dialects the absence of one of these suffixes shows that both persons are singular and plurality of one participant is marked in the same way: by /-in-a:n/ for the 1st person and /-in-a:wa:w/ for the 2nd person. The difference arises when both persons are plural, but in both cases this is handled by extending one of the other plural markers: the one for 1st person in dialect 1, and that for 2nd person in dialect 2. Any analysis can predict the contents of each cell by a separate stipulation, but it would be much better if the analysis were to reveal the deeper pattern. How can this be done?

Anderson handles these facts by positing the two rules,

- (39) a. +me  
+pl  
/X/ --> /Xa:n/  
b. +you



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+pl

/X/ --> /Xa:wa:w/

and introducing a principle of block organization of morphological rules with disjunctive rule application within a block. By the latter Anderson means that only the first relevant rule within a block may apply. He then claims that the a and b rules are in a block and are ordered differently for the two dialects (dialect 1 having the order a,b and dialect 2 having the order b,a). The effect of the block organization is thus that dialect 1 has rule a and dialect 2 has rule b.

What is attractive about this analysis is the idea that the two dialects have the same rules and categories, but the relationships between the rules are different. However extrinsically ordered rules are theoretically controversial because they seem not to be needed in syntax, so it is important to look for alternatives.

Word Grammar allows a very simple alternative. Suppose we assume that each of the morphological patterns defines a distinct inflection, as follows:

- (40) a. ki-X-in [verb: sing]  
b. ki-X-in-a:n [verb: 1plur]  
c. ki-X-in-a:wa:w [verb: 2plur]

These inflections are all positioned directly under the same node (which for simplicity we can call simply 'verb') in the inheritance hierarchy shown in Figure 5.

[Figure 5 here]

## Inflectional morphology in Word Grammar

For each inflection we must define not only its whole, but also the restriction on its 1st- and 2nd-person dependents. This is easy for the two longer forms:

- (41) a. The 1st-person dependent of a [verb: 1plur] is plural.  
b. The 2nd-person dependent of a [verb: 2plur] is plural.

However, it is not enough to demand plurality in these cases; we must also demand singularity in the cases where it is obligatory. In both dialects, 1st- and 2nd-person are treated differently: singularity is treated as the default value for one of them, but not for the other. The default value is attached to the super-category 'verb', whereas the non-default one is attached directly to the inflection [verb: sing]. This is where the dialects differ: the default is singularity of 1st-person in dialect 1, but of 2nd-person in dialect 2.

Let's see how this works. Take the inflection [verb: 1 plur] /ki-X-in-a:n/ in dialect 1, where the following rules apply (including those quoted above, repeated here as (a) and (b)):

- (42) a. The 1st-person dependent of a [verb: 1 plur] is plural.  
b. The 2nd-person dependent of a [verb: 2 plur] is plural.  
c. The 1st-person dependent of a verb is singular.  
d. The 2nd-person dependent of a [verb: sing] is singular.

Given that the inflection is [verb: 1plur], rule (a) applies, and by default inheritance it takes priority over rule (c), so the 1st-person dependent must be plural. However, these rules say nothing about the 2nd-person dependent in this case, since rules (b) and (d) don't apply. This being so, the 2nd-person is free to be either singular or plural, which is precisely the pattern found in dialect

## Inflectional morphology in Word Grammar

1. In contrast, of course, if the inflection had been [verb: 2plur], the rules say not only that the 2nd-person dependent is plural, but also that its 1st-person dependent must be singular, this being the default (rule c).

Dialect 2 is just the same except that the higher level singular default is 2nd person rather than 1st person and the lower level - [verb: sing] - singular specification is 2nd person rather than 1st. These differences are located in rules (c) and (d):

- (43) a. The 1st-person dependent of a [verb: 1plur] is plural.  
b. The 2nd-person dependent of a [verb: 2plur] is plural.  
c. The 1st-person dependent of a [verb: sing] is singular.  
d. The 2nd-person dependent of a verb is singular.

Here the default, attached to 'verb', is a singular 2nd-person dependent. Once again the same logic applies. The inflection [verb: 2plur], /ki-X-in-a:wa:w/, may have either a singular or a plural 1st-person dependent because the rules that apply to it say nothing about this dependent; but [verb: 1plur] must have a singular 2nd-person dependent because this is the default.

Notice that we have only used the term 'dependent' in the preceding analysis. We have made no mention of 'subject' and 'object'. Since this is so, we can very simply extend our analysis to cover the upper right hand quadrant of Table 3 by introducing a new inflection type, '1>2', meaning '1st person takes priority as subject over 2nd person'. Figure 6 shows that this inflection (which is optional) combines freely with any of the others, [verb: sing], [verb: 1plur] and [verb: 2plur].

