

A CONSUMER'S GUIDE TO CONTEMPORARY MORPHOLOGICAL THEORIES

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1. Preface

When a linguist goes in search of “the best” theory in some domain, it is important for him or her to ask “best for what purpose?” Individuals will of course prefer to work with an approach that makes sense to them, one that complements—or at least does not contradict—other assumptions they hold with respect to grammatical theory. This is not to say, however, that “it’s all relative,” that theory choice is solely an aesthetic selection from among notational variants. The relative quality of a theory can be evaluated on empirical grounds, based on the particular predictions that the theory’s assumptions entail.

In this study, intended as a consumer’s guide, so to speak, I give characterizations of various morphological theories currently used by different linguists. For the reasons stated above, in the theory characterizations to follow, I have chosen to begin each section with a table by which one may readily compare and contrast some of the guiding assumptions in each theory. Criticism of each framework, both theoretical and empirical in nature, will be presented where available, and replies or adjustments in the literature will follow. A bibliography of leading publications for each framework concludes the respective section.

2. How to Interpret a Table

The first continuum, *morpheme-based* versus *word/lexeme-based*, concerns the basic units assumed to organize morphological activity. In a strongly morpheme-based

theory, the *morpheme* is the atomic meaningful unit, and morphology is about how morphologically complex expressions come to have the meanings and attributes they do, thanks to these morphemic units. Morphological analysis, therefore, is analysis down to, and up from, the level of constituent morphemes. In a strongly word/lexeme-based theory, the *word* (subject to definition) is the organizing principle of morphological structure. Analysis below the word level, especially that which takes derived bases back to source roots is not of primary concern to such a theory. Derived lexical items may owe some part of their lexical character (semantics, grammatical category, phonology) to their source roots, but in word/lexeme based theories, the exhaustive analysis into parts is often (but not always) seen as an excess, a hypersegmentation which goes beyond the requirements of syntax at least, since rules of syntax are generally presumed not to care about the internal constituency of the words they manipulate (the Lexicalist Hypothesis (Chomsky 1970)).

The second continuum, *formalist versus functionalist*, has to do with a broader perspective on what linguistic theory and analysis are supposed to accomplish. This is therefore a fundamental distinction which may shape the types of phenomena one chooses to address, what sort of data constitute real counterexamples to theoretical claims, and what role evidence external to the grammar (language acquisition, psycholinguistic testing, sociolinguistic patterning, and typological evidence) is given in support or as counterevidence to a theory. Formalist approaches focus primarily on rules, constraints, and units which are particular to language structure, usually with the goal of capturing “all and only” those generalizations relevant to the characterization of linguistic competence. Functionalist approaches are interested more in contextualizing language as cognitively and socially grounded behavior. Functionalist analyses tend to be more tolerant of gradient behaviors, appealing often to constraint satisfaction, trade-offs, relative frequencies, etc. For these reasons in particular, functionalist discussion draws formalist fire for being fuzzy, vague, and indeterminate. Formalist approaches receive criticism for being artificially “neat” in the data they consider, abstracting over variation, and ignoring the language user as part and parcel of the language-use equation. This distinction might equally be termed “micro” versus “macro” theorizing, respectively.

The third continuum, *in grammar versus in lexicon*, refers to the “location” of morphology in the architecture of a grammar. Theories which place morphology in the grammar may do so as its own component or sometimes distributed among independently motivated components, typically syntax or phonology. Much work in generative morphology has taken an ‘in-grammar’ approach to morphology, according very little role indeed to the lexicon, other than as a repository for idiosyncrasy (e.g., Di Sciullo and Williams 1987). An approach which puts morphology in the lexicon, on the other hand, has a very different perspective on just what the grammar does. The lexicon is a repository for most if not all lexical knowledge, predictable or not, and the complex lexical entries interact with grammatical structures in as many distinct ways as grammatical structure requires. What the former approach gains in reducing redundant lexical listing it loses in its failure to naturally characterize inflectional paradigms, for example. The latter approach, on the other hand, presents the opposite problem, a rich and rather redundant lexicon, but an accordingly streamlined grammar. Issues of storage versus computation are relevant at this level, with computation being the focus of ‘in-grammar’, and storage the emphasis of ‘in-lexicon’. This is not necessarily an either-or

proposition, however, since it is possible, according to the Split-Morphology Hypothesis, e.g., to handle derivational morphology in the lexicon and inflection post-syntactically (Anderson 1982). Theories assuming some version of the Split-Morphology Hypothesis will be marked in the center column of this continuum.

The fourth continuum, *Phonological formalism* versus *Syntactic formalism*, is not entirely independent of the third, but neither is it fully predictable from it. Approaches which place morphology in the grammar will, for consistency's sake, tend to formalize morphological rules to be as similar as possible to the rules assumed for the relevant adjacent component of grammar. Word-Syntax (Lieber 1992; Di Sciullo & Williams 1987), for example, makes great use of hierarchical structure and percolation, whereas Lexical Morphology (Kiparsky 1982a) formalizes lexical and post-lexical phonological rules in similar ways, distinguishing them by domain of application, rather than making a formal distinction in rule construction. Approaches which place morphology in the lexicon, yet nonetheless use a formalism akin to some component of the grammar may do so for expository purposes, but there is less motivation on theoretical grounds to do so. A mark in the center column for this continuum will indicate a qualitatively distinct rule format for morphology.

Borrowing terminology from Stump (2001:2-9), the fifth continuum, *incremental* versus *realizational*, focuses on the input/output conditions on the morphological component. A choice along this dimension will entail a very different picture of just what morphology "does." In an incremental approach, the meaning and other attributes of morphologically complex expressions are built up gradually as a more or less additive process (thus 'incremental'). This addition can happen, metaphorically speaking, either through the concatenation of morphemes or through the application of morphological rules. From this perspective, every attribute or element of meaning not present in a lexical root must be added to that root in the morphology.

In a realizational approach, by contrast, the input to morphology is more abstract. A lexical base (whether root, lexeme, or lexical stem) and some set of properties (appropriate both to that base and to the context in which the complex expression finds itself) jointly determine the morphophonological 'spell-out' of the fully inflected word in that context. Incremental methods are most appropriate in describing languages where there is an overt exponent for all and only the meanings and attributes of the word in question, e.g., especially highly agglutinative languages, like Turkish. Where the overt morphology does not match one-to-one with the meanings and grammatical functions of the word as a whole, i.e., where the overt morphology either overdetermines or underdetermines the whole, an incremental approach will be forced into either abstract or *ad hoc* elements in the analysis, either phonetically null (zero-)morph(eme)s, or rules which apply but effect no discernable phonological change (roughly, a zero-derivation).

There are many undesirable consequences of countenancing null elements in an analysis, even if their "distribution" is constrained, not the least of which is learnability, i.e., how does a child know a zero when s/he "hears" one, and how does a child recognize which zero s/he "heard"? Realizational frameworks can, in principle, avoid the zero-morph trap because the association between a word and its morphosyntactic features is the input to the morphology, i.e., the meaning 'licenses' the presence of particular

exponents, the meaning does not ‘depend’ on the introduction of meaningful pieces. What an incremental approach gains in concreteness of representation, it loses when faced with morphemes without meaning (so-called ‘empty morphs’) or meanings without exponents, as mentioned above. On the other hand, what the realizational perspective gains in formal versatility, i.e., empirical coverage, it loses in its apparently unnecessarily complicated treatment of the most transparent morpheme-like instances of morphological composition. This would not be such a problem if edge affixation were no more common than other types of morphological marking. As it is, however, the disproportionate amount of concatenative morphology found cross-linguistically looks rather like an accident on the realizational approach.

Now, it is certainly possible to think of more theoretical distinctions that one could use in the classification of morphological theories, and likewise it might also be possible to make do with fewer distinctions. This set of five, however, allows for some interesting similarities and differences to come out, and the dimensions are substantial enough that any given linguist can quickly identify the theory or theories which best match their own predispositions.

Accordingly, in what follows, I survey 13 current theories of morphology: A-Morphous Morphology, Articulated Morphology, Autolexical Syntax, Categorical Morphology, Distributed Morphology, Lexeme-Morpheme Base Morphology, Lexical Morphology and Phonology, Natural Morphology, "Network Model", Network Morphology, Paradigm Function Morphology, Prosodic Morphology, and Word Syntax, and discuss each according to the classifying features just described. I then, in the appendices, show how each theory would handle the facts from two well-known morphological phenomena: inflection of nouns in Scottish Gaelic, and verb agreement in Georgian.

3. A-Morphous Morphology

Morpheme-based					<input checked="" type="checkbox"/>	Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar			<input checked="" type="checkbox"/>			In lexicon
Phonological formalism		<input checked="" type="checkbox"/>				Syntactic formalism
Incremental					<input checked="" type="checkbox"/>	Realizational

Many of the assumptions which coalesced in the form of Anderson (1992) are laid out in an extended series of articles stretching back over at least fifteen years. While continually pointing out a resurgence of interest in morphology as a field of inquiry in linguistics after an extended drought, Anderson just as repeatedly asserts (1977:17) that “the notion of a separable morphological ‘component’ is probably untenable.” The name A-Morphous Morphology is intended to directly challenge the traditional role of the morpheme as a primitive in word structure, focusing instead on lexical roots or stems, and operations applied thereto. Halle and Marantz (1993:112-13) are baffled by this move and fundamentally misappraise the claims made by Anderson (1992), assuming that morphemes must be included in Anderson’s structural representations, the morphemes’ phonological representations then removed, and (incredibly) reinserted later in the derivation, for how else could morphosyntactic information get into a syntactic

structure than through the insertion of meaningful pieces (i.e., morphemes), however temporarily or covertly? Explicitly acknowledging the asymmetry between lexical roots and morphological operations constitutes something of a paradigm shift (no pun intended) in morphology, and between the word-based and morpheme-based camps is quite a large chasm (cf. Aronoff 1976, 1994; Anderson 1988b:162-64; 1992:48-72; Zwicky 1992:338).

