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The Representation of Inflectional Morphology
Within the Lexicon*

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In Lapointe (1980) i attempted to show that it is possible to maintain something like the Generalized Lexical Hypothesis (1) in spite of the existence of various grammatical agreement phenomena.

(1) Generalized Lexical Hypothesis (GLH)

No syntactic rule can refer to a morphological feature or category.

If the GLH is correct, then two major consequences follow from it. First, inflectional as well as derivational morphological processes are handled in the lexicon, and second, a non-syntactic device is responsible for explaining discontinuous cooccurrences of morphological elements in sentential contexts. Most of Lapointe (1980) was devoted to showing that the three main traditional types of agreement can be accounted for through the interactions of the semantic translations of agreeing elements in a suitably specified logical form, and hence that non-syntactic devices are indeed responsible for accounting for morphological agreement. In addition, certain minimal assumptions about the way that inflectional morphology operates in the lexicon had to be made in that work in order to insure that the lexical representations of the sort required by the logical form theory of agreement could be produced in a fairly general way.

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I will not be discussing the issues surrounding the non-syntactic treatment of agreement phenomena in this article, the interested reader being asked to consult Lapointe (1980) for further details. Instead, I would like to focus on the problem of generating inflectional forms within a GLH system. Specifically, I will first present several requirements which we would want any theory of inflectional morphology lexical or otherwise to meet, next I will present a revised version of the assumptions about inflectional morphology made in Lapointe (1980), and finally I will show how the proposed lexical theory meets the general requirements on theories of inflection and briefly discuss what this analysis has to say about several types of counterexamples to a broad generalization about the relation between notional categories and morphological forms.

1. Requirements on a Theory of Inflectional Morphology

To begin, let us consider the work that we would want an adequate theory of inflections to do for us in general. Four requirements on such a theory come immediately to mind, and each will be discussed in turn below.

(A) Basic notions. As a minimal requirement, a reasonable theory of inflectional morphology ought to provide a formal characterization of the following conceptually fundamental morphological notions. First, there are the two traditional senses of the term word, which I will refer to as the individual word and the whole word senses. In the individual sense, the term is used to refer to any element which behaves as a distinct minimal unit in syntactic contexts. Thus, in the standard orthographic representations for the English sentences in (2), all of the elements separated by spaces are individual words.

- (2)a. I will sing.
 b. Edward sang.
 c. Georgia has sung.

In the whole word sense, the term is used to refer to the entire set of individual words which are inflectionally related to the same morphological stem or root. For example, the individual words sing, sang, sung in (2) along with sings and singing constitute a whole word in this sense. Next, related to the notion of an individual word is the notion form (of a word) which usually refers to the particular morphophonemic shape that an individual word appears in. Third, there is the notion inflectional paradigm (of a word) which is the set of all forms in which a given whole word can possibly appear. Finally, there is the notion different forms of the same word, a relation obtaining between any two forms belonging to the same inflectional paradigm.

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(B) Relations between notional categories and forms. Next, an adequate theory of inflections should be able to capture the following generalizations about the relation between notional categories (e.g., 'nominative singular', '2nd person plural perfect', etc.) and inflected forms. In particular, it appears that each notional category of a (whole) word, for whatever notional categories that class of words in that language may exhibit, typically has just one morphological reflex.² I have added the word typically in stating this fact because both of the possible types of counterexamples to it exist; that is, there are cases in which alternate forms exist for a single notional category (for example, English past tense forms like dived/dove), and there are cases in which no forms appear for a notional category of a word (traditionally termed paradigm defectiveness, exemplified by various Latin nouns like cor 'heart' which apparently lack genitive plural forms). Such cases are, however, very much the exception rather than the norm. It therefore makes sense first to construct a theory of inflections on the basis of the above generalization and then at a later point to ask what changes, if any, are required in the proposed theory in order to account for these sorts of counterexamples. This is the approach that I will adopt here, and I will present a further discussion of these issues in section 4.