## Inflectional morphology in Word Grammar

[Figure 6 here]

To accommodate these examples we need to add two sets of rules, one set for the morphological structure of '1>2' verbs, and another set for their syntactic characteristics. We shall use this opportunity to fill out the grammar for the forms discussed earlier. The morphological rules will introduce the morpheme /it/, but they must also put this morpheme in the right position among the other morphemes as defined by the following general formula:

(44) The whole of a verb is its prefix < its stem < its suffix-1 < its suffix-2 < its suffix-3.

In this formula, suffix-1 is /it/, suffix-2 is /in/ and suffix-3 is either /a:n/ or /a:wa:w/, as defined by the earlier rules. These identifications are easily stated:

- (45) a. A verb's suffix-1 is /it/.
- b. A verb's suffix-2 is /in/.
- c. The suffix-3 of a [verb: 1plur] is /a:n/.
- d. The suffix-3 of a [verb: 2plur] is /a:wa:w/.

All that remains is to say which verbs have which suffixes. We assume that every verb has a suffix-2, a suffix-3 and a prefix, so the only variability is the presence or absence of a suffix-1, which distinguishes '1>2' verbs from the rest. Consequently, at the node [verb: 1>2] we locate the propositions:

(46) A [verb: 1>2] has a suffix-1.

This overrides the default which is no suffix-1, but the other defaults apply without conflict:

### Inflectional morphology in Word Grammar

- (47) a. A verb has no suffix-1.  
b. A verb has a prefix.  
c. A verb has a suffix-2.  
d. A verb has a suffix-3.

It should now be possible to predict the morphological structure (and pronunciation) of any verb on the basis of its lexical stem plus a specification of its inflectional classification.

Turning now to the syntactic problem of '1>2' verbs, we assume that the bottom-left corner of Table 3 contains the default pattern, leaving the top-right corner as the exception, labelled '1>2'. It should be recalled that we have recognised so far just two types of dependent, '1st-person dependent' and '2nd-person dependent', but these dependencies must also be mapped onto the more familiar subject and object. In a WG analysis, it is permissible for dependencies to be cross-classified in this way, using the same multiple-inheritance logic as for word classes, and similar analyses have been assumed for some patterns in English. For Cree, then, the dependency system will include the options in Figure 7, and the grammar's task is to map the two dependency types onto each other. The default mapping is as follows:

(48) The 1st-person dependent of a verb is its object.

(49) The 2nd-person dependent of a verb is its subject.

The special case of '1>2' verbs is handled by the more specific rules for these verbs, which automatically override the defaults:

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(50) The 1st person dependent of a [verb: 1>2] is its subject.

(51) The 2nd person dependent of a [verb: 1>2] is its object.

[Figure 7 here]

This analysis of Anderson's Cree data is as explanatory as his, because it locates the difference between the dialects in a single pair of closely related rules (rules c and d in (42) and (43)), just as in his analysis, but it has the added attraction of not involving a formal mechanism which is unique to morphology and phonology. Instead of extrinsic ordering we have used nothing but default inheritance.

### **10. WG morphology related to other theories**

There are substantial areas of agreement between the approach to morphology given in EWG and other modern approaches. An approach to morphology which is very similar to the Word Grammar approach is that of network morphology (Corbett and Fraser, 1993; Brown et al, 1996). Network morphology takes its systematic use of inheritance networks from Word Grammar (Brown et al 1996:59), makes use of both default inheritance and multiple inheritance, and differs primarily from Word Grammar in that its treatment of morphology is not integrated into a larger theory of the overall organisation of grammar. A specific difference is that network morphology does not separate the parts contributed to the morphological makeup of words by lexemes and by inflectional

## Inflectional morphology in Word Grammar

categories. The network treats lexemes simply as nodes which are located below the nodes for declensional classes (more precisely the nodes at which facts traditionally associated with declensional classes are recognised). Figure 8 (Corbett and Fraser 1993:126) makes this clear.

[Figure 8 here]

Although this approach seems to work well for Russian, it is not clear that it is sufficiently general to handle the variety of relationship between stems and inflectional apparatus that we have seen in this paper. Moreover, its lack of anything analogous to the WG relation of 'X-form' means that choices have to be made as to what is basic and what is derived, which are avoided in WG. Thus accusative nominals inherit nominative morphology (Corbett and Fraser 1992:131). On the other hand, network morphology, by not positing relations such as whole, stem and X-form, is more parsimonious than WG.

Network morphology has been implemented in the lexical knowledge representation language DATR (Evans and Gazdar 1996), and DATR has also been used by Gazdar (1992) in a critique and alternative DATR analysis of an analysis of Swahili inflectional morphology by Stump (1991). In his own analysis, Gazdar treats the whole of Swahili object prefixes as inherited from subject prefixes except in cases where this default is overridden by object-specific wholes. In other words Gazdar's approach is exactly that followed in network morphology -- choosing as basic one context in which a form appears

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and deriving the other from it. In the case of Swahili, there is no reason to do this, and our own analysis (see (27) in section 6) is preferable.