In A-Morphous Morphology (and its immediate predecessor, the Extended Word and Paradigm (EWP)¹ framework, from which there is little discernable break), primary attention is given to inflection (Anderson 1977, 1988a, 1992:ch. 4-6). In EWP, for example, derivation, cliticization, and compounding each get one chapter to inflection's three chapters.

The lexicon in A-Morphous Morphology is not the minimal "idiosyncraticon" (Zwicky 1992:338) inherited from Bloomfield (1933:269), but rather an un-list-like collection of knowledge that a speaker may have, governed by rules of varying generality (Anderson 1992:183). Anderson takes the relevant word-like unit to be the *stem* (using the word *lexeme* rarely, if at all), derivation to be a lexicon-internal phenomenon (cf. LMBM, below; contrast PFM, also below), and inflection to "fall 'outside the lexicon' in the sense that [inflectional rules] represent knowledge not of particular words, but rather of the form taken by words as a consequence of the syntactic structure in which they appear" (Anderson 1992:183-84). The model of the grammar (see Anderson 1982:594), then, entails the Split Morphology Hypothesis (Perlmutter 1988; Booij 1993; cf. Beard 1995), with inflection effectively 'in' the syntax and derivation in the lexicon.

An interesting perspective may be gained through the comparison of the attributes of inflectional and derivational word-formation rules (WFRs) in A-Morphous Morphology (Anderson 1992:123, 185):

Inflectional WFRs are characterized by:

- a. A formal Structural Description, specifying conditions on **S** (the lexical stem in the input) and conditions on **M** (the aspect(s) of the morphosyntactic context realized by the particular WFR); and
- b. A formal Structural Change, which may involve "not only affixation but also other phonological changes such as metathesis, substitution, deletion, etc." (123);

whereas Derivational WFRs are characterized by:

- c. A formal Structural Description, specifying the class of input stems the rule can apply to and any additional conditions;
- d. A formal Structural Change, specifying the alteration the rule performs in creating the phonological form of the derived stem from the form of the input stem;
- e. A Syntactic Structural Description and Change; and
- f. A Semantic Structural Description and Change.

¹ The name EWP is perhaps at odds with the limited usefulness Anderson (1992:79) ascribes to the notion *paradigm*.

Inflectional WFRs are not additive, or 'invasive', beyond the level of the phonological form (contrast the rules of AM, below). Because of the inflectional feature content of a particular syntactic terminal node, its associated morphosyntactic representation (MSR) 'licenses' (not Anderson's term) the introduction of inflectional exponents via inflectional WFRs, i.e., inflection *presupposes* the morphosyntactic representation, rather than *creating* it, as the metaphor goes in morpheme-based frameworks. Derivational WFRs can potentially effect a broader range of changes in the input, but this is done without reference to particular (morpho-)syntactic contexts.

In contrast with the Word Syntax and LMBM positions (both below), A-Morphous Morphology accords little significance to word internal derivational hierarchical structure, since syntax apparently does not have or need access to that sort of information (the Lexicalist Hypothesis (Chomsky 1970)). The intricate relationship of inflection and syntax, however, leads Anderson (1992:84) to conclude that the Lexicalist Hypothesis must be relaxed in inflection, although it may safely be assumed to hold in derivation. Compounding is a hybrid case in A-Morphous Morphology (Anderson 1992:292), because there is motivation for a syntactically-accessible hierarchical structure in headed compounds, in contrast with ordinary derivation: "The formation of compounds seems to involve a genuinely syntactic combination of lexical elements below the level of the word."

Probably the most noteworthy and controversial aspects of A-Morphous Morphology have to do with the implementation of inflectional WFRs so that the "inflectional formatives of a word [are placed] in their correct relation to one another" (Anderson 1992:123). The null hypothesis is that no special ordering mechanisms will be required, and an unordered list of morphosyntactic features will be sufficient to direct the phonological realization automatically. This cannot be the case, however, for two reasons:

1. one and the same inflected word may bear two or more distinct values for the same morphosyntactic feature (e.g., agreement in Person and/or Number for multiple arguments of a verb)(Anderson 1977:23), and
2. of two or more contextually motivated inflectional rules, there are numerous cases cross-linguistically where only a subset of these rules actually apply, implying a disjunctive relation between particular rules (Anderson 1986:7-8).
Rather than a full conjunctive application of all applicable rules, or the more limited (but still reasonable) expectation that every feature be realized at least once in the inflected form, the actual details of realization require that some provision be made in an adequate grammar for rule ordering.

In response to the first issue, Anderson (1977:21) proposes that words in syntactic contexts have *morphosyntactic representations* (MSRs, mentioned above), i.e., inflectional feature matrices whose contents are internally unordered by default, but which gain layers just in case "a rule of the grammar assigns features to an element, and that element already carries specifications for those features" (see also Anderson 1992:94). For example, an MSR with complex [-F +G], if further assigned the value [+F], will not unify to *[+F -F +G], but rather to the layered structure [+F [-F +G]], with any and all duplicate features (whether they bear contrastive values or not)

appearing in an outer layer with respect to earlier-assigned and unduplicated feature-value pairs. Layering is in principle unlimited, but there is apparently no practical need for more than three layers in any one MSR. Similarly, there is no overt constraint that layering is limited to agreement (or so-called Φ -)features and so, to the extent that layering is not invoked except in cases of repeated or conflicting person, number, gender, case, or animacy specifications, this generalization is missed. If layering is triggered during the sequential creation of an MSR (it must be sequential in order to determine, in cases of duplicate features, which instance is inner, and which outer), the inherent features of a possessed noun should be inner with respect to those of a possessor and correspondingly, the internal arguments of a verb should be inner with respect to external arguments. In Anderson (1977:21), the token offer at an alternative formalization is made, more specific features “[\pm 1st person possessor], [\pm plural possessor], etc., but this would be of little interest.” This is true, certainly, and a fairly *ad hoc* response to the situation, but it is owing to the binary nature of features in A-Morphous Morphology (cf. *n*-ary features in, e.g., PFM, below).

In the case of Georgian “inversion” (e.g., Harris 1981, 1984; Anderson 1984), Anderson (1992:141-56) proposes a “purely morphological transformation” whereby an inner layer of the MSR is moved to an outer position. Thus, inflectional WFRs which happen to be keyed to particular layers (i.e., have particular layers specified as part of their Structural Description) will be effectively ‘tricked’ into applying to a different layer, producing the observed agreement marking mismatches (see Appendix B for some discussion). In order to ‘force’ features into particular layers, however, Anderson (1992:147) invokes a dummy placeholder, apparently the only instance of a zero in A-Morphous Morphology. In its favor, the zero is purely formal, and has neither semantics nor reference (cf. zeroes in DM, Word Syntax, below). Such uses of the MSR device allow A-Morphous Morphology to engage in a measure of “virtual Relational Grammar,” while technically avoiding a backwards reach into syntax proper.

On the issue of disjunctive rule ordering, A-Morphous Morphology relies on a version of the Elsewhere Condition (*EC*; Anderson (1969), Kiparsky (1973), not to mention Pāṇini). The Pāṇinian Principle, often mistaken for the full EC, is a precedence principle, whereby the most narrowly defined of a set of competing rules (alternatively, morphemes; see DM, below) precedes the other competitors in application, and thus rules may apply conjunctively or disjunctively and still respect the Pāṇinian Principle (cf. PFM, below, in which disjunctive application is derived independently). Anderson’s (1986:4, 1992:132) EC formulations include a (weak) disjunctivity rider:

“...whenever one rule is more specific than another in the sense that the forms subject to the first constitute a proper subset of those subject to the second, the application of the more specific rule precludes the later application of the more general, less specific one.”

Anderson (1992:132, fn. 30) notes that this formulation entails disjunctive application only if the more specific rule applies, and applies first. Subtly, therefore, this EC allows four of the five logically possible outcomes of trying to apply two rules, a specific one (**S**) and a general one (**G**) (Janda (n.d.):3):

- (neither applies)
- G (only G applies)
- S (only S applies—G, which must be applicable given the ‘proper subset’ definition above, is blocked by the EC, i.e. *S, G)
- G, S (G applies first, S is not blocked by the EC, and therefore applies as well)

This condition is claimed to account for disjunction between rules, between a stem and a rule, and between stems as well (Anderson 1986:4, 1992:133-34). This principled disjunctivity is not empirically justified, however², and so Anderson (1992:129) adds not only the device of stipulated *rule blocks* (the rules within which blocks may, but need not, realize the same or similar inflectional properties), but also the option of extrinsic (*ad hoc*) rule ordering within these blocks, substantially weakening the predictive power of the account overall. The result is an observationally adequate description, but there is little insight into why the observed order obtains rather than any number of readily describable alternative patterns. Similarly unaccounted for is the tendency for disjunctively related exponents to have similar if not identical linear placement restrictions with respect to the stem (cf. PFM, below).