(C) Treatment of inflectional paradigms. The third general requirement on a theory of inflections is that such a theory should be able to define the inflectional paradigm of a word without actually having to list the entire paradigm in the lexical entry for that word. This requirement runs counter to the suggestion concerning paradigms made by Halle (1973),³

but there are two solid reasons why in the absence of compelling evidence to the contrary we would not want whole paradigms to be listed in lexical entries. First, not listing paradigms would take a potentially immense burden off of the lexicons of grammars with extensive inflectional systems. In the case of Latin verbs for example, a single verb stem will appear in 6 persons and numbers for each of 15 separate simple tense forms (not counting participles or periphrastic constructions) for a total of 90 forms per verb stem. Multiplying this by the thousands of verbs in the language would require the ideal Latin speaker to store an enormous number of forms without regard to the inflectional regularities and subregularities among them. Second, not listing paradigms would potentially help unify the structure of lexicons across grammars both with and without extensive inflectional systems, since at least in the case of inflectionally regular words, lexical entries in the two types of grammars would be objects of essentially the same sort, the only difference between the two being that in a grammar with extensive inflections, many more inflected forms would be produced from a single lexical entry than in the case of a grammar with a paucity of inflected forms.

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(D) The regular/irregular distinction. Finally, the theory of inflections should be able to capture the relevant distinctions between regular and irregular forms of words. I take these to be the following. (i) Irregular forms are either not related or are related subregularly to the underlying morphological structure of a word. (ii) Irregular forms and morphological subregularities must be listed in an appropriate manner in the lexicon, as must the underlying morphological structures of words, for whatever level of morphological structure is taken to be the one defining 'underlying structures' for purposes of inflectional processes. (iii) Regular forms must be generated in a completely general way from the underlying morphological structure of a word. (iv) Regular forms should count more than irregular forms so that, other things being equal, a child learning a grammar will prefer a regular form over an irregular form for a given notional category of a word.

2. Some Proposals Concerning Morphological Structures and Lexical Entries

In order to satisfactorily meet the above requirements within a theory which generates inflected forms lexically, it seems that at least three systems must be defined: a system for generating morphological structures, a system which characterizes the representation of lexical entries, and a system which governs the interactions of structures and entries. I will present my assumptions about each of these systems below.

2.1 Morphological structure. Following Selkirk (forthcoming) i will assume the general morphological categories in (3), and i will assume that morphological structure (MS) rules in individual grammars conform to a modified \bar{X} schema such as (4).

(3) Morphological categories

X^0 -- words Af -- affixes
 X_s -- stems Aug -- augments (stem extensions)
 X_r -- roots

where X is a feature bundle consisting at least of the features which define the major syntactic categories N, A, V, and P.

(4) Morphological structure (MS) rule schema (simplified)

$X^i \rightarrow (Af)^* (Aug) X^{i-1} (Aug) (Af)^*$,

where X^0 -level nodes dominate X_s -level nodes which dominate X_r -level nodes.

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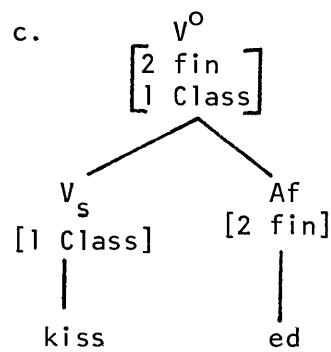
In addition, I assume that individual grammars have available to them a set of arbitrary, n -ary morphological features which are used to specify morphological categories as appearing in particular forms; some examples are given in (5).

- (5)a. [m fin] -- tensed forms of a V
 b. [n Class] -- morphophonemic classes (1st declension, 4th conjugation, etc.)
 c. [p Gend] -- gender classes
 d. [q Case] -- case forms of a N

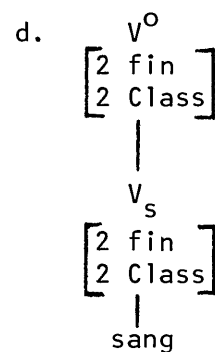
The features appearing on a morphological node M are assumed to be a sum of the features on all of the nodes that M immediately dominates. Finally, I follow Selkirk (forthcoming) in assuming that morphological insertion frames (MIFs) govern the morphological configurations in which an Af (and only an Af) can appear, parallel to the way that subcategorization frames are supposed to restrict the syntactic configurations in which words can appear in syntactic theories such as the one proposed by Chomsky (1965).