It is difficult to evaluate the work done on morphology in other generative traditions. To the best of our knowledge no one has ever attempted an approach which handles all kinds of morphological systems. The most comprehensive approach, that of Anderson (1992), turns out to consist of a basic word-and-paradigm model supplemented by a variety of ad hoc devices. We have already discussed one of these -- the use of rules extrinsically ordered in blocks and shown how the facts that it is required for are handled naturally within the Word Grammar approach.

An approach from another generative tradition with which the WG approach shares some elements is that of distributed morphology (DM) (Halle and Marantz, 1993). DM contrasts with the morpheme-less approach to inflectional morphology of Anderson (1992) in that it retains morphemes. It provides a way of dealing with many-to-one relations between meaning and form by conceiving of morphemes as abstract bundles of syntactic and morphological features which are mapped onto morphs (elements of words). In very rough terms, it could be said that the approach we have developed is a modified word-based approach to morphology and DM is a modified morpheme-based approach to morphology. In addition to inheriting the Government-Binding/minimalist theoretical tradition in which the minimal unit in syntax has been the morpheme rather than the word, DM has inherited all of the baggage that results from this decision. Such dubious processes as Affix



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Hopping (in early years) and Verb-INFL Movement in modern times are the result. It seems to us that the WG approach to syntax, which is strictly word-based, is cleaner yet accounts for the same range of phenomena as DM. Our approach to morphology is thus designed to allow us to express what seem to be valid generalisations involving morphemes without giving up the fruits of the insight that syntax is about words not morphemes.

### **11. Conclusion**

In conclusion, we believe that Word Grammar offers a theory of morphology which should be considered as an alternative to the more familiar theories. We have shown how it can deal with a range of different morphological patterns -- agglutination, fusion, syncretism and dialect variation. Our main claim is that Word Grammar allows a unified treatment of morphology, in two senses. It allows all these different morphological patterns to be handled by means of the same theoretical apparatus; but it also allows morphology to be integrated into the rest of the grammar, since it is handled by means of the same theoretical apparatus (whose main foundation is default inheritance) as syntax, the lexicon and semantics.

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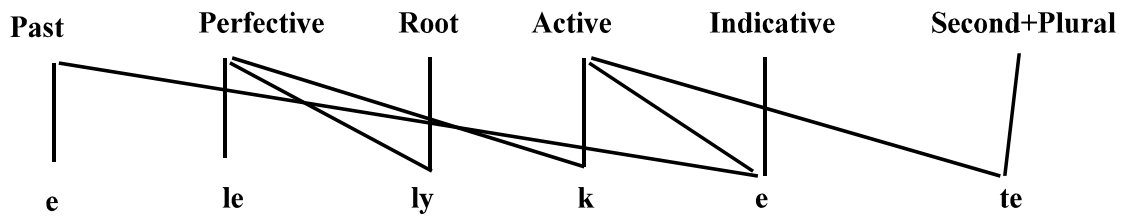


Figure 1

Inflectional morphology in Word Grammar

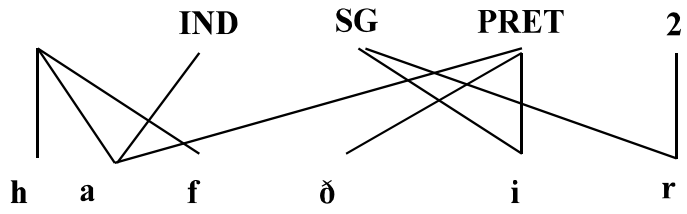
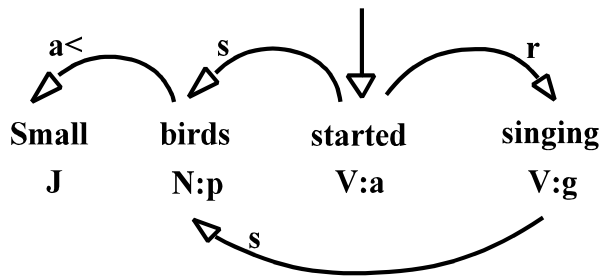