Although it makes rather less use of the *word* and the *paradigm* than one might expect from a “word-and-paradigm” type of theory, A-Morphous Morphology makes a number of important and provocative contributions in its denial of the relevance of the morpheme as a basic unit of language. A-Morphous Morphology borrows some trouble by adopting the Government and Binding (GB) approach to syntax which is not particularly morphology-friendly. Unlike LMBM and DM (both below), however, A-Morphous Morphology does not focus on the formal interface as much as the logical necessities such an interface would entail, and is therefore somewhat vague. Anderson borrows Chomsky’s (1981:92) dismissive phrase “merely a matter of execution” on two occasions—instead of taking a stand on when “lexical insertion” should happen (i.e., at D-Structure (DS) or S-Structure (SS))(1992:91, fn. 16), and when tentatively considering whether Generalized Phrase Structure Grammar (GPSG) might not have a better account of agreement than GB (1992:109). Of course, this is a theory of morphology, and so some hand-waving with respect to syntactic-theoretic detail is no great flaw. The architecture of grammar given in Anderson (1982:594) is much more specific, and already in that article it is suggested that SS is the locus of “lexical insertion” and that derivation was ‘in the lexicon’, but the diagram clearly includes “inflection” in a component marked “Phonology.” This is misleading, however, because MSRs are present at SS, however, so ‘inflection’ here must refer to feature realization, the application of inflectional WFRs.

As an analytic tool, the formalism of A-Morphous Morphology is generally transparent, and accommodations are made for both affixal and more processual operations. Trouble spots are generally restricted to truly controversial areas (e.g., the EC and language-specific ordering). That compounds, clitics, and morphophonology are treated as well in Anderson (1992) is especially helpful, although it remains clear that

² For counterexamples, see Janda and Sandoval (1984); for extended discussion and further counterexamples, see Janda (n.d.).

Anderson's answer to his own (1982) question "Where's morphology?" is an ambivalent "everywhere, yet nowhere," that is, in many places, not one single place.

Anderson, Stephen R. 1977. On the formal description of inflection. *Chicago Linguistic Society* 13.15-44.

Anderson, Stephen R. 1982. Where's morphology? *Linguistic Inquiry* 13(4).571-612.

Anderson, Stephen R. 1984. On representations in morphology: Case, agreement, and inversion in Georgian. *Natural Language and Linguistic Theory* 2.157-218.

Anderson, Stephen R. 1986. Disjunctive ordering in inflectional morphology. *Natural Language and Linguistic Theory* 4.1-31.

Anderson, Stephen R. 1988a. Inflection. *Theoretical Morphology*, ed. by Michael Hammond and Michael Noonan, 23-43. San Diego: Academic Press.

Anderson, Stephen R. 1988b. Morphological theory. *Linguistics: The Cambridge Survey* [vol. 1], ed. by Frederick J. Newmeyer, 146-91. Cambridge: Cambridge University Press.

Anderson, Stephen R. 1992. *A-Morphous Morphology*. Cambridge: Cambridge University Press.

4. Articulated Morphology

Morpheme-based				<input checked="" type="checkbox"/>		Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar		<input checked="" type="checkbox"/>				In lexicon
Phonological formalism			<input checked="" type="checkbox"/>			Syntactic formalism
Incremental	<input checked="" type="checkbox"/>					Realizational

Of all the frameworks to be considered here, Articulated Morphology (AM) stands with the least representation in the literature. It is noteworthy, however, because it is set out in significant detail in Steele (1990, 1995), and it has a unique combination of attributes. It is "amorphous" in the sense that affixation is secondary with respect to lexical stems, yet AM is incremental in that no information (beyond the root) is present in a complex construction that the application of some rule did not put there. Operations are parts of rules, and these rules are applied so as to create an output of the intended sort. AM is limited to the inflectional domain (Steele 1995:261), and so some of the questions a more general theory faces are not addressed here. Since the framework presupposes the operation of derivation, and since the rules are construed as applying to stems, AM may fairly safely be characterized as word/lexeme-based in its orientation. Inflectional rules in AM are strictly information-adding—they cannot replace or delete information already present in a morphological object to which they apply.

Because rules must be sensitive to the informational content of their inputs, the question of extrinsic ordering of rule application is neatly sidestepped. A rule applies to an object of a certain type and augments its informational content, possibly modifying its phonological shape in the process (262). Since AM is not morpheme-based, it is no problem to construct a rule which adds information but performs no phonological operation whatsoever. This sort of rule is an identity function on the phonological level, so a “zero-morph” is not introduced into the structure, which results in the following metatheoretical bonus (Steele 1995:288-89):

Potawatomi: rule adding [singular] in the transitive animate

X		X
[] [ANIM: +]	→	[] [ANIM: +]
Person: -speaker, -hearer		Person: -speaker, -hearer
		Number: singular

AM is based on three principles (Steele 1995:271-72):

1. Associate a stem with that informational subpart specifically identified with the stem, in the absence of the inflectional operations at issue (i.e., stems are informationally reduced);
2. Analyze inflectional operations as adding information to the morphological object they are performed on (i.e., rules result in feature specifications; they may add values for as-yet-unspecified features present in their input, they may add feature-value pairs not at all present in the input, or they may do both at once);

and

3. Classify morphological objects according to the kind of information they present, and classify operations according to the kind of object they are performed on and the kind of information they add.

Steele claims that these principles allow “the organization of a morphological system in AM [to be] entirely *intrinsic*, driven by the fact that the operations effecting phonological modifications also introduce a distinctive kind of information to a particular kind of morphological object” (272-73). While other theories try very hard to prevent access to the internal structure of bases/stems beyond the outermost layer (LM&P, see below), AM invests its rules with rich conditions on application, stating what rules must have already applied before the rule in question may apply.

The AM approach may work so long as, for example, exponents of Person occur consistently inside a rule introducing Number. The rule introducing Number could (and would) be written with a reference to the pre-existing specification for Person. If some Person exponents appear before and others after, this would effectively block the application of the rule introducing Number in the latter cases. Responses to this situation could be of at least two sorts—either the introduction of a second (back-up) rule

introducing the Number information without the crucial Person information in the base, or else rendering the Person information in the base optional. In the latter case, however, the intrinsic ordering effect is lost, since the rule could then apply optionally before or after the rule introducing Person information. (Georgian comes to mind—see Appendix B—as an example of a language where exponents of the same basic category appear in radically different positions with respect to the stem.) Steele (1995) avoids dealing with prefixal subject Person markers in Potawatomi, for example, by claiming that these are likely proclitics rather than inflectional markers, and thus outside the domain of inflection (273, fn. 14; 278-79).

AM rules formally consist of a *domain* (input conditions) and a *co-domain* (output conditions), as essentially a before-and-after photo set of the representation (Steele 1995:276). There is no acknowledgement that the rules are consequently highly redundant, that if one subtracts the domain contents from the co-domain, the difference would be simply an inflectional morpheme. The contrast with A-Morphous Morphology is quite apt, since its realizational emphasis on fully-specified representations and minimal rules is exchanged in AM for minimal representations and enriched inflectional rules. Steele makes a virtue of AM's capacity for allowing "in principle, any number of distinctions in the morphological types" (279)—Potawatomi requires three or four, depending on whether the person prefixes/proclitics are in or out of inflection (277, 279):

Stem: "a morphological object lacking Number"

Extended Stem: "a transitive object that has one fewer N[umber] attributes than arguments"

Word: "an object whose arguments are all associated with the property of Number"

Indexed Form: "a morphological object where both Person and Number are saturated"

These definitions are not only specific to the Potawatomi language; they are specific to verbs within the Potawatomi language. Nouns and adjectives would certainly require different definitions within the same language, and all of these are subject to cross-linguistic redefinition. Languages with fusional agreement markers would, presumably, rule out the extended stem type of object since the same rule would always have to introduce both Person and Number at once. The result is that there is no definition of *stem* and *word* independently available, separate from language-particular systems. If operations are classified "according to the kind of object they are performed on and the kind of information they add" (Steele 1995:272, part of principle 3 above), this inextricably ties the operations to language-specific details as well, and thus both the operations and the morphological object types lack all but the most abstract generality. This is not a descriptive advantage. A-Morphous Morphology is derided for being able to express the following "simple generalizations" (279-80):

1. Suffix₁: stem → stem
2. Suffix_{2a}: transitive stem → extended stem
3. Suffix_{2b}: stem → word

$$4. \text{Suffix}_3: \left\{ \begin{array}{l} \text{intransitive stem} \\ \text{extended stem} \end{array} \right\} \rightarrow \text{word}$$

Steele apparently does not take into account that these “simple generalizations” are effectively telling us what each suffix does, i.e., this is a morpheme-based set of statements. It is neither surprising nor a defect in A-Morphous Morphology that it cannot make these statements.

AM's intrinsic rule ordering would be more impressive if there were any relation to the distribution of inflectional properties as handled by the syntax. The proper application of rules in a derivation presupposes knowledge of the properties of the goal state, the triggers for the application of these rules. Once they get started, as promised, the rules will not apply until they are supposed to, sequentially speaking, but there is feigned ignorance of the overall goal state that any given inflectional derivation is intended to achieve. The logic of this incremental (re-)creation of a known end-state in the morphology is directly attributable to the too-literal interpretation of the derivation metaphor³. Other problems include the necessary introduction of stipulated negative conditions on the domain for a significant number of the rules proposed (Steele 1995:291, 294, 296), floating feature values where problematic feature unifications are foreseen (287), and *ad hoc* ‘avoidance strategies’ to block formally predicted but actually unattested effects of rules, e.g., the AVOID 3RD PERSON strategy (287), something that the inflectional component should never have to do, unless it were trying to take over functions more appropriately located in the semantics and syntax.

The formal and potential empirical difficulties that AM faces (even in the analysis of Potawatomi, the data set which was chosen specifically to show off the advantages of the theory) go a long way toward inadvertent self-incrimination. AM offers little prospect of yielding cross-linguistically comparable descriptions, but if a linguist is interested in describing individual languages on their own terms, without reference to meaning or structure outside of inflection, then AM might be suitable.

Steele, Susan. 1990. Pass it on! A combinatorics-based approach to feature-passing. *Chicago Linguistic Society* 26.407-21.

Steele, Susan. 1995. Towards a theory of morphological information. *Language* 71(2).260-309.