Some examples of MS rules and trees are given in (6) and (7).

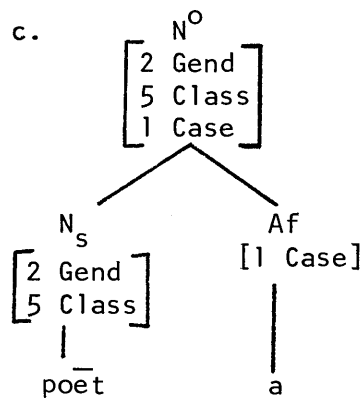
- (6)a. $V^0 \rightarrow V_s$ (Af)



- b. $-ed: \langle V_s _ \rangle$



- (7)a. $N^0 \rightarrow N_s$ (Af)



- b. $-a: \langle _ N_s _ \rangle$

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The MS rule in (6a) is supposed to generate English V forms. Since the MIF for -ed in (6b) simply says that this Af can appear after a V_s , as things now stand ungrammatical forms like *singed are being allowed. I would like to say that the exclusion of such forms is not a matter for MIFs to deal with but rather that non-occurring forms like *singed are ruled out by a general condition on the process which derives inflected forms from stems which will be introduced shortly. The MS rule in (7a) is supposed to generate Latin N forms, poet- being a masculine N_s (marked for instance as [2 Gend]) of the first declension (marked, say, as [5 Class]) to which an affix like the nominative, singular -a can attach.

2.2 Lexical entries. Looking now at the question of what information needs to be represented in lexical entries solely from the viewpoint of inflectional processes, I assume that elementary entries of the sort defined in (8) are stored in the lexicon.

- (8) Def: An elementary entry is an object of the form $[\sigma_0, \tau / \sigma_1, \dots, \sigma_m]$, where
- σ_0 , the basic morphological structure of the entry, is represented at the stem-level,
 - τ is the semantic translation for σ_0 , and
 - $\sigma_1, \dots, \sigma_m$ are optional non-basic structures represented at the word-level.

Since as we have already seen one of the basic requirements on a theory of inflections is that it must be able to provide an adequate treatment of the distinction between regular and irregular forms, I assume that regular forms are derived from the basic structure of an entry, represented at the stem-level, whereas irregular forms are simply listed as non-basic, word-level structures in an elementary entry. Two types of entries, simple and complex can therefore be distinguished as in (9).

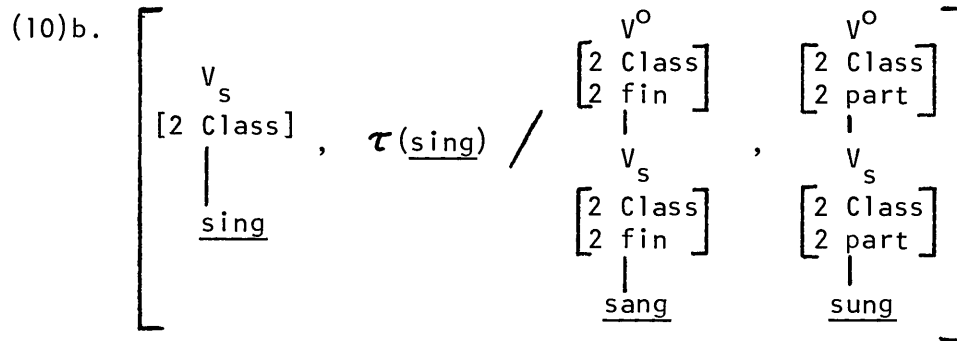
- (9) Def: A simple entry is one containing just a basic structure, i.e., one of the form $[\sigma_0, \tau]$. A complex entry is one containing at least one non-basic structure.

Some examples of elementary entries are given for Vs in English and Ns in Latin in (10) and (11).

