Abstract

Based on the notion of a lexicon with default inheritance, I address the problem of how to provide a template for lexical representations that allows us to capture the relatedness between inflected word forms and canonically derived lexemes within a broadly realizational-inferential model of morphology. To achieve this we need to be able to represent a whole host of intermediate types of lexical relatedness that are much less frequently discussed in the literature. These include transpositions such as deverbal participles, in which a word's morphosyntactic class changes (e.g. verb $\Rightarrow$ adjective) but no semantic predicate is added to the semantic representation and the derived word remains, in an important sense, a "form" of the base lexeme (e.g. the 'present participle form of the verb'). I propose a model in which morphological properties are inherited by default from syntactic properties and syntactic properties are inherited from semantic properties, such as ontological category (the *Default Cascade*). Relatedness is defined in terms of a Generalized Paradigm Function (perhaps in reality a relation), a generalization of the Paradigm Function of Paradigm Function Morphology (Stump, 2001). The GPF has four components which deliver respectively specifications of a morphological form, syntactic properties, semantic representation and a lexemic index (LI) unique to each individuated lexeme in the lexicon. In principle, therefore, the same function delivers derived lexemes as inflected forms. In order to ensure that a newly derived lexeme of a distinct word class can be inflected I assume two additional principles. First, I assume an Inflectional Specifiability Principle, which states that the form component of the GPF (which defines inflected word forms of a lexeme) is dependent on the specification of the lexeme's *morpholexical signature*, a declaration of the properties that the lexeme is obliged to inflect for (defined by default on the basis of morpholexical class). I then propose a Category Erasure Principle, which states that 'lower' attributes are erased when the GPF introduces a non-trivial change to a 'higher' attribute (e.g. a change to the semantic representation entails erasure of syntactic and morphological information). The required information is then provided by the Default Cascade, unless overridden by specific declarations in the GPF. I show how this model can account for a variety of intermediate types of relatedness which cannot easily be treated as either inflection or derivation, and conclude with a detailed illustration of how the system applies to a particularly interesting type of transposition in the Samoyedic language Selʹkup, in which a noun is transposed to a similitudinal adjective whose form is in paradigmatic opposition to case-marked noun forms, and which is therefore a kind of inflection.

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1 Introduction: Types of lexical relatedness

There are many ways in which words may be related to each other. The most obvious ways are by regular inflection and regular derivation. Inflection can be thought of as a function which maps a lexeme's representation or index and a set of morphosyntactic features to a cell in a paradigm, characterized as a word form and the same set of morphosyntactic features. Derivation can be thought of as a function which relates a full characterization of a lexeme (its basic form, its syntax, and its semantic representation) to another lexeme. In Sag et al. (2003) two distinct types of lexical rule achieve these mappings. However, it's important to realize that inflection and derivation are just two very specific types of relatedness. When we consider the full set of possibilities for ways in which words can be related systematically we find we need a more nuanced approach to the definition of relatedness.

Among the commonly observed types of relatedness we can note the following (other types can be observed in addition to these):

- (contextual) inflection
- (inherent) inflection
- asemantic transposition
- transposition with added semantic predicate
- asemantic argument structure alternation
- argument structure alternation with added semantic predicate
- asemantic derivation
- (canonical) derivation

Contextual inflection is opposed to inherent inflection (the terms are due to Booij 1994). Contextual inflection refers to inflection which is not associated with any addition of content to the lexical representation. Agreement morphology on a syntactic target is a prime example (e.g. the 3sg agreement in English non-past verbs). Inherent inflection is inflection which (ultimately) is associated with some kind of semantic interpretation. The plural and past tense morphology of English and Dutch which Booij cites as instances of inherent inflection are better thought of as processes which realize feature values on word forms, which then regulate the way that entire phrases are interpreted semantically. Such inflection therefore doesn't involve the addition of a semantic predicate to a lexical representation (in this respect my approach to such matters differs from the analyses in, say, Sag et al. 2003). Clear-cut cases of meaning-changing inherent inflection are found with languages such as Hungarian which have rich case systems including a series of semantic/local cases, bearing meanings similar to spatial adpositions in other languages. In many instances such case forms have a purely adverbial function (they don't function as 'structural cases' for instance) and the natural way of treating them is to say that they add some kind of spatial modificational meaning, such as 'from the inside of (the box)' or 'in the capacity of (a ship)' (see Spencer 2010, 145).

(Asemantic) transposition refers to a type of word which appears to be derived from a more basic lexeme and which has a different morpholexical/syntactic category from that base lexeme, but which preserves the content of the base lexeme (see Spencer 2005 for more detailed discussion). A typical example is an active deverbal participle. In many languages such a participle functions exactly like an attributive adjective, for instance, agreeing in nominal features with its head noun, while retaining the meaning, argument structure and sometimes even tense/aspect properties of the original verb. Because such transpositions change word category, and require the word to be inflected in the manner of the new category (e.g. an adjective rather than a verb) they are sometimes characterized as a type of derivation. Yet derivational morphology is principally a way of creating new lexemes with the addition of a semantic predicate and (asemantic) transpositions crucially add no content to the lexical representation of the base. In that respect they are less derivation-like than, say, inherent inflection.