5. Autolexical Syntax

Morpheme-based		<input checked="" type="checkbox"/>				Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar				<input checked="" type="checkbox"/>		In lexicon
Phonological formalism				<input checked="" type="checkbox"/>		Syntactic formalism
Incremental		<input checked="" type="checkbox"/>				Realizational

³ Word Syntax also pays special attention to overcoming the same concern.

Autolexical Syntax directly addresses the interface between syntax and morphology. Sadock (e.g., 1988) has assembled a modular, but or non-serial modular non-serial, theory of grammar, in which semantic, syntactic, and morphological modules operate separately, yet simultaneously constrain the class of well-formed expressions in a language. In this way, a potential expression may be semantically interpretable, but not syntactically parsable, or vice versa, and in either case the expression would be ruled out. The same is true with respect to morphological structure. The suggestion is, then, that one can ‘troubleshoot’ any ungrammatical expression and trace the source of the problem to one or more of the components. More recent work in the framework (e.g., Singer 1999), however, has invoked the violable-constraints approach of Optimality Theory to allow for variable effects of violations of the requirements of the three components, undercutting the restrictiveness of the original model. Although Sadock uses the term *lexeme*, he never directly defines it. He clearly includes affixes, clitics, bound roots, and stems in this category, and thus his definition must be something closer to the traditional *morpheme*, although morphologically complex stems are treated as units by the rules of morphology. This stand puts Autolexical Syntax at or at least near the morpheme-based pole of the first continuum.

Sadock (1991) proposes a subsystem (not a *module* in the sense of Fodor (1983)) which he calls the *Interface*. This subsystem has “direct access to all varieties of grammatical information” and uses this information to coordinate “the several representations produced by the autonomous modules”(36). The lexicon is a part of the interface subsystem, and it, too, does not constitute a module in its own right. A grammatical (i.e., well-formed) expression of any size in a language corresponds to a triple $\{r_{\text{syn}}, r_{\text{sem}}, r_{\text{mor}}\}$ of acceptable outputs from the three components posited in this grammar (20; cf. triples in *Categorial Morphology*, below). The lexical entry for any “lexeme” in this theory is a set of three representations, one for each component, and these three representations define the grammatical use of the “lexeme” (30). For example, *dog* would have the following lexical entry:

dog
 syntax = N[0]
 semantics = F-1
 morphology = N[-0]

This means that *dog* is a noun, bar-level 0, a function of one variable on the semantic level, and a noun stem, from the point of view of morphology. Somewhat counter-intuitively, the minus (-) on a morphological bar-level representation is simply a marker of the morphological domain of analysis, i.e., a greater negative integer does not mean a smaller morphological unit, but rather a larger one, such that [-0] is a stem, [-1] is a(n inflected) word, and [-2] is a “super-word”, i.e. a word plus an attached clitic element. Lexical stems and larger expressions—those “placed” by the syntax—have a specific syntactic representation. Affixes, on the other hand, have a semantic and a morphological representation, but no syntactic representation, therefore they are inaccessible to (not manipulable by) the rules of syntax. While Sadock does not make the claim that all morphology is concatenation, he sets aside non-concatenative processes to be handled (at

another time) autosegmentally, in the manner of Prosodic Morphology (McCarthy 1981, see below).

The formal focus in Autolexical Syntax is clearly on (primarily binary-branching) tree structures, and the representations within lexical entries are interpretable only with respect to such tree structures. Much of Sadock (1991) is devoted to cases where the structure implied by one component is at odds with that of another, such as the cases of clitics, which attach morphologically to constituents other than syntax or semantics might suggest (48), or incorporation, whereby arguments, which are syntactic atoms in the general case, are morphologically proper subparts of other words (79). The precise details of these analyses are not important here, besides the general clue that the mixed behavior is ironed out within the simultaneous triple representation, as facilitated by principles of the Interface subsystem. As Sadock rightly points out, such a “simultaneous treatment ... is precluded in a hierarchical model of grammar, where the output of one component is modified by the next component downstream” (51). Both clitics and incorporation have been chronic sources of aggravation and fascination in grammatical theory, and so it seems a genuine advance to have a fairly unified account of them.

Sadock (1988:281) proposes a classification scheme for “lexemes”:

	I	II	III	IV	V	VI	VII	VIII
Syntax	+	+	+	+	–	–	–	–
Semantics	+	+	–	–	+	+	–	–
Morphology	+	–	+	–	+	–	+	–

where + means “has a representation in that module” and – “has no representation in that module.” Of these eight classes, class VIII is ruled out in principle as being empty in every regard, a victim of “intermodular suicide” (281). Sadock identifies instances of classes I, III, V, and VII, i.e., those classes which have at least a morphological representation. Class I is exemplified by the ordinary lexical stem, like *dog* above, with a representation at all three levels. Class III is exemplified by pleonastic and purely functional elements like dummy *it*, infinitive *to*, and complementizer *that* (280). Class V is a derivational affix, which is semantically a property expression, a function on the meaning of the stem, e.g., the German diminutive *–chen*, as in *Hühnchen* ‘chicken, pullet’, but which has no independent representation in the syntax (281-82).

–chen

syntax = nil

semantics = Prop

morphology = N[M1, Ntr]/N

‘M1’ refers to a particular morphological rule in Sadock (1988:274), category-changing derivation on a stem, and the slash formalism is parallel to that used in Categorical Grammar. The ‘Ntr’ condition on the affix is a condition imposed on the output of affixing *–chen* to a stem, i.e., the result will be of neuter gender. In this sense, Sadock claims, the affix is the head of the construction (akin to the ideas of Williams 1981, but with a more substantial, rather than positional, definition of ‘head’). Class VII is a stem forming element like the *–s* in the non-head of certain German compounds, e.g.,

Freiheitskämpfer ‘struggler for freedom’, where the *-s* is not simply the genitive marker (gen. *Freiheit*).

-s
 syntax = nil
 semantics = nil
 morphology = N[M2, CF]/N[F]

Such elements have no syntactic or semantic representation, they are present in the morphology only, for the creation/marketing of a combining form (CF), a stem (formed by lexemes of class N[F]) for use in compounding only, by means of morphological rule 2 (M2; Sadock 1988:247, 282). A more complete classification takes the five attested classes of lexemes and contrasts them in terms of the general formal content of their representations in the three modules (289):

	Stem	Inflectional	Derivational	Incorporating	Clitic
Syntax	X[0]	_____	_____	[_{v[1]} X[2]__]	[_{z_n} X[2]__]
Semantics	Property or Relation	_____	F(X[0])	F(X[2])	F(X[2])
Morphology	X[-0]	[_{x[-1]} X[-0]]	[_{v[-0]} X[-0]]	[_{v[-0]} X[-0]]	[_{w[-2]} Y[-1]]

These formulations are intentionally abstract on Sadock’s part, and the variables allow for a range of instantiations of each type.

A more satisfying contextualization of the “lexemes” is to be found in the set of intermodular defaults based on Sapir (1921), at least in spirit. These are predictions that hold in the general case between a representation in one module and that in another.

1. Prop or Rel → X[-0]
 If a lexeme is semantically a property or a relation, then it is a morphological stem.
2. X[-0] → X[0]
 If a lexeme is a morphological stem, then it is a syntactic atom.
3. X[M1] → semantics = F(Y[-0])
 If a lexeme is subject to morphological rule 1 (as *-chen*, above), then it has the semantics of a function on a stem.
4. X[M2] → semantics = nil
 If a lexeme is subject to morphological rule 2 (inflection, (274)), then it has no independent semantic representation.
5. X[M_n] → syntax = nil
 If a lexeme is subject to any morphological rule whatsoever, then it has no independent syntax.

These are defaults only, of course, and particular “lexemes” in various languages can override these defaults, but at a cost. The prediction of Autolexical Syntax is that “the more deviant a form, the rarer it is both among languages of the world and within the lexicon of a particular language” (289). This of course raises the question of the nature of such a “form” that both exists within one language and has a cross-linguistic frequency as well.

In a more general assessment, Autolexical Syntax commits one to a fairly idiosyncratic architecture of the grammar, and the interactivity of an omniscient and omniscient interface subsystem is somewhat worrisome as a theoretical construct (see Sadock's (1991:20) Figure 2.1 for a graphic 'black hole' metaphor). The theory is at its best when it takes on clitics and incorporation, but its take on more commonplace morphology is rather less insightful. Whereas many theories which posit components make the components themselves do most of the work and an interface (if any) tidies up around the edges; in Autolexical Syntax, by contrast, the components are essentially abstract formal filters on what takes place in the arena of the Interface, where representations are compared and lexemes inserted in structures.

Spencer (1993:151) wonders in a review quite pointedly, "do we need the machinery of Autolexical Syntax to account for all this?" Spencer's answer is "no," and it does indeed seem that even though the formalism is not in itself unnecessarily powerful, the character of the Interface, inasmuch as the three representations of any expression need not in principle have much of anything to do with each other, belies the well-considered formalism. The account of cliticization also has some empirical challenges (Spencer 1993:149-50) in the area of 2P clitics in Serbo-Croatian. A user of Autolexical Syntax must be aware that even though Sadock invokes a number of major theories (GPSG (Gazdar et al. 1985), Prosodic Morphology (McCarthy 1981), Word Syntax (Selkirk 1982), Stratificational Grammar (Lamb 1966), Montague/Categorial Grammar (Dowty 1979)), and claims to be borrowing from them at several points, the overall Autolexical picture is not readily compatible with the broader range of assumptions found in any of the sources, and so an Autolexical analysis will be somewhat "in a world of its own"—a potentially stimulating world, but isolated nevertheless.

Sadock, Jerrold. 1985. Autolexical syntax: A theory of noun incorporation and similar phenomena. *Natural Language and Linguistic Theory* 3.379-440.