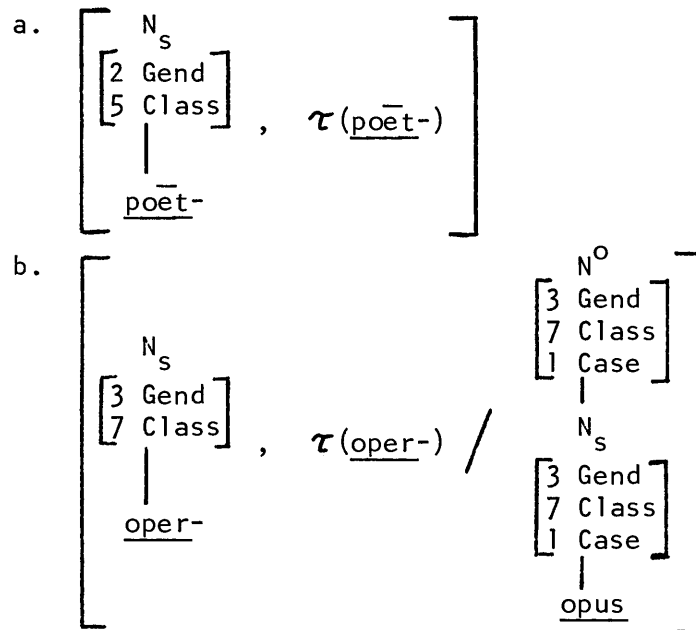
- (10) Entries for English kiss, sing

$$a. \left[\begin{array}{c} V_s \\ [1 \text{ Class}] \\ | \\ \text{kiss} \end{array} \right], \tau(\text{kiss})$$

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(11) Entries for Latin *poēta*, *opus* 'work'



In (10a) and (11a) we have simple entries for *kiss* and *poēta* which inflect regularly in their classes; in (10b) and (11b) we have complex entries for *sing* and *opus* which show inflectionally irregular forms which are listed as non-basic structures in these entries. There is infinitely more to be said about the representation of basic vs. non-basic structures in elementary entries, but the distinctions just drawn will suffice for the present discussion.

2.3 Interactions of structures and entries. For the purposes of inflectional processes, we need assume that only the items in (12) are listed in the lexicon.

(12) Elements listed in the lexicon

- a. set of elementary entries
- b. set of affix entries (including MIFs)

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- (12)c. set of MS rules (plus the corresponding lexical semantic translation rules)

More needs to be said here however since we want to be able to insert word-level structures into syntactic PS trees, and as things now stand, regularly inflected word-level structures are not represented in the lexicon; all that is represented are the corresponding stems. Nevertheless, all of the information needed to define distinct entries containing word-level MS trees is already at our disposal. This can be accomplished through the definition in (13).

- (13) Def: Let E be an elementary entry of the form $[\sigma_0, \tau / \sigma_1, \dots, \sigma_m]$. Then an entry E' of the form $[\sigma', \tau']$ is inflectionally derived from E if it is related to E in the following ways:

- a. $\sigma' = \sigma_i$, for σ_i a non-basic structure in E,
- b. σ' is a word-level MS related to σ_0 by the MS rules and affix entries of the grammar, for σ_0 the basic structure in E, and
- c. τ', τ are related by the corresponding lexical semantic translation rules.

To take some examples, several of the entries inflectionally derived from the elementary entries (10a) for kiss and (10b) for sing are given in Table 1 (next page). In accordance with (13), the single basic structure in (10a) is used in deriving all of the entries at the top of the table, while each of the structures in the elementary entry (10b) is used in deriving a distinct entry at the bottom of the table.

This notion of inflectional derivation is assumed to be constrained by the conditions in (14).

- (14) Condition on Sets of Inflectionally Derived Entries

Let \mathcal{D}_E be the set of entries inflectionally derived from an elementary entry E. Then,

- a. every morphological structure in E must appear as (part of) the structure in at least one entry in \mathcal{D}_E , and
- b. if E_1' and E_2' are any two distinct entries in \mathcal{D}_E s.t. C_1^0 and C_2^0 are the word-level node labels of the structures in those entries, respectively, then $C_1 \neq C_2$ (i.e., they must be featurely distinct).