Some transpositions are not entirely asemantic: a participle may add nuances of aspect, for instance, and action nominalizations may well add nuances such as 'name of event/name of process/name of proposition' and others (Spencer, 2010). However, such transpositions are not typical derivational relations because it's far from clear that we are creating an entirely new lexeme. For instance, the German nominalized infinitive (or 'verbal nominal', Bierwisch 2009) brings with it an atelic interpretation which is not found with the basic verb (or with alternative nominalizations in *-ung*). But the regularity of the construction makes it look like a nominalized form of the verb and not like a completely new lexeme.

Asemantic argument structure alternations are most famously represented by constructions such as the English passive, or, slightly more controversially, the English 'Dative shift' double object ('applicative') alternation. The morphosyntax of these constructions is complicated in English (periphrastic in the case of the passive, zero morphology/conversion in the case of the double object construction), but in many languages the morphology is perfectly regular. Argument structure alternations may also regularly add a semantic predicate, most famously the causative alternation. In languages in which these alternations are regular, lexically unrestricted, productive and so on it appears to all intents and purposes as though we are dealing with a type of inflection. Indeed, the morphology of such alternations often has the character of inflectional morphology. In many languages (e.g. Latin, Greek, Sanskrit) it would be perverse to treat a passive verb form as a distinct lexeme from the active verb form. However, where, say, causative alternations are concerned, descriptive practice varies, because the additional causative predicate (and the additional causer argument) give the impression of lexical derivation. Nonetheless, in the case of truly productive and regular morphology it is perverse to regard even the causative as derivation rather than inflection. It is precisely the existence of such morphological alternations that make the ‘inflection/derivation’ dividing line so hard to draw.

Canonical and indisputable derivation adds a semantic predicate to the lexical representation and hence changes the ontological category of the derived word. As a result, the syntactic and hence morphological category of the derived word is changed. However, we should be aware of the fact that huge swathes of the lexicon of a language might well be related to each other in a purely formal manner without any regular semantic relationship whatever. Prefixed verbs in Indo-European languages generally (especially Slavic, Greek, German, Sanskrit, ...) are a case in point. It is an indisputable fact about the German verb lexicon that the vast majority of its members can be analysed as a prefix+stem combination. Moreover, these verbs are constructed from a small number of prefixes and a recurrent set of stems. However, in a very large number of cases (perhaps the majority depending on how you define ‘lexical entry’) there can be no systematic semantic relation between the base verb and its prefixed derivates or between the verbs derived from a single stem by different prefixes. Thus the verb *versprechen* ‘promise’ is clearly derived from *ver*- and *sprechen* (note the conjugation!) but its meaning cannot be related to that of either *ver*- or *sprechen*. Indeed, both stem and prefix are cranberry morphs. A quick glance through any dictionary of German will immediately convince you that this is a general fact about the German verb. Thus, the grammar of German has to have a way of recording that fact that verbs are generally of the form (meaningless) prefix + (meaningless) stem (Spencer, 2001).

Any complete account of lexical relatedness has to have a way of describing these relationships and capturing the fact that they are typically systematic features of a language’s lexicon. Moreover, the various intermediate types of lexical relatedness make it very difficult to draw a principled distinction between any one pair of types. In particular, there is absolutely no justification in elevating (canonical) inflection and (canonical) derivation to unique types of relatedness. Rather, in the spirit of the hierarchical lexicon, what we need is a way of characterizing the individual ways in which words may be related to each other, by ‘factorizing’ lexical relatedness into its components, and defining the various intermediate types of relatedness in terms of sets of choices from among those components (Spencer, 2010). However, defining a type hierarchy of lexical relatedness is a relatively trivial task. Much more difficult is building a model of lexical representation which will allow us to capture such relationships in an explicit grammatical description. This is the task I address in this paper.

2 Paradigm-based approaches to lexical relatedness

I will take as my starting point the assumption that morphology, and hence, morphologically expressed lexical relatedness, is to be defined in terms of a paradigm-based model of some kind, for instance, the Paradigm Function Morphology (PFM) model of Stump (2001). Paradigm-based (realizational-inferential) models of morphology are defined over a notion of 'lexeme'. In such a model, inflectional morphology defines the set of word forms which realize various morphosyntactic properties sets (MSPSs) for a given lexeme (e.g. from PRINT, $\{$*print, prints, printing, printed*$\}$. By contrast, a derivational process, say, Subject Nominalization (SubjNom), yields a new lexeme PRINTER with its own inflected word forms $\{$*printer, printers*$\}$. These are not word forms of the lexeme PRINT. In the classical PFM model inflection is defined by a paradigm function (PF) which specifies the word forms realizing a given MSPS for that lexeme.