Sadock, Jerrold. 1988. The Autolexical classification of lexemes. *Theoretical Morphology*, ed. by Michael Hammond and Michael Noonan, 271-90. San Diego: Academic Press.

Sadock, Jerrold. 1991. *Autolexical Syntax*. Chicago: University of Chicago Press.

6. Categorial Morphology

Morpheme-based		<input checked="" type="checkbox"/>				Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar			<input checked="" type="checkbox"/>			In lexicon
Phonological formalism					<input checked="" type="checkbox"/>	Syntactic formalism
Incremental		<input checked="" type="checkbox"/>				Realizational

Schmerling (1983) calls for a return to fundamentals among practicing Montague Grammarians, particularly those who were practicing the category theory (Montague 1973) without involving Montague's (1970) particular brand of linguistic metatheory, which is indeed quite different from the standard assumptions in other theories of grammatical structure. Schmerling notes that, from the perspective of Montague (1970), the theoretical framework "has distinct phonological, syntactic, and semantic *systems*, while invoking neither 'morpheme' nor 'levels'" (Schmerling 1983:222). Schmerling takes the core of a language to be a set of expressions *A* and an indexed set of operations. The set *A* contains not only the basic expressions (i.e., morphological simplexes), but also "all the expressions derived from these by repeated application of the operations; it contains nothing else" (223). Schmerling characterizes her version of Montague Grammar as a formalization of the Item-and-Process (IP) approach to word formation (although the lexicon she defines is more populous than a morpheme-based theory typically requires)(223). It is not about the position of discrete meaningful pieces (à la Item-and-Arrangement (IA)), but rather operations, separate from the words they participate in defining (224). The remaining parts of language are "an assignment of category indices to the basic expressions ... and a set of rules to assign category indices recursively to derived expressions" (223). A category-assigning rule is tripartite, containing (1) the index of the operation employed in the rule, (2) the index of the input categories, and (3) the index of the output category of the rule (223-24).

The idea of operations applying at the edges of expressions, despite Schmerling's de-emphasis on concatenation, is a common occurrence in Categorical Grammar. The pattern of functors taking arguments, and together forming a larger expression of a distinct category is the bread and butter of the theory, so to speak. Schmerling (1983) in particular talks about things that happen in response to cliticization, an example of "internal modification of an expression at its periphery" (226). Mutations and alternations, as operations, are assumed to be triggered by edge concatenation (226-27). This assumption is in trouble on empirical grounds for untriggered mutations and ablaut, e.g., English *man/men*. Cases like these involve affixation only under remarkably abstract assumptions, and actually support her early argument that morpheme-as-thing (IA-type) analyses are unnecessarily limited. Her approach to portmanteau forms such as French *du* and *au* involves a substitution operation of the "amalgamated" form for the sequence, *de + le* and *à + le*, respectively (228-30). Cliticization is similarly to be handled by a substitution of the clitic group for the host (226).

At a more concrete level, if we take any given operation to be the equivalent of any other, then non-concatenative morphology is no different from concatenative morphology. If, on the other hand, we consider the relative power and latitude of a substitution operation as opposed to an operation which takes an expression as an argument and *does something to that expression*, it seems that non-concatenative operations do not achieve equality in Schmerling's model.

The next major step in Categorical Morphology is Hoeksema's (1985) dissertation. Written without reference to Schmerling (1983), Hoeksema acknowledges that there is more to morphology than edge affixation, but decides to forgo those complications until after a solid theory of Categorical concatenation is in place. Hoeksema takes the more conservative approach to Montague metatheory, whereby expressions are represented as

triples: a phonological projection, a categorial projection, and a semantic projection, formally (12):

For every lexical entry L : $L = \langle p_p(L); p_c(L); p_s(L) \rangle$

Hoeksema (1985) is not particularly interested in phonological details, so the phonological projection, where mentioned at all, is typically just the standard orthographic form of the expression in question. Similarly, the details of the semantic projection are left fairly underspecified—where necessary, the semantic projection takes the form of expressions of intensional logic (13). The categorial projection, Hoeksema's (1985) true interest, is given significantly more detailed discussion. Basing the “word syntax,” as he puts it, on the general framework of Categorial Grammar, “the categorial representations will be members of the set defined by the recursive statement” (13):

X is a category iff:

- (i) X is a member of the set of primitive categories PC (i.e., N, NP, and S); or
- (ii) X is of the form V/W , where V and W are categories; or
- (iii) X is of the form $V \setminus W$, where V and W are categories.

Now the primitive category set is truly minimal, and it entails some rather complex derived categories at times, e.g., $(NP \setminus S)/NP =$ transitive verb, i.e., an expression such that, if it finds an NP to its right, will form an expression $NP \setminus S$, which in turn, if it finds an NP to its left, will form an S (17). The information is “in there,” but it takes some patient unpacking.

Hoeksema (1985:17-22) has a clear morphemic bias, since he defines one-place versus two-place operations, based on whether concatenation is involved (two-place) or not (one-place). Again, as with Schmerling, this makes concatenative and non-concatenative morphology qualitatively different. One-place operations include substitutions and zero-conversion (alias *transpositions*), whereas two-place operations include affixation and compounding (17-18). One-place operations are set aside almost entirely for the remainder of the book (subsequent chapters focus on compositionality and different types of compounding).

It will be useful at this point to summarize the approach to affixation. The two-place operations employed in the Categorial Morphology of Hoeksema (1985:19) are *right-cancellation* (RC) and *left-cancellation* (LC), common in Categorial Grammar:

$RC(A/B, B) = A$ $LC(A, A \setminus B) = B$

These operations, incorporated into lexical rule schemata of prefixation and suffixation are as follows (19):

$Pref(v, w) = \langle [p_p(v) + p_p(w)]; RC(p_c(v), p_c(w)); p_s(v)(p_s(w)) \rangle$
 $Suff(v, w) = \langle [p_p(v) + p_p(w)]; LC(p_c(v), p_c(w)); p_s(w)(p_s(v)) \rangle$

Using these schemata, phonological projections are simply concatenated, categories are cancelled and resolved into new, derived categories, and semantic functors take scope over their arguments. This is fine as far as it goes, and Hoeksema (1985) has other fish to fry, so to speak, so the present focus should turn to Hoeksema and Janda (1988), where operations other than affixation take center stage.

In Hoeksema and Janda (1988), now in light of both Schmerling (1983) and Hoeksema (1985), the basic Categorical Morphology formalism is presupposed. From the very first expository section, ‘Addition’, context sensitivity beyond the purely categorial is assumed. Prefixation and suffixation, jointly referred to as *extrafixation*, are the only even potentially context-free operations (Hoeksema and Janda 1988:204). Addition operations which are context sensitive may be sensitive to phonological properties of their arguments (phonological constraints on the English suffix *-en* in *soften*, *tighten*), of prosodic constituents of varying sizes and qualities (e.g., consonants, vowels, clusters, syllables, stressed vowel/syllable etc.)—infixes are regularly placed with reference to one of these categories, rather than with reference to a morpheme boundary *per se*. Infixes and certain clitics are generally placed just within the edges of expressions, and a mechanism proposed by Bach (1984) called ‘wrapping’ is invoked to handle these cases. The first step is to distinguish the first and last elements in a string from the non-first and the non-last, respectively.

Let x be the string $x_1 \dots x_n$.

(i) $\text{FIRST}(x) = x_1$

(ii) $\text{RREST}(x) = x_2 \dots x_n$

(iii) $\text{LAST}(x) = x_n$

(iv) $\text{LREST}(x) = x_1 \dots x_{n-1}$

Once these basic operations are defined, the operations R[ight]WRAP and L[eft]WRAP can be defined in terms of them:

$\text{RWRAP}(x, y) = \text{FIRST}(x) y \text{RREST}(x)$

$\text{LWRAP}(x, y) = \text{LREST}(x) y \text{LAST}(x)$

The disposition of y with respect to the discontinuous parts of x needs to be determined, especially in the case of clitics, but also prosodically in general for issues of syllabification or metrical foot assignment, e.g., and so the further complex operations are defined (209):

(i) $\text{LWRAP-pref}(x, y) = (\text{LREST}(x) (y \text{LAST}(x)))$

(ii) $\text{LWRAP-suff}(x, y) = ((\text{LREST}(x) y) \text{LAST}(x))$

(iii) $\text{RWRAP-pref}(x, y) = (\text{FIRST}(x) (y \text{RREST}(x)))$

(iv) $\text{RWRAP-suff}(x, y) = ((\text{FIRST}(x) y) \text{RREST}(x))$

This allows the placement of a morpheme in second position (iii & iv) or in penultimate position (i & ii), with prosodic or other dependency to the left (ii & iv) or to the right (i & iii). As may be seen from the above, Hoeksema and Janda (1988) are very much about

responding to empirical challenges with independently motivated formal mechanisms in an enriched version of Categorical Grammar and (especially prosodic) phonology.

As suggested by Schmerling (1983:223), the operations in Hoeksema and Janda (1988:212ff) are indexed with respect to the level of analysis at which they apply (e.g. segments, syllables, words, phrases). The potential power of this indexation may be worrisome to some, but at least the levels mentioned are independently available in any general theory of grammar. A distinction between operations and the morphological rules which employ them is useful (cf. Zwicky 1987a), especially for cases where the same or very similar operations figure in multiple rules (German Umlaut, Gaelic Initial Lenition; see Janda and Joseph (1986)). In this way also, a single rule may perform multiple operations, so as not to unnecessarily fragment operations which pattern together (cf. PFM, below).