(14) says in essence that otherwise regular forms like the non-

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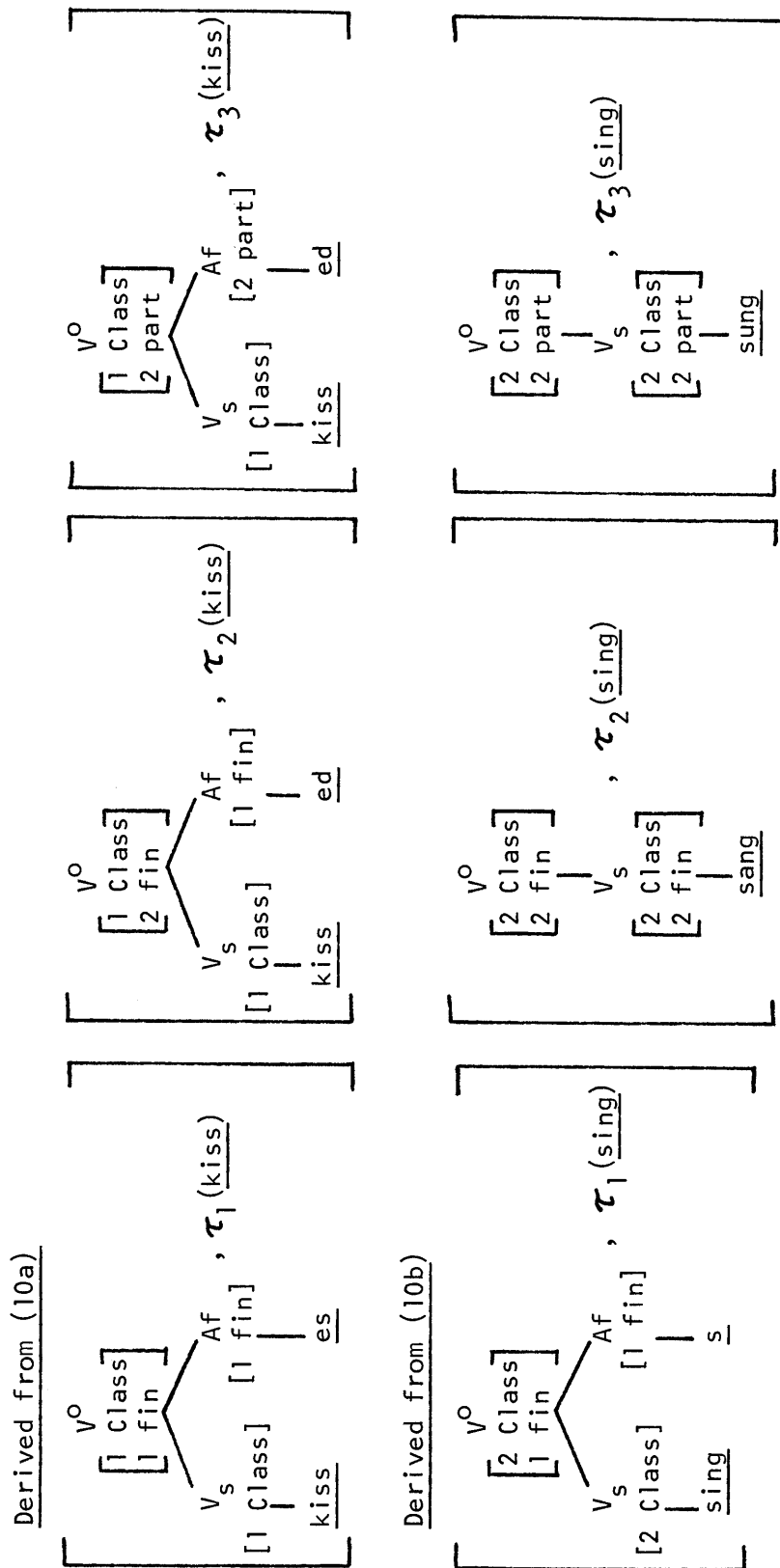


Table 1. Some of the inflectionally derived entries for the English

verbs kiss and sing.