Now, Stump treats fully regular (paradigmatic) derivation in the same way as inflection, at least from the formal point of view. He discusses PrivativeAdjective formation in English, in which an adjective with the meaning 'lacking N' is derived from a noun with the meaning 'N'. In Stump's account, this process is governed by a derivational feature δ. The paradigm function applied to the pairing of noun lexeme and the feature δ then delivers the *-less* suffixed form: PF($<$friend, $\delta>$) = $<$friend-less, $\delta>$. But this approach leaves several questions open.

1. How do we reconfigure the classical model to reflect the fact that derivation involves the addition of a semantic predicate, not just the realization of a morpholexical feature?

2. How do we ensure that the derived lexeme inflects in the appropriate way (i.e. ensuring that PRINTER inflects as a noun rather than a verb, and ensuring that FRIENDLESS doesn't inherit the singular/plural distinction from the base noun FRIEND)?

3. How do we capture types of lexical relatedness intermediate between inflection/derivation, especially transpositions, inherent (meaning-changing) inflection, argument structure alternations?

4. Given point 1, how do we nevertheless account for the fact that derived lexemes often undergo semantic drift while still exhibiting the morphological idiosyncrasies of the regular derivate, e.g. *transmit* $\sim$ *transmission* (of a car), and often show no semantic relatedness (German *versprechen*)?

I propose a model of lexical representation and lexical relatedness for use in any realizational-inferential model which permits us to treat inflection, all the various kinds of derivation, and all intermediate types of lexical relatedness as the result of the same formal class of operations at a certain level of abstraction. An additional property is that this model will also define the basic lexical entry itself using the same formal machinery as that used for defining relatedness between distinct word. Effectively, a lexical entry is defined as a representation which is (trivially) related to itself.

This model of lexical representation will crucially depend on the idea that lexical entries/lexical representations are in general underspecified for default properties, exactly as argued in Sag et al. (2003). Indeed, I assume that it would be straightforward, in principle, at least, to encode my proposals in some fairly standard model of the HPSG lexicon. I will not do this however, for the following reasons. First, I am not sufficiently competent in the formalism of HPSG to do this. Second, there are important differences between certain aspects of the proposals I make here and the standard ways of structuring lexical entries in HPSG (not least to do with the role of the Lexeme Identifier or LID, Sag 2007) which require more careful attention than I can give here. Third, my aim is to remain as formally neutral as possible so that my proposals can be implemented in other frameworks that might deploy similar apparatus (specifically, default inheritance) and a detailed formalization might hinder such 'cross-platform' comparison.

3 Lexical representations

I assume that a lexical representation is at least a four-dimensional object as in (1):[1]

(1)
$$\begin{bmatrix} \text{FORM} & \begin{bmatrix} \begin{bmatrix} \text{STEM0} & \text{/draw/} \\ \text{STEM1} & \text{/drew/} \\ \text{STEM2} & \text{/draw-n/} \end{bmatrix} \\ \text{MORCAT Verb} \end{bmatrix} \\ \text{SYN} & \begin{bmatrix} \text{SYNCAT} & \text{VERB} \\ \text{A-STR} & \langle \text{SUBJ, OBJ} \rangle \end{bmatrix} \\ \text{SEM} & [_{Event}\ \text{DRAW(x,y)}] \\ \text{LI} & \text{\textsc{draw}1} \end{bmatrix}$$

The LI is the Lexemic Index, an arbitrary label unique to each lexeme. The LI has much in common with Sag's (2007) notion of Lexeme Identifier, LID, the main difference being that the LI in my model is not tied to semantic representations in the way the LID is. In fact, the LI is best thought of as a unique integer functioning much like a 'key' in a database, serving to identify each separate lexeme and hence acting as a record of our decisions on how exactly lexical entries are individuated. For instance, we may ask ourselves whether two related meanings of a word constitute mild polysemy or frank homonymy. For instance, does the word PLAY represent one lexeme or two in the contexts *to play chess* and *to play soccer*? In the former case the verb would have the same LI in both uses, while if we decided to treat this as two separate verbs we would give it two distinct LIs.

Note that I have furnished the representation in (1) with an attribute [MORCAT Verb], in addition to a syntactic attribute [SYNCAT VERB]. The reason for this apparent profligacy of feature marking is that we frequently find mismatches between

[1] I assume without comment that 'past tense' forms in English are really morphomic stems, here 'STEM1'. For one thing, this is the only way to make sense of the fact that the *-ed* form of a regular verb realizes three entirely different functions: past tense, perfect participle, passive participle.

syntactic and morphological category. A natural history of some of these is provided in Spencer (2002, 2005, 2007). For instance, in Spencer (2002) I discuss instances in which a noun is derived by conversion from an adjective but retaining the morphology (and even some of the morphosyntax) of that adjective. A German example would be the noun *Angestellte(r)* ‘employee’, which is formally an adjective (though one which itself is derived by transposition from a verb, as a passive participle). By default, of course, a word inherits its morphological category from its syntactic category.