Although there are many other details available in Hoeksema and Janda (1988), it will suffice to mention a pair of related predictions which follow automatically from the formal nature of Categorical Morphology. "Rules that combine RWRAP and suffixation and rules that combine LWRAP and prefixation do not occur" (213), and "Prefixation (suffixation) on level x is sensitive only to the properties of the leftmost (rightmost) constituent on that level" (218). Fula consonant mutation would seem to cast doubt on the latter prediction (Lieber 1992:166):

waa 'monkey'	waa-ndu	Class 11
	baa -di	Class 25
	m baa-kon	Class 6

Although these are otherwise apparently well-founded generalizations, it should be noted that they are both phrased with respect to extrafixation, despite the article's explicit focus on process morphology.

Categorical Morphology has a long and respected ancestry, although it has not particularly caught on outside of the company of practicing Categorical grammarians. Since it is a challenge to motivate this approach without first motivating a Montague view of linguistic metatheory, there are some inevitable obstacles to the accessibility of an analysis cast in this framework. As Hoeksema and Janda (1988) show, however, there is room under the umbrella for more than concatenation (compare Word Syntax, below), and this is clearly a(n unanticipated) bonus in empirical coverage.

Hoeksema, Jack. 1985. *Categorical Morphology*. New York: Garland. [1984. Rijksuniversiteit Groningen dissertation].

Hoeksema, Jack, and Richard D. Janda. 1988. Implications of process-morphology for Categorical Grammar. *Categorical Grammars and Natural Language Structures*, ed. by Richard T. Oehrle, Emmon Bach, and Deirdre Wheeler, 199-247. Dordrecht: Reidel.

Schmerling, Susan F. 1983. Montague morphophonemics. *Chicago Linguistic Society* 19(P).222-37.

7. Distributed Morphology

Morpheme-based	<input checked="" type="checkbox"/>					Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar	<input checked="" type="checkbox"/>					In lexicon
Phonological formalism			<input checked="" type="checkbox"/>			Syntactic formalism
Incremental				<input checked="" type="checkbox"/>		Realizational

Together with Word Syntax and LMBM (both below), Distributed Morphology (DM) hopes to lay claim to the morphological interface of choice with GB–Principles and Parameters Syntax. Primarily a theory of inflection, DM adds a component to the traditional T- or Y-diagram of the grammar, placing *Morphological Structure* (MS) between S[urface] S[tructure] and P[honological] F[orm] (Halle and Marantz 1993:114). In this way, mismatches between syntactic, morphological, and phonological constituency can be accommodated before phonological implementation (115). The name, Distributed Morphology, is intended to “highlight the fact that the machinery of what traditionally has been called morphology is not concentrated in a single component of the grammar, but rather is distributed among several different components” (111-12). Word formation, they claim, can take place at any level of grammar, but they recommend only methods based on syntactic movement of heads (112). This is consistent with a post-SS component dealing with inflectional implementation and little else.

Inflection in DM is the result of lexical insertion of individual abstract morphosyntactic features in (sub-)terminal nodes under X^0 . As many nodes are created under X^0 as there are inflectional categories to be realized, plus one for the lexical stem. “Morphological operations” apply to these morpheme-nodes, uniting those which are realized by a single fused exponent; morphemes with multiple exponents are ‘fissioned’ and the pieces moved to their respective positions. In DM, therefore, it is important to arrive at the right number of (sub-)terminal nodes for correct (lexical) insertion of inflectional morphemes. The question of what triggers the creation of (sub-)terminal nodes under X^0 , something one might want to attribute to position or function in a syntactic construction, never arises in DM (perhaps because it is too obvious?), but the resulting metaphor is one of building structures to suit prospective residents (the inflectional properties), then remodeling to permit cohabitation (fusion) or separation (fission). With fusion, relative order is of little concern because one feature moves to be with another. Fission likewise operates without regard to ordering—it clones a node, and then separate positioning rules determine where the co-nodes end up. All the while, one knows ‘what to do’ because one knows ‘what’s about to happen’, that is, which morphemes are to take up residence in these structures. Halle and Marantz (1993:115) refer to fission and fusion as “well-motivated” operations, but this is only true on the assumption that abstract morphosyntactic nodes are atoms that must be created individually and then dealt with before it is too late, i.e., before PF. This is not at all a necessary assumption, but it is consistent with much of the Government and Binding (GB) emphasis on minimal units, extensive abstract structure, and computation.

Morphosyntactic features are represented as binary in DM, but their use is largely *ad hoc*, with features of any sort ([±strong] next to [±past] next to [±participle]) as

needed. This gives the desired impression that this is a unified picture, despite the lexical-class character of the first, the morphosyntactic character of the second, and the arguably purely morphological nature of the third.

Vocabulary insertion in DM is quite late, into abstract, well-formed syntactic structures, on the condition that the features present in the (sub-)terminal nodes are non-distinct from the morphemes to be inserted (Halle and Marantz 1993:121-22). The phonological features of all morphemic material are inserted at MS and not before (122). The particular morphemes inserted may trigger 'morphologically conditioned phonological rules' called 'readjustment rules' in DM. Since there is no phonological material to act on before MS, it makes sense that such readjustments are subsequent to vocabulary insertion.

Halle and Marantz (1993:121) suggest that "the most striking difference between SS and MS derives from the systematic difference in the type of features found in the terminal nodes in the two structures." A more significant difference is that SS is a state, a structure, and MS corresponds to a derivation of indefinite complexity between SS and PF. MS is not simply the creation of (sub-)terminal nodes—it includes morphological operations, node placement, vocabulary insertion, allomorph selection, and readjustment. For Halle and Marantz (1993:114), "MS is a syntactic representation that nevertheless serves as part of the phonology." Why even a pretense of modularity, then? When it is convenient, MS is the representation after nodes are created but before fission and/or fusion, however, if one says in the same breath that vocabulary insertion happens "at MS" (122), then it clearly must be subsequent to the morphological operations, otherwise no fusional morphemes or multiple exponents could be inserted.

Halle and Marantz (1993:121) claim to subscribe to the Separation Hypothesis of Beard while giving the credit to Chomsky (1965), because there is a separation between the creation and manipulation of abstract nodes, on the one hand, and the phonological side of vocabulary insertion on the other. They "extend this separation to stems (lexemes) as well as affixes" (172, fn. 10), which shows their own peculiar definition of *lexeme*, and which furthermore is distinct from the position taken in Halle (1990), where particular lexemes were inserted at DS and inflectional affixes at MS. The thoroughly abstract position of freely generated syntactic structures, freely inserted morphosyntactic features, and freely inserted vocabulary items to be sorted out by a range of co-occurrence constraints and other filtering devices (Halle and Marantz 1993:121) makes late insertion possible, although an instinct to insert at least the major category items earlier to somehow give direction to the derivation is understandable. Halle and Marantz admit that there is "insertion" of vocabulary items at SS (122, quotes in original), but without any phonological substance. It turns out, then, that the information contained in the final construction is "there" all along, and that the requirements of PF necessitate a certain amount of "last minute" (i.e., MS) busy-work. This makes morphology seem more like a repair strategy (or set of strategies) than an integral aspect of a grammar.

Because in DM morphosyntactic features are attributes of terminal and (sub-)terminal nodes only, stem selection is sensitive to the addition of particular (potentially phonetically null) affixes. The selection of a past stem *rang*, for example, is determined by the presence of a (sub-) terminal node bearing the feature [+past] in which no overt

morpheme is to be inserted. If [+past] were a feature of the head V, the appropriate stem could be selected without this appeal to inter-morpheme dependency, and the zero-morpheme could be dispensed with altogether. The assumptions of DM's MS, however, entail that [+past] have its own node, and that this is separate from the stem node. Localizing morphosyntactic features in the (sub-)terminal nodes under the X^0 nodes allows DM to avoid 'spell-out' rules found in rule-based realizational theories (Halle 1990:155), but the morpheme-based realization in DM requires an "intra-word constituent structure" that is not part of the rule-based alternatives (A-Morphous Morphology, above, and PFM, below).

DM characterizes the choice among inflectional morphemes as one of competition, a common metaphor in realizational theories. As mentioned above, however, vocabulary insertion in DM is context-sensitive, only possible after the atomic (sub-)terminal nodes of MS have been resolved into the required content and position. Only at this point, therefore, can the context be identified with certainty and the correct morphemes even begin to compete for insertion. As also observed with respect to A-Morphous Morphology (above), and both LM&P and PFM (below), a principle of proper inclusion precedence, the so-called Pāṇinian Principle, is appealed to in DM as well (Halle and Marantz 1993:123). Competition is relevant, of course, only among actually insertable morphemes, i.e., those compatible with the insertion context, non-distinct from the features present in the (sub-)terminal node. In DM, the criterion for precedence is appearance "in the most complex, most highly specified context" (123; cf. the criteria of A-Morphous Morphology and PFM).

Despite the variety of manipulations available within MS, Halle and Marantz (1993:124) still find it necessary to appeal to rule blocks consisting of all morphemes realizing the same features. This move is redundant in frameworks that index rules to lexical classes (cf. PFM, Network Morphology), but it is necessary here, since DM implementation has blinders on⁴ with respect to the stem node (or anywhere else the inherent attributes of the lexeme in question might be located). A sample rule block is given here to demonstrate three things: (1) how strongly motivated Halle and Marantz are to make even questionably phonetically similar effects part of a single rule (*beat-en* vs. *go-ne*), (2) how they have organized the block as a *position class*, even though the claim is one of content-oriented block organization, and (3) that DM must appeal to lexemes and morphologically defined classes thereof, despite their focus on the morpheme level (126):

[+participle, +past]	↔ /-n/ / X + ____ where X = <i>hew, go, beat, ...</i>
[+past]	↔ Ø / Y + ____ where Y = <i>beat, drive, bind, sing, ...</i>
[+past]	↔ /-t/ / Z + ____ where Z = <i>dwell, buy, send, ...</i>
[+past]	↔ /-d/

⁴ This narrowness of focus is a fleeting thing in DM, since stem allomorphy is claimed to be sensitive to the featural content of the other (sub-)terminal nodes, yet the inflectional class of the stem is not accessible to the insertion of affixes, necessitating the rule blocks.