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occurring forms *singed, *operis (as a nominative), etc. are passed over in favor of the irregular forms sang, opus, etc. when inflectionally derived entries are generated. To see that this is the case, consider the following possibilities for the past tense form of sing, given the elementary entry (10b) and letting \mathcal{d} stand for the set of entries inflectionally derived from (10b). First, if *singed rather than sang appeared in an entry in \mathcal{d} , (14a) would be violated, since a structure in the elementary entry, namely the one for sang, would not appear in any entry in \mathcal{d} ; next, if both *singed and sang appeared in an entry in \mathcal{d} , (14b) would now be violated, since the X^0 nodes of the two forms would have exactly the same features; and if neither form appeared in an entry in this set, (14a) would again be violated. This just leaves the possibility in which only sang appears in an entry in \mathcal{d} , a possibility which meets both of the conditions in (14) and is just the one which we actually find.

Finally, to complete the discussion of the interactions of structures and entries, lexical insertion of words into syntactic structure can be defined simply as the insertion of the structure in an inflectionally derived entry into a syntactic position, since (14) guarantees that all structures appearing in such derived entries will be word-level MS trees.

Before continuing, it is worthwhile to emphasize an important claim which is being made by this analysis -- elementary entries are listed in the lexicon, but inflectionally derived entries are not. Derived entries are viewed as being defined or induced under the universal principles (13) and (14) by the elementary entries, affix entries, and MS rules which are listed. The claim being made then is that whenever an (individual) word has to be inserted into a syntactic tree, a new inflectionally derived entry must be created. As we are about to see, this aspect of the present analysis will allow us to meet several of the requirements set forth in section 1.

3. Evaluation of the Proposed Lexical Theory of Inflections

Returning now to the general requirements on theories of inflections presented in section 1, we can see that all of these are met by the proposed lexical theory in a straightforward way.

Let us begin by distinguishing words from forms in the following manner: words are associated with entries of some sort (i.e., they constitute pairings of MSs and lexical semantic translations), whereas forms are simply the terminal (phonemic) strings of MSs. Parallel to (13), a form w' can now be defined as being inflectionally derived from an elementary entry E whenever w' is a form in an entry E' inflectionally derived from E, and parallel to the set \mathcal{d}_E , the set \mathcal{F}_E can be defined as the set of all forms inflectionally derived from E. The basic notions in (A) of section

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l can now be defined as in (15).

(15) Basic inflectional notions.

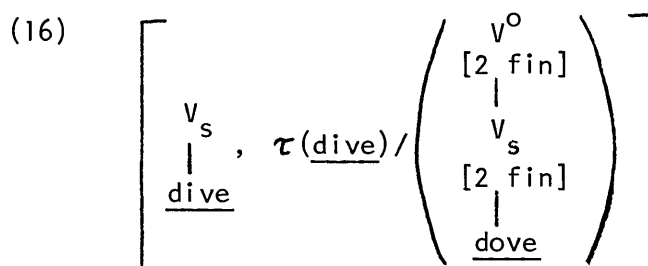
- a. Identify the notion 'individual word' with the notion 'inflectionally derived entry E_i '.
- b. Identify the notion 'whole word' with the notion 'elementary entry E'.
- c. Identify the notion 'individual form' with the notion 'form w_i ' appearing in an inflectionally derived entry E_i ' (i.e., with the notion 'inflectionally derived form w_i ').
- d. Define the inflectional paradigm (of E) to be the set \mathcal{F}_E of all forms inflectionally derived from an elementary entry E.
- e. Define the relation α, β are different forms of the same word (E) to hold whenever α, β are forms which both belong to the same inflectional paradigm \mathcal{F}_E .