The semantic representation follows the practice of authors such as Jackendoff (2002) in representing explicitly the ontological category. It seems reasonable that such information about a lexeme should reside in its semantic representation. Of course, in the default case the ontological category of a major lexical class will determine the syntactic category, after the manner of the ‘notional’ theory of word classes (Lyons 1966, Spencer 2005). For the mappings *Thing* ⇒ noun, *Property* ⇒ adjective, *Event* ⇒ verb this is fairly obvious (though I don’t pretend to understand how to characterize the ontology object ‘Property’). For other categories the mapping is less clear. In Jackendoff (1990) the category *Place* generally corresponds to a prepositional phrase (he is discussing English exclusively) but a simplex word denoting a place, such as *France* or *home* is likely to be a noun (or sometimes an adverb) in English. In many languages with a spatial inflectional case system, inflected forms of nouns can denote places.

4 The Default Cascade

As should be obvious from the previous section I take it as obvious that the morphosyntactic properties of a given level will, in general, derive from the properties of the SEM representation by virtue of default specification: a word denoting an ontological Event will, by default, be a syntactic verb which will, by default, be a morphological verb. I enshrine this observation in the *Default Cascade*, illustrated schematically in (2):

(2) The Default Cascade (illustrative)

$$\begin{array}{lcl} \text{SEM=}[_{Event}\ \mathscr{P}{<}\ldots{>}] & \Rightarrow & \text{SYNCAT=VERB} \\ \text{SEM=}[_{Event}\ \mathscr{P}{<}\text{x, y, }\ldots{>}] & \Rightarrow & \text{A-STR=(SUBJ, OBJ, }\ldots) \\ \text{SYNCAT=VERB} & \Rightarrow & \text{MORCAT=Verb} \end{array}$$

and so on.

The principle of the Default Cascade runs through the notion of lexical entry: for example, in many complex inflectional systems we find that a given lexeme is inflected over a whole series of stems (see Aronoff 1994; Stump 2001 for an extended justification of the stem notion in inflection and derivation). The normal expectation is that each stem inflects according to one and the same inflectional class (i.e. a second conjugation verb can be expected to take second conjugation inflections throughout its paradigm). Of course, this, like any default in the cascade can be overridden, either in the lexical representation itself or by a rule.

An important assumption about lexical entries that I shall be making is that an inflecting lexeme is associated with a *morpholexical signature* (m-l signature), a declaration of the MSPS which that lexeme (must) inflect for. Such an assumption seems to be implicit (and sometimes explicit) in most discussions of lexical entries and it's difficult to see how we could engineer inflectional morphology without it. When we come to consider more subtle cases, including lexical representations which deviate from default mappings in various ways, we will find that specifying such a declaration of MSPSs is far from trivial.[2] For the present we can take the specification of MSPSs as part of the Default Cascade.

5 Generalizing the Paradigm Function

Recall that canonical derivation crucially creates a distinct lexeme (with distinct LI) by adding a semantic predicate. I therefore generalize the definition of PF: a Generalized PF (GPF) maps an entire lexical representation (<FORM, SYN, SEM, LI>) to another lexical representation. The GPF is an ensemble of four component functions, f_{form}, f_{syn}, f_{sem}, f_{li}. Each function is defined over an ordered pair <LI, {set of features}>.

For 'pure' (i.e. contextual) inflection the GPF is non-trivial only for the FORM attribute. For the SYN, SEM, LI attributes it is the identity function (relation). For instance, the English GPF for Xs = 3sgPresIndic of any (nonmodal) verb, with LI VERB, root form X (i.e. Stem0(VERB)), will be informally represented as in (3) (this is essentially identical to the PF in the classical model):

(3)	f_{form}(VERB, {3sg})	=	X-s
	f_{syn}(VERB, {3sg})	=	identity function
	f_{sem}(VERB, {3sg})	=	identity function
	f_{li}(VERB, {3sg})	=	identity function

The role of the m-l signature is made explicit in the *Inflectional Specifiability Principle*, (4):

(4) *Inflectional Specifiability Principle (ISP)*:
The f_{form} component of the Generalized Paradigm Function maps a set of forms to cells in the property paradigm defined by the lexeme's morpholexical signature.

The effect of the Inflectional Specifiability Principle is that a bare lexical entry is uninflectable. This is because a bare lexical entry for a well-behaved lexeme lacks

[2]See Spencer (2002) for detailed discussion. Some of the mismatches I have in mind are discussed under the rubric of 'paradigm linkage' in Stump (2006).

a morpholexical signature and hence by (4) cannot (yet) be inflected.[3]

For (regular) derivation, GPF non-trivially maps all four component representations of the base lexeme to distinct outputs, including an enriched semantic representation, addressing Q2 above. Thus, for the SubjNom process applied to WRITE we might have (5):

(5) GPF for SubjNom process by *-er* suffixation (preliminary formulation):

f_{form}(WRITE, $\{$SN$\}$)	=	Stem0(WRITE) $\oplus$ er
	=	MORCAT = N (by Default Cascade, from SYN)
f_{syn}(WRITE, $\{$SN$\}$)	=	SYNCAT = N (by Default Cascade, from SEM)
f_{sem}(WRITE, $\{$SN$\}$)	=	[$_{Thing}$PERSON, x, such that WRITE(x, ...)]
f_{li}(WRITE, $\{$SN$\}$)	=	WRITER

where $\{$SN$\}$ is a (morpholexical) feature which defines the SubjNom relation, and Stem0(WRITE) is the root form of the lexeme WRITE.