[+participle]	↔ /-ing/
[3sg]	↔ /-z/
	↔ ∅

This is simply the entire set of verb inflecting suffixes, organized into a single block, connected by (only sometimes valid) bi-directional implications. Given DM's assumptions about the featural content of MS (sub-)terminal nodes at the point of vocabulary insertion, the /-ing/ and /-z/ affixes are not in serious competition with the others. The condition on insertion that a morpheme not be "featurally distinct" from the node into which it is to be inserted would technically allow the /-ing/ into the competition, but the simple fact that it is never used in the realization of a past participle in English suggests that a more careful formulation of either context or rule would eliminate such spurious competitors. Note that stem allomorphy is handled entirely separately from suffixation, in the readjustment rule division, even though the context in question ([±past, ±participle]) is responsible for triggering the choice of stem allomorph as well as the choice of suffix (see Halle and Marantz (1993:128) for sample readjustment rules).

The DM framework has very little to recommend it. Generalizations are fragmented, structure can be created and manipulated (and possibly deleted with no perceptible sign of ever having been there) by the notoriously powerful device of transformation, zeroes abound in representations, and the readjustment rules are *ad hoc* clean-up operations. While a theory must have adequate descriptive power, the conflicted internal logic of the DM assumptions makes MS a potentially very messy 'place' to be, with an unusually great need for representation-tweaking. Pullum and Zwicky (1991:387) claim that DM "represents a rejection of the proposals in *Aspects* (Chomsky 1965) and most subsequent work on the morphology-syntax interface, and a reversion to some of the earliest work in generative grammar."

Embick, David, and Rolf Noyer. 2007. Distributed Morphology and the syntax-morphology interface. *The Oxford Handbook of Linguistic Interfaces*, ed. by Gillian Ramchand and Charles Reiss, 289-324. Oxford/New York: Oxford University Press.

Halle, Morris. 1990. An approach to morphology. *Proceedings of the 20th annual meeting of the Northern-Eastern Linguistic Society*, 150-84.

Halle, Morris, and Alec Marantz. 1993. Distributed Morphology and the pieces of inflection. *The View from Building 20*, ed. by Kenneth Hale and Samuel Jay Keyser, 111-76. Cambridge, MA: MIT Press.

<http://www.ling.upenn.edu/~rnoyer/dm/>

8. Lexeme-Morpheme Base(d) Morphology⁵

Morpheme-based				<input checked="" type="checkbox"/>		Word/Lexeme-based
Formalist			<input checked="" type="checkbox"/>			Functionalist
In grammar			<input checked="" type="checkbox"/>			In lexicon
Phonological formalism			<input checked="" type="checkbox"/>			Syntactic formalism
Incremental				<input checked="" type="checkbox"/>		Realizational

Lexeme-Morpheme Base Morphology (LMBM) is a complicated and ambitious theory of language. It can be called a theory of language because of the role its originator sees for a morphological component. “All the borders between all linguistic modules [are] defined as morphological interfaces comprising algorithms which convert the representations of one module to those of the other” (Beard 1995:389). From this description, it might seem that LMBM would be a morphologist’s paradise, since it makes the grammar apparently morpho-centric. It is an ambitious theory because its implementation requires a revision of almost every traditional component of grammar, so even though the sequence of assumptions cohere, there are many unorthodox assumptions concerning categories, morphological realization (the Morphological Spelling (MS) component), the nature and content of the lexicon, and considerably more as well. The assumptions require much exposition and justification, and so LMBM’s adoption in a particular analysis is almost guaranteed to run into confused resistance from the uninitiated majority.

In LMBM, a base component creates hierarchical structures which stand as general potential inputs to both the lexicon and the syntax. The content of such structures is some number of basic (underived) *lexemes* (defined as the major categories N, V, and Adj only). A subset of a putative universal set of 44 basic grammatical functions are assigned to nodes in the structure (Beard 1995:391-95). Derived lexemes are created in the lexicon from the base-generated structures through an *amalgamation* metaphor, whether through head to head raising or through bracket erasure. If derivation is not opted for, then every node in the base-generated structure must be accounted for (somehow filled, with a lexical or a functional head, in GB—but not LMBM—parlance) according to the general rules of GB syntax. It is crucially important to note that the output of the syntax and the lexicon is quite abstract, and the only phonological content is the underlying phonological representations of the basic lexemes in the structure. Morphological information, by which is meant anything that is realized by bound morphology or closed class free morphemes (including adpositions, pronominals, auxiliaries), is spelled-out in the MS component.

Ordering of affixes is determined based on the assumption that grammatical features in representations are ordered. Inherent features of the lexeme are spelled out first, then those of any derivational functions picked up in the lexicon, and then finally any grammatical features which were acquired by virtue of syntax (i.e., inflection). The MS component need not ‘see’ the layering of features, it is simply that the ordering is

⁵ Earlier work on this theory indeed used “based” in the name, but in more recent work, e.g. Beard (1995), an increasing role for the base component in the architecture of the theory led Beard to alter the name, although many people have apparently not noticed the change, since references in the literature as often have the ‘d’ as not.

determined in up to three distinct stages, and the Affix Ordering Generalization is consistent with this layering (to the degree that the Generalization holds up empirically). Since all that the MS component gets as phonological input is the stem of the lexemes, it follows that morphological realization proceeds from the 'inside-out'. Beard (1995:54-55) casts doubt on Bybee's (1985; see "Network Model," below) *relevance* hierarchy as a universal category order, but at the same time has his own universal set of categories to propose; this can hardly be a coincidence.

There are several ways in which LMBM tries to "have it both ways," theoretically speaking. In order to account for those aspects of structure which are shared between derivational morphology and syntax, Beard strengthens the notion of the base component, which serves as the common input to both components. In order to keep the effects which motivate the Split Morphology Hypothesis without losing the generalization that many of the same sorts of marking processes are used in both inflection and derivation, LMBM posits the late-applying MS component which formally implements all of the grammatical functions and features distributed in the lexicon and the syntax (the *Integrated Spelling Hypothesis* (Beard 1995:101). In this way, derivation and inflection are functionally distinct, but formally united.

In LMBM, the notion of Case, which has been widely used in GB syntax (but with little independent motivation that did not overlap with either thematic roles or hierarchical structure), is redefined as a purely morphological notion. Given the universal set of grammatical functions, these functions are expressed by various syntactic constructions and morphological markings. Because the relation between grammatical function and morphological Case is typically not one-to-one, Case is seen as a morphological means of spelling out, in part or in whole, grammatical functions (Beard 1995: 254). These grammatical (i.e., not semantic) functions serve a crucial role in LMBM, and so it is important that a practitioner of LMBM accept the validity of the grammatical functions as a closed and universal set.

Agent	Means	Location	Prolation
Patient	Route	Goal	Proximity
Subject	Manner	Origin	Opposition
Object	Ession	Inession	Perlotion
Possessivity	Duration	Adession	Circumession
Possession	Iteration	Anteriority	Termination
Measure	Accordance	Posteriority	Concession
Material	Purpose	Superession	Distribution
Partitivity	Exchange	Subession	Exception
Distinction	Cause	Transession	Privation
Absolute	Sociation	Intermediacy	Themacity

(white = primary functions; light gray = primary spatial functions; darker gray = secondary functions)

LMBM assumes that any nominal entity in a sentence bears one (or two) of the above functions. A nominal may bear two functions if one is primary (spatial) and the other secondary, e.g., [Goal[Posterior]] *He went **behind the camera***.

An important innovation in LMBM is the disposal of several syntactic categories. This change is entailed when grammatical morphemes, both free and bound, become part of morphological spelling and consequently do not require a structural position in syntactic trees. It has long been noticed that there are functional parallels between prepositions and Case marking. Beard takes this as an indication that the functional parallels motivate a formally unified treatment. The tradition of classifying adpositions as $[-N, -V]$ lexical items, despite their closed class status, has been misguided, according to Beard, who suggests that adpositions and Case marking co-operatively serve to identify grammatical functions of NPs, and thus that there are no syntactic PPs at all. This is a strong claim, with a *prima facie* counterexample in the Celtic so-called “inflected prepositions,” but it does follow from the cross-linguistic distribution of adpositions with respect to case marking (extended argumentation in Beard 1995:229-77).

LMBM maintains a strict distinction between abstract grammatical functions and the formal pieces involved in the realization of those functions, i.e., the *Separation Hypothesis*. The separation in LMBM is more than just a logical conceit—the architecture of the grammar directly reflects this separation, since the grammatical functions are available even in the base component, but no phonological representations other than the stems of lexemes is available until the (post-syntax, post-lexicon) MS⁶ component.

It must be acknowledged that LMBM takes the spirit of the GB post-syntactic level of Phonological Form (PF) very seriously. LMBM finds itself caught between two goals:

- (1) to serve as a replacement to Word Syntax (see below) as a morphological interface with GB syntax, and
- (2) to remain true to the several ways that LMBM architecture uncompromisingly deviates from the GB architecture.

Aspects of the latter goal include, for example, the fact that the base component would replace D-structure; the grammatical functions would more than replace GB’s Case and Theta theory; and the reassignment of all function words to the MS component would fundamentally change tree-structure. These are large and sweeping revisions that would not go down smoothly in GB circles.