Next, the 'one-form-per-notional-category' generalization follows as an immediate consequence of condition (14) as we have just seen. Third, entire inflectional paradigms are not listed in the lexicon under this theory; they, like the derived entries which they are defined in terms of, are taken to be derivative entities which are not represented as such within the lexicon. Nevertheless all of the information normally represented in a traditional paradigm is completely well-defined by the entries and rules which are assumed to be listed in the lexicons of individual grammars. Finally, requirements (ii) and (iii) under (D) of section 1 on the representation of irregular and regular inflected forms follow immediately from the way that elementary entries, inflectionally derived entries, and their interactions are defined. Requirement (iv) follows from an implicit markedness convention on elementary entries which takes simple elementary entries to be the unmarked case and adds to the markedness value of an entry depending on the number of non-basic structures it contains, whether or not any of these conform to morphological subregularities, and so on. The only requirement which is not obviously met by the proposed theory is the explanation for morphological subregularities which may obtain between irregular forms and the basic MS of an elementary entry. Although it is clear from the recent work of Lieber (1980) that such relations can be captured in a fairly comprehensive way, space limitations do not permit a full discussion of subregularity relations here; see Lapointe (in preparation) for further discussion.

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4. Exceptions to the "One-form-per-notional-category" Generalization

Before concluding, I would briefly like to consider how the exceptions to the "one-form-per-notional-category" generalization mentioned in section 1 can be treated within the proposed theory. First, instances where alternate forms for a notional category of a word exist (the dived/dove type of case) can be handled straightforwardly if we allow optional non-basic structures in elementary entries as in (16).



Such entries can be viewed as the collapsing of two entries into one parallel to the way that parentheses are generally used in collapsing PS rules; one of these entries contains the non-basic MS which gives rise to the past tense form dove, while the other contains no non-basic structure and gives rise to dived as the past tense form inflectionally derived from the regular stem of the V.⁵

Next, cases of paradigm defectiveness can be divided into two separate groups. On the one hand, there are cases of what might be called global defectiveness in which a word appears in only a few of the forms which we would otherwise expect a word of its class to exhibit (e.g., Latin Vs like fari 'to speak', salve, ave 'hail', etc. which appear in only a few persons and numbers). Instances of global defectiveness can also be handled in a fairly straightforward way within the proposed theory, since presumably all that has to be assumed is that the few forms of these words are simply all listed in the words' elementary entries. On the other hand, there are cases of selective defectiveness in which a word is lacking only one or perhaps two of its expected forms (e.g., the Latin Ns mentioned in section 1 which lack genitive, plural forms, Russian Vs which lack 1 singular, imperfect forms like *lažu 'I climb' discussed in Halle (1973), and the like). This type of defectiveness poses a tougher problem for the proposed theory, since selective paradigm gaps are not expected under it. Several strictly mechanical ways of accounting for these gaps suggest themselves; one would be to have roots and stems, in addition to affixes, be governed by MIFs and to have those MIFs prevent stems from appearing with the offending Afs, another would be to list non-basic structures with null phonetic shapes for the non-occurring forms in elementary entries, but neither of these solutions is particularly desirable.

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A more interesting approach to the problem would be to take the fact that the proposed theory presents no principled account of selective defectiveness seriously and to claim therefore that such gaps are to be explained by the action of constraints imposed by other components of the grammar. Halle (1973) has suggested for instance that a morphophonemic constraint may be responsible for the Russian V gaps just cited. If this suggestion could be developed into a general explanation for cases of selective defectiveness, that would be a good result for at least two reasons. First, it would mean that the proposed theory of inflections would not have to resort to one of the undesirable solutions outlined above to account for selective gaps, and second, this sort of approach would be entirely consistent with the Autonomous Systems view of the interactions of rule systems recently argued for in the case of syntactic overgeneration by Hale, Jeanne, and Platero (1977). If their hypothesis has any generality beyond such syntactic cases, selective paradigm gaps would seem to be the perfect place to explore the possibility of formulating interacting rule system explanations for non-syntactic overgeneration.

5. Conclusion

To summarize then, the basic motivation for this study was to try to show that it is possible to construct a plausible lexical theory of inflectional morphology which captures the required generalizations about regular vs. irregular forms without having to list everything in the lexicon. The proposed theory does this by (a) listing the irregular forms in elementary entries, (b) defining derived entries, which are not themselves listed in the lexicon, in terms of the elementary entries and rules that are listed, and (c) having lexical insertion apply to information contained in derived entries. This sort of inflectional system can be modified in various ways to accommodate a system of derivational morphology along the lines proposed by Allen (1978). I am exploring this more comprehensive system of morphological processes in work in progress (Lapointe, in preparation) which I hope to be able to report on in the near future.