At this point it is worth considering where such a model lies in Stump's (2001) classification of morphological theories. Stump divides morphological models using a 'realizational/incremental' axis and a 'lexical/inferential' axis (Stump, 2001, 1-3). The classical morpheme model is lexical and incremental: morphemes are stored lexical representations and the form/meaning of a complex word is obtained by 'summing' the forms/meanings of the component morphemes. Paradigm Function Morphology is realizational/inferential: rules realize feature bundles (they don't add any content to the representation) and they do so on the basis of default inheritance logic, by permitting us to infer the form of one word on the basis of the forms of other words. A example of a model which is inferential-incremental is Aronoff's (1976) model of word formation expressed in terms of word formation rules. Some of the Generalized Paradigm Functions that I shall be appealing to do not fit neatly into Stump's typology. This is because they have the character of a inferential-realizational system at the level of FORM but the character of inferential-incremental systems at the level of SYN or SEM representations. Thus, for classical derivation such as that illustrated in (5) the functions f_{sem}, f_{li} are 'incremental' while f_{form} remains 'realizational/inferential'. (See below for f_{syn}.)

I now refine the notion 'lexical entry'. Many words are like DRAW in that they are distinct homonymic lexemes which share the same (irregular) morphology. I

[3]Strictly speaking, of course, it is only word classes that inflect that are obliged to have a m-l signature, and it is only languages that have inflecting word classes that are obliged to make any reference to m-l signatures and the ISP. This means that a complete and universal theory of lexicon has to type grammars, and word classes within grammars, as 'inflecting' or 'non-inflecting', so that the m-l signature is defined only for the inflecting type. I leave aside this consideration, noting that it raises a number of interesting conceptual and definitional issues.

represent this sharing of properties by permitting the FORM, SYN, and SEM attributes of the basic lexical entry to be defined over sets of LIs rather just a single LI. Thus, for a verb such as DRAW, which has the same (irregular) morphology in both of its (unrelated, homonymous) meanings, the FORM properties are given by $f_{form}(\{\text{DRAW1, DRAW2}\}) = \{$*draw*, *drew*, *drawn*$\}$, while the SEM attributes for each meaning are defined separately: f_{sem}(DRAW1) = MAKE_ GRAPHITE_ IMAGE_ OF(x,y), but f_{sem}(DRAW2) = EXTRACT(x,y) (or whatever). Similarly, exact synonyms share SEM values but have distinct FORM entries. The SubjNom process can now be written more generally as (6), where X=Stem0(VERB):

(6)	f_{form}(WRITE, $\{$SN$\}$)	=	Xer
		=	MORCAT = N
	f_{syn}(WRITE, $\{$SN$\}$)	=	SYNCAT = N
	f_{sem}(WRITE, $\{$SN$\}$)	=	$[_{Thing}$PERSON, x, such that WRITE(x, ...)]
	f_{li}(WRITE, $\{$SN$\}$)	=	WRITER = SN(WRITE)

In (6) I reflect that fact that the SubjNom process is regular and paradigm-driven by defining a derived LI, obtained by applying the SN feature to the base verb's LI, so that for any verb, with LI VERB, which has a SubjNom, the LI of that SubjNom will be SN(VERB). For irregular SubjNoms such as '*fly* (an aircraft) $\sim$ *pilot*', SN(FLY) is defined suppletively as PILOT. I now assume the Category Erasure Principle, (7):

(7) *Category Erasure Principle*:
Assuming the ordering SEM $>$ SYN $>$ FORM, any GPF which alters a categorial representation automatically deletes the category specification of lower attributes.

By the Inflectional Specifiability Principle it is impossible to inflect a lexeme without a m-l signature and the m-l signature requires a morpholexical category specification. Hence, the output of a category-changing GPF cannot be inflected until the Default Cascade applies so as to redefine the SYNCAT/MORCAT values of the deverbal nominalization as 'N/Noun'. Note that 'category-changing' may refer to purely morphomic categories such as 'perfect stem' (for instance, where its inflectional class is different from that of the lexeme as a whole), so this property is not specific to derivation. (Of course, any value can be respecified by the GPF itself in the case of non-default category specifications.) Thus, application of GPF(WRITE, $\{$SN$\}$) in (6) will erase SYNCAT, MORCAT specifications and the Default Cascade will redefine these, furnishing the derived lexeme with the m-l signature of a noun (Q1).[4]

[4] For morphology which Stump calls 'headed' this categorial erasure doesn't apply. For instance, asemantic prefixation of *stand* by *under-* preserves the morphological irregularity of the base verb. I assume with Stump that such cases are structurally distinct from, say, SubjNom, so that in effect the prefixed derivative inherits the inflection of the unprefixed lexeme.