Figure 2

Inflectional morphology in Word Grammar



KEY

**J** adjective  
**N** common noun  
**V** full verb

**:p** plural  
**:a** past  
**:g** present participle

**s** subject  
**a<** pre-adjunct  
**r** `sharer' = xcomp

Figure 3





Inflectional morphology in Word Grammar

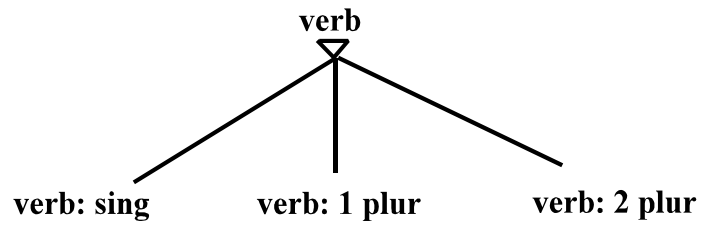


Figure 5

Inflectional morphology in Word Grammar

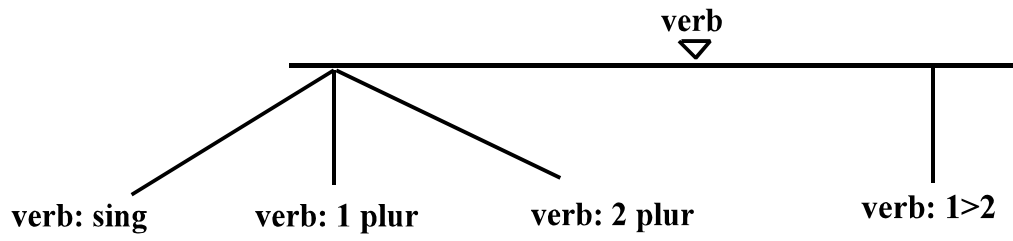


Figure 6

Inflectional morphology in Word Grammar

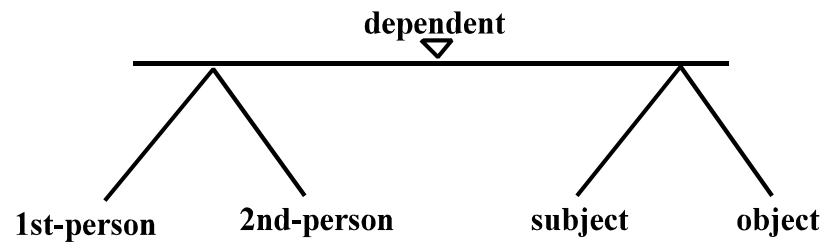
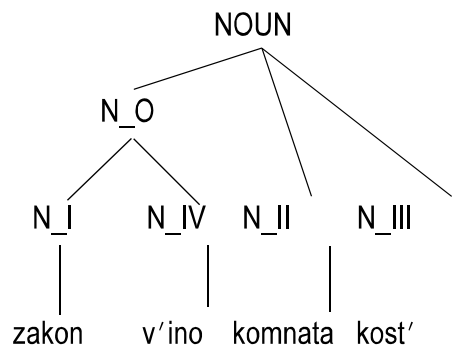


Figure 7

## Inflectional morphology in Word Grammar



**Figure 8**

## Inflectional morphology in Word Grammar

	<i>-fer</i>	<i>-mit</i>	<i>-sume</i>	<i>-ceive</i>	<i>-duce</i>
re-	re-fer	re-mit	re-sume	re-ceive	re-duce
de-	de-fer	de-mit		de-ceive	de-duce
pre-	pre-fer		pre-sume		
in-	in-fer				in-duce
con-	con-fer	com-mit	con-sume	con-ceive	con-duce
trans-	trans-fer	trans-mit			trans-duce
sub-		sub-mit	sub-sume		
ad-		ad-mit	as-sume		ad-duce
per-		per-mit		per-ceive	

Table 1

## Inflectional morphology in Word Grammar

Object:	1		2		3	
Subject	S	P	S	P	S	P
1S		ni...tu	ni...ku	ni...wa	ni...m	ni...wa
1P	tu...ni		tu...ku	tu...wa	tu...m	tu...wa
2S	u...ni	u...tu		u...wa	u...m	u...wa
2P	m...ni	m...tu	m...ku		m...m	m...wa
3S	a...ni	a...tu	a...ku	a...wa		a...wa
3P	wa...ni	wa...tu	wa...ku	wa...wa	wa...m	

Table 2

## Inflectional morphology in Word Grammar

Object	1 sg.	1 pl.	2 sg.	2 pl.
Subject				
1 sg.	--	--	ki-X-it-in	ki-X-it-in-a:wa:w
1 pl.	--	--	ki-X-it-in-a:n	1. ki-X-it-in-a:n 2. ki-X-it-in-a:wa:w
2 sg.	ki-X-in	ki-X-in-a:n	--	--
2 pl.	ki-X-in-a:wa:w	1. ki-X-in-a:n 2. ki-X-in-a:wa:w	--	--

Table 3



Inflectional morphology in Word Grammar

		1st person	
		singular	plural
2nd person	singular		-a:n
	plural	-a:wa:w	1. -a:n 2. -a:wa:w

Table 4