Footnotes

* I would like to thank the participants in the Graduate Linguistics Seminar Spring 1980 Quarter at the Univ. of California, Irvine, and especially Stephen Anderson, for their comments on an earlier version of this work. I alone am responsible for the material presented below. This work was supported in part by NIH Grant no. NS16155 to Johns Hopkins University

¹ The GLH itself does not actually force us to the conclusion that inflectional processes must be carried out in the lexicon; it merely asserts that such processes cannot be carried out by

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syntactic means. However, the following facts taken together with the GLH strongly suggest that inflection is indeed a lexical process.

- (i) Inflection is a matter of word-internal modifications.
- (ii) There already exists a component of grammars, the lexicon, which handles word-internal processes of derivational morphology.
- (iii) The morphophonemic changes which occur in inflection and derivation are of the same types (affixation, stem-initial changes, infixation, reduplication, or a combination of these).

² Notice that there is considerable counterevidence against the converse of this generalization, namely, the statement that each inflectional form represents just one notional category. Consider for instance the various notions associated with the form sing in English (to sing, i sing, they sing, etc.), with the 1st declension forms ending in -ae in Latin (e.g. poetae = 'poet, genitive singular/dative singular/nominative plural'), and so on for many other examples.

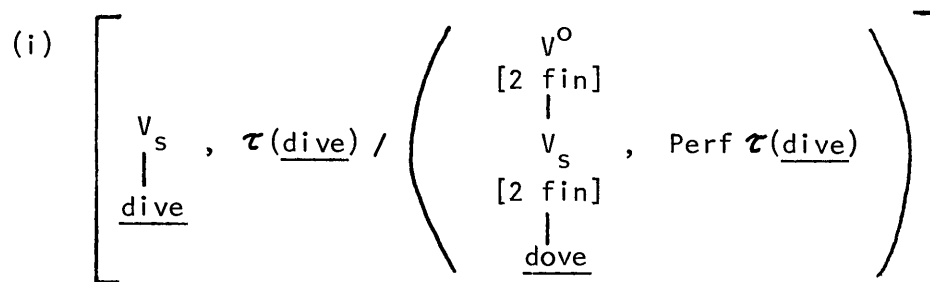
³ Halle (1973) gives two plausibility arguments in favor of this suggestion, neither of which is compelling. The first is theory-dependent and does not hold in theories in which lexical insertion occurs at surface structure, such as the one assumed in Lapointe (1980); the second, which involves the traditional notion 'change through paradigm pressure', requires a more detailed description of the way in which stored paradigms actually exert pressure for change in order to be fully convincing. For some further discussion, see Lapointe (in preparation).

⁴ This assumption is different from the one made in Lapointe (1980) where it was assumed that stems as well as Afs could be governed by MIFs. The reasons for making this latter assumption had to do with the particular kinds of features which are involved in adjective agreement and the representation of such features in MS trees. These reasons are not at all necessary, and I have therefore adopted the more restrictive assumption about MIFs here in order to bring the present system closer in line with recent work by Selkirk (forthcoming) and Lieber (1980).

⁵ As pointed out by Wayles Browne in the discussion after the talk, regular and irregular alternate past tense forms in English have slightly different senses; for instance, Quirk (1970) in discussing dialect variation between regular -ed and irregular -t past forms (learned vs. learnt, burned vs. burnt, etc.) notes that the -ed forms have a durative sense while the -t forms have a punctual sense for many speakers of both the British and American dialects. This suggests that irregular forms need to be listed along with idiosyncratic semantic translations whenever this is

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required. The elementary entry for dive would therefore be as in (i) rather than as in (16).



The changes required in the definitions of elementary and inflectionally derived entries are straightforward; see Lapointe (in preparation) for details.

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