For transpositions the GPF changes just the FORM, SYN attributes (Q3). In (8) I give the representation for the Russian participle *komandujušč-* from the verb *komandovat′* 'to command (e.g. army)'. All forms of the verb, including the participle, take an instrumental case marked complement. The participle inherits that property from the stipulation in the lexical entry for the verb as a whole:

(8)	f_{form}(VERB, {ActPart})	=	Stem0(VERB, {ActPart}) ⊕ jušč
	f_{syn}(VERB, {ActPart})	=	
	SYNCAT(VERB, {ActPart})	=	A
	A-STR(VERB, {ActPart}) (= < subj, obj[instr]> by default)	=	identity function
	f_{sem}(VERB, {ActPart})	=	identity function
	f_{li}(VERB, {ActPart})	=	identity function

The representation in (8) correctly makes the participle a form of the verb lexeme, retaining the verb's a-structure, but stipulating the change SYNCAT ⇒ A (hence, by the Default Cascade, MORCAT ⇒ Adj).

To summarize the lexical machinery: a morphological process, such as inflection, derivation, transposition, ..., is defined as a set of mappings over the set <FORM(LI, {features}), SYN(LI, {features}), SEM(LI, {features})>. Representations must be furnished with a m-l signature to be inflected. The CEP and the Default Cascade guarantee that categorial features are redefined appropriately in the regular cases. For instance, the Russian present active participle transposition in (8) results as follows: The {ActPart} property is defined as part of the m-l signature of a verb, hence GPF(KOMANDOVAT′, {ActPart}) is well-defined. The functions f_{sem}, f_{li} are the identity functions, as is the A-STR component of f_{syn} ($f_{syn|a\text{-}str}$), thus guaranteeing that the subcategorization "obj = instr. case" is inherited by the participle. The GPF maps the SYN|SYNCAT value to A, overriding the default SYNCAT=V. FORM|MORCAT category information is thereby erased by the CEP and the Default Cascade specifies MORCAT=Adj and respecifies the m-l signature accordingly (in fact, placing the participle in the default adjectival inflectional class).

Given this machinery we can now represent the basic lexical entry of a lexeme as a kind of trivial GPF where the set of triggering properties is empty, {*e*}. Hence, for WRITE we have (9):

(9)	f_{form}(WRITE, {*e*})	=	Stem0(WRITE, {*e*})	=	raɪt
		=	Stem1(WRITE, {*e*})	=	rout
		=	Stem2(WRITE, {*e*})	=	rɪt-n
	f_{sem}(WRITE, {*e*})	=	[$_{Event}$WRITE(x,y)]		
	f_{li}(WRITE, {*e*})	=	WRITE		

SYNCAT=V, MORCAT=Verb and the m-l signature are given by the Default Cascade. The specifications for Stem1, Stem2 will override the forms otherwise provided by regular inflection, namely {raɪtəd}. The specification 'identity function' in (8) is now interpreted to mean that, e.g., $f_{syn|a\text{-}str}$(VERB, {ActPart}) = $f_{syn|a\text{-}str}$(VERB, {e}). This will be given by default, since the GPF will not itself specify a value for $f_{syn|a\text{-}str}$(VERB, {ActPart}).

We now obtain the result that the output of regular, category-changing derivation is equivalent to the lexical entry for the derived lexeme. In other words, we can show that f_{li}(WRITE, {SN}) ≡ f_{li}(SN(WRITE), {e}) and so on for the GPF of WRITER generally. The Default Cascade will furnish the m-l signature required to inflect the new lexeme without the need for further machinery. In this way we fully answer Q1.

Derivational morphology frequently defines multiply polysemous/homonymous lexical entries that have non-compositional semantics or other irregularities. Thus, alongside regular *friendless* we find adjectives such as *clueless, priceless, hopeless, ...* In ordinary English *clueless* almost always means just 'stupid'. In such a case the SEM and LI attributes are not given by applying all four PrivAdj functions to the LI CLUE. Rather, we have a 'lexical referral', under which the regular output of the PrivAdj process serves as a 'redundancy rule' specifying the form, but not the meaning, of the derived word. Thus, the SEM attribute of CLUELESS is lexically stipulated to be STUPID(x) and the LI is CLUELESS (NB *not* PRIVADJ(CLUE)!) but the FORM attribute can be defined as f_{form}(CLUELESS, e) = f_{form}(CLUE, {PrivAdj}). This fractionation of form from meaning is particularly valuable when semantic drift preserves idiosyncratic allomorphy (*car transmission*) (Q4). The existence of non-compositional derivates doesn't prevent the standard defaults associated with PrivAdj from applying, to give additional entries with the compositional (if less likely) meanings 'lacking a clue/price/hope', alongside the more frequent meanings.

There is an important class of derivational categories which contradict the Default Cascade. In many languages an adjective can be converted into a noun syntactically while remaining an adjective morphologically. For instance, the Russian adjective BOL′NOJ 'sick' converts into a noun meaning '(doctor's) patient' (synonymous with PACIENT). It is easy to show that the derived noun is a noun and not an adjective modifying a null noun. Moreover, the semantic representation of the noun is distinct from that of the adjective because 'X is a patient' doesn't entail 'X is sick'. Yet the converted noun inflects exactly like the adjective,[5] and it is the apparent target of agreement processes, just like the original adjective. For instance, it obligatorily has feminine gender forms when the referent is female and it takes genitive plural inflections when modified by numerals 2–4 rather than genitive singular inflections.[6] Now, if the derivational process creating the noun BOL′NOJ from the homophonous adjective were well behaved it would force the adjective root to inflect like a noun, by virtue of the CEP, (7). That principle must therefore be

[5]Unlike what we see in many Indo-European languages, the Russian adjective inflectional class is significantly different from that of any noun class.

[6]Compare the similar mismatch with German nouns such as ANGESTELLTE(R) mentioned above.

circumvented by means of a ‘referral’ written into the conversion process, which effectively defines the m-l signature of the derived noun to be identical to that of the base adjective lexeme, despite the fact that syntactically the derived word is a noun in all respects, except for its ‘agreement’ properties (nouns, of course, are never the target of agreement, they are agreement controllers).

We noted that inherent inflection can add a semantic predicate to the semantic representation of the inflected lexeme, as though we were dealing with derivation. For instance, many of the ‘semantic’ case suffixes in languages such as Hungarian have no grammatical role but act effectively like PPs in English. Thus, the suffix *-ként* ‘as, in the capacity of’ has no function other than to add the IN THE CAPACITY OF predicate to the base noun semantics. But *-ként* satisfies all the morphological properties of a case suffix and cannot be said to create a distinct lexeme. It is therefore part of the inflectional system (Kiefer, 1987, 2000). Such inherent inflection can be distinguished from derivation by allowing the f_{sem} function to introduce a semantic predicate while defining f_{li} as the identity function.[7] Entertainingly, it is difficult in the generalized model to decide whether some highly regular non-category-changing derivation might be inherent inflection. For instance, should *unhappy*, *re-print* be treated as {AdjPol:Neg}, {Asp:Repet} inflected forms of HAPPY, PRINT or as derived lexemes which preserve SEM category and hence escape the CEP? This indeterminacy accurately mirrors the shakiness of the intuitions of linguists and especially of dictionary writers in such cases.

I conclude with a particularly interesting case of lexical relatedness found in the Samoyedic (Uralic) language, Selkup. In their grammar of this language Kuznecova et al. explicitly point to the pervasiveness of transpositions in Selkup morphosyntax and describe a wide variety of transpositional processes under their heading of ‘representation’ (*representacija*): thus a noun transposed to an adjective (a relational adjective) is the ‘adjectival representation’ of that noun (Kuznecova et al., 1980).

Selkup nouns share the general structure of Uralic nouns in having three suffix position slots, for number ([Number:{singular, dual, plural and collective}]), possessor agreement ([PossAgr:{person/number}]) and case ([Case:{nominative, accusative, genitive, instrumental, caritive, translative, coordinative, dative-allative, illative, locative, elative, prolative, vocative}]). The three features are paradigmatic, i.e. the values of [Number], [PossAgr], [Case] are mutually exclusive. A typical example of a fully inflected noun is shown in (10) (Kuznecova et al., 1980, 201):

(10) qoː-iː-nyt-kɔːlyk
leader-PL-2PL.POSS-CAR
‘without your(3+) leaders (3+)’

In addition to these clearly inflectional forms, there are three major ‘adjectival

[7]Whether and how the CEP is deployed depends on the individual morphologies of the languages concerned.

representation of nouns'. These are denominal forms derived by suffixation:

(11) Adjectival representations of Selkup nouns

associative representation	kana-l′	'dog's, pertaining to dogs'
similitudinal representation	alako-ššal′	'similar to a boat'
locative representation	mɔːt-qyl′	'located in the/a house'

The adjectival representations of nouns serve for attributive modification. Unlike canonical inflection, the similitudinal and locative representations add semantic content to the noun denotation, essentially creating a representation of the form SIMILAR_TO(N) and LOCATED_IN(N). The semantics of these predicates means that such a word will denote a property as well as denoting an object.

Here I focus on the similitudinal representation of nouns. Kuznecova et al. (1980) make a clear distinction between true adjectives and adjectival representations of nouns in terms of their morphosyntax. The two types are similar in that both can function only as modifiers and do not differ in their external distribution, but adjectival representations of nouns are analyzed as part of the nominal paradigm (and hence, are in this sense inflectional). The crucial difference is that, unlike true adjectives, the associative and similitudinal adjectival representations have (inflectional) possessive forms. Thus, in addition to the associative form of the unpossessed noun *qaqly* sledge', *qaqly-l′* 'pertaining to a sledge', we have forms such as *qaqly-nɪː-l′* 'pertaining to our.DU sledge' and *qaqly-ntyty-l′* 'pertaining to their.(3+) sledge', where *-nɪː-* and *-ntyty-* are possessive affixes.

(12) (mat) pɔːra-ny-šal′ qum
I.GEN size-1SG-SIM man
'man of my size (lit. man similar to my size)'

Although it is not itself a case suffix in any traditional sense of the term, the similitudinal belongs functionally to the same set of suffixes as the case suffixes. It should therefore be treated as the output of an inflectional process, on a par with case marking, but deriving a word which shares some of the properties of an adjective. Not surprisingly, there is no traditional term for this type of lexical relatedness so I shall call it an 'inflectional transposition'. In the case of the similitudinal it is an instance of meaning-changing inflectional transposition.

(13) a. GPF(SLEDGE, <sg, unpossessed, associative>)

	maps	to
FORM:	qaqly-	qaqly-l′
SYN:	N	A*[N*]
SEM:	[SLEDGE(x)]	[SLEDGE(x)]
LI:	SLEDGE	SLEDGE

b. GPF(SLEDGE, <sg, 2pl.possessor, associative>) ‘pertaining to your(pl) sledges’

	maps	to
FORM:	qaqly-	qaqlynty-ty-l′
SYN:	N	A*[N*]
SEM:	[SLEDGE(x)]	[SLEDGE(x)]
LI:	SLEDGE	SLEDGE

The syntactic representations are meant to reflect that fact that the base noun component is to some extent syntactically accessible in some cases of transposition of this sort – in Selkup, for instance, the noun can be modified even in the ‘adjectival representation’ as in (12). A more detailed description of how this can be achieved is given in Spencer (1999), and for detailed discussion of a specific example of this kind of category ‘mixing’ see Nikolaeva (2008).

Finally, we must account for the fact that the transposition is meaning changing, so that the GPF adds a semantic predicate to the inflectional transposition, without, however, changing the lexemic status of the output:

(14) GPF(SLEDGE, <sg, 2pl.possessor, similitudinal>) ‘similar to your(pl) sledge’

	maps	to
FORM:	qaqly-	qaqlyn-ty-ššal′
SYN:	N	A*[N*]
SEM:	[SLEDGE(x)]	[SIMILAR_TO(x, y)[SLEDGE(y)]]
LI:	SLEDGE	SLEDGE

6 Conclusions

I have argued for the need for a formal model of lexical relatedness that is capable of capturing all the attested types of lexical relatedness without having to shoehorn intermediate cases into categories of inflection or derivation. Once we take into account the full richness of lexical relatedness cross-linguistically it becomes immediately apparent that we need an enriched conception of the way lexical entries can be related to each other. This is especially evident in the case of the Selkup inflectional transpositions, but even for the much commoner situation found with, say, deverbal participles or (purely) relational adjectives, some machinery such as that proposed here will be necessary. As a result we can cast both canonical inflection and canonical derivation as the output of the same formal operation, the Generalized Paradigm Function. This is an important result for realizational-inferential approaches to morphology because it means that we no longer have to draw a strict (if implicit) distinction between inflection and derivation. That distinction is all but entailed in classical paradigm-based realizational approaches (of a kind which are presupposed, for instance, in Sag et al. 2003 and Sag 2007) and is a serious impediment to finding a unified model which doesn't have to make completely arbitrary and unmotivated choices in the case of intermediate types of lexical relatedness. In effect, the GPF states that a form of the verb PRINT such as *printed* is lexically related to a form of the derived lexeme PRINTER (say, *printers*), but only distantly. Moreover, the notion of lexical entry itself turns out to be a special case of lexical relatedness as defined by the GPF.

My proposals hinge on the idea that information common to several different types of lexical entry can be factored out in the form of a default inheritance hierarchy. A crucial innovation in my approach is the use of defaults to define the morpholexical signature of a lexeme, together with the principle of Inflectional Specifiability and the Category Erasure Principle. These allow us to define (canonical) regular/productive derivational morphology as a form of lexical relatedness which is semantically driven: the change in semantic representation mediated by derivation entrains natural changes in the rest of the representation by default. The use of this simple set of devices thus permits us to capture a notion of 'overwriting' inherent in derivational processes, without losing sight of the fact that most of the changes are predictable. It is even possible to provide a natural description of polysemy due to lexicalization, as in *clueless* (which, of course, would render the standard model relational rather than functional).

The proposals are formally non-trivial, and future work must focus on establishing a secure formal basis for these types of representation and integrating them into a fully-operational grammar fragment.

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