By translating grammatical functions into an abstract set, LMBM hopes to achieve cross-linguistic applicability in a way that theories which have a richer array of lexical categories and structural positions often do not. If the grammatical functions do indeed prove a viable approach, the focus of work in syntax and morphology would likely, almost necessarily, change extensively. There are some apparent logical problems of sequencing, such as having both a generative lexicon and a generative syntax, and the switching back and forth from one component to the other that sentence-building in LMBM would seem to require. There is also the apparent countermodular need for the base to have access to the stock of lexemes in advance of submitting the base-generated

⁶ LMBM’s MS ≠ DM’s MS.

output to the lexicon. Even though the proposed meshing of LMBM with GB theory would require only “a modest adjustment” in GB, according to Beard (1995:361), LMBM has a distinct agenda as far as linguistic theory and investigation go. LMBM leaves an autonomous syntax with considerably less to work with than GB is used to having.

Although Beard (1995) does occasionally mention speakers of languages, the metaphors are more generally in terms of the automatic implementation of systems of deductive algorithms, the mapping function between components that morphology serves. Rhetoric can get a little mystical sometimes: “The lexicon has two options... If the lexicon chooses the former tack...” (339-40). Considerable thought has gone into both big picture and small picture issues in LMBM, but it seems that the revolution in orientation that LMBM's acceptance would require stands as a serious obstacle. That said, it takes an open mind (and not much of a vested interest in the pre-eminence of syntax) to fully engage this theory, but this is only because the framework contains a great many challenges to the conventional wisdom about what words and affixes are like.

Beard, Robert. 1986. Neurological evidence for Lexeme–Morpheme Based Morphology. *Acta Linguistica Academiae Scientiarum Hungarica* 36.1-22.

Beard, Robert. 1987. Morpheme order in a Lexeme/Morpheme-Based Morphology. *Lingua* 72.1-44.

Beard, Robert. 1988. On the separation of derivation from morphology: Toward a Lexeme/Morpheme-Based Morphology. *Quaderni di Semantica* 9(1).3-59.

Beard, Robert. 1995. *Lexeme–Morpheme Base Morphology*. Albany, NY: SUNY Press.

<http://www.facstaff.bucknell.edu/rbeard>

9. Lexical Morphology and Phonology

Morpheme-based		<input checked="" type="checkbox"/>				Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar					<input checked="" type="checkbox"/>	In lexicon
Phonological formalism	<input checked="" type="checkbox"/>					Syntactic formalism
Incremental	<input checked="" type="checkbox"/>					Realizational

The literature on Lexical Morphology and Phonology (LM&P) is at the same time rich and convoluted. It represents a convergence between a morphological approach (level ordering) and a phonological approach (rule strata) with similar but not always identical theoretical assumptions about causes and effects in morphophonology. No piece of LM&P writing is complete without a box-and-arrows representation of modules in the grammar, because much of the concern in LM&P is getting the surface facts right with as general a rule set as possible, or as unified an underlying representation as possible, or (somewhat contradictorily) both of these at once.

LM&P holds fast to the one-meaning, one-form principle in the construction of underlying representations for morphemes. From the concatenation of abstract (morpho-)phonemic entities, there arise questions of deviation between presumed underliers and the surface pronunciation. LM&P assumes that all but the most recalcitrant alternations are effected by a rule of some sort. The recurrent question when looking at a morphologically complex expression in LM&P is “which came first?” The linear order of affixes is taken to reflect in some measure the sequence of sound-structural rule application to a base. On the (controversial) assumption that all sound-structural rules are primarily (or entirely) phonological, the issue of modularity in grammar arises again and again. Morphological processes add material, and then phonological process ‘iron out’ the discrepancies between what biuniqueness would predict and what actually occurs.

The method outlined above would be relatively simple if there were never any interaction between alternations associated with one affix and those with another, or if the changes observed were clearly phonetically motivated. To the degree that rules from different “levels” are interleaved and phonetically arbitrary (synchronically at least), LM&P has had plenty of grist for the theoretical mill.

Cyclicity of rule application has been a longstanding issue in LM&P because on the one hand, morphologically complex expressions are assumed to be built from the inside out in layers, represented by labeled bracketing, but on the other hand, there are numerous rules which would seem to apply in conjunction with the addition of a number of distinct affixes, rather than being affix-specific. LM&P assumes that some rules must apply cyclically, because certain rules apply multiple times, but cannot be handled by purely phonological conditioning. Cyclic rules apply in the lexicon, as words are built, and non-cyclic rules apply across the board postlexically. The two rule types have certain general attributes, e.g., lexical rules apply only in derived environments and are subject to lexical exceptions, whereas postlexical rules are exceptionless, general rules. Within the (universal construct of a) lexical rule component, rules are assigned to distinct language-specific strata, according to their behavior. Ideally, of course, the number of strata should be minimal, since the assignment of already idiosyncratic rules to such strata involves extensive stipulation. Most descriptions of languages use two rule strata, with the notorious exception of Halle and Mohanan (1985) who invoke four strata to handle English, alternating levels of rules and readjustments (cf. DM, above). An alternative approach to this from a more morphological perspective is the assignment of *affixes* to strata, and then having the sound-structural rules be concomitants of morphological rules. This is more in line with the work of Siegel (1979) and Allen (1978), the approach called *level-ordering*. The prime investigators in LM&P, however, are phonologists, especially Kiparsky (1982a and b, 1985), and this influential group, along with the formalism carried directly over from generative phonology, kept the ‘meaning’ side of morphology to a minimum. Kiparsky (1982a:39) warns with (trisyllabic) gravity that an appeal to “morphologization” (quotes original) is “the most unfortunate treatment of all,” that it constitutes a claim “that there are as many ‘Trisyllabic Shortening’ rules as there are suffixes that can trigger the process.” This last statement clearly establishes LM&P as morpheme-based and incremental. It is an Item and Process theory of morphology (if not Item, Arrangement, and Process).

Booij and Rubach (1985) suggest that there is a further lexical component, a post-cyclic lexical rule block that, as the name applies, follows the application of all cyclic lexical rules, yet still participates in determining the shape of particular words, and therefore is distinct from the postlexical rule block as well. This move leads them into a position where they must posit functionally parallel rules in different components, a problem which they dismiss on the grounds that the repetition is not 100% (15-18). Making redundant formulation an all-or-nothing issue, however, is an innovation with Booij and Rubach, since generalizations can be lost in sometimes very subtle ways.

Booij and Rubach's investigation of clitics in Dutch and Polish leads them to the claim that not only are clitics in the lexicon, they are affixed to bases in the lexicon, because they correlate with sometimes quirky alternations in the shape of the host (35ff.). Given what is known about the promiscuity of clitics vis-à-vis the distribution of affixes, this means that in the lexicon is an entry for the combination of every clitic and every potential host element in the language, a massive expansion of the lexicon. This claim is maintained despite their positing a separate operation of cliticization in the syntax, for all and only those clitics that do not correlate with alternations in their hosts (i.e., those that are phonologically uninteresting)(50). Rather than unify cliticization in the phonology, Booij and Rubach claim that there are lexicalized and non-lexicalized clitic-host combinations. This is equivalent to saying that only the parts of words which show alternations are ever "in the phonology"—that phonology only exists when it is actively altering something.

The justification for positing strata and for the assignment of particular rules to particular strata is grounded in surface sound-structural effects. Despite bracketing conventions, there is a strong tendency for words and morphemes to fade into the background. They represent the raw material for the operation of the rules, but they have little other reason for being in LM&P. Indeed, Kiparsky claims that "the output of every cycle is a lexical item" (Kiparsky 1982a:23). At the same time, and with no apparent irony, Kiparsky (1982a:46) suggests that every lexical entry itself constitutes an identity rule, which, because of its specificity, blocks alternative realizations of the same meaning, thanks to the Elsewhere Condition (the most narrowly specified of competing applicable rules precedes—and precludes—the application of all other competitors)(Pāṇini, Anderson 1969; Kiparsky 1973). A subtle distinction here (one which is probably too subtle for its own good) is that between the (monomorphemic) lexical *entry* and the (possibly derived) lexical *item*. In Kiparsky's minimally redundant lexicon (1982a:25-26), and with morphemes being sometimes rule, sometimes thing, it is easy to lose sight of what is 'in' and 'out' of the LM&P lexicon.

As alluded to at the beginning of this section, not only have the lines and arrows been drawn and redrawn in LM&P, the sense of what exactly the lines divided and the arrows related has changed. An acknowledged forerunner of LM&P, Chomsky and Halle (1968, i.e., *SPE*) appealed to different sorts of boundary markers in the phonological representations, on a par with phonemic segments, which phonological rules could refer to at no cost. The above-mentioned approaches of Siegel (1979) and Allen (1978) kept the boundary markers, but made them something that classes of morphemes were sensitive to, determining legal attachment sites, and thus creating level-ordering. LM&P replaces distinct boundary markers with distinct types of rule application (lexical and

postlexical), and posits distinct components in the grammar (which includes the lexicon) to oversee the proper application of the rules. In this way rules are limited to strata within components, and the insertion of particular morphemes serves to trigger the application of certain lexical rules. In general, it can still be said that *-ity* in English is a “stratum 1 affix,” but this is only determinable on the basis of the stratum 1 phonological rules which its insertion triggers, e.g., Trisyllabic Shortening, Obstruent Voicing: *brief - brevity*.

In the resulting picture, with the burden (apparently) shifted out of morphology and onto two species of phonology, there is very little insight into morphology beyond its effect on sound structure, i.e., morphophonology. The prediction that stratum X affixes will appear outside stratum X-1 affixes is no explanation for the affixes’ presence on their particular stratum— occasionally there is a separate correlate for affixes which seem to pattern together (Latin affixes in English), but the primary and overriding factor for generalizations about morphology is the behavior they exhibit with respect to units of sound. As a theory of morphology, LM&P is oblique at best, because the whole enterprise serves to enlarge phonology at the expense of morphology. Underlying representations are abstract, despite Kiparsky’s (1982a) recurrent references to constraining abstraction, and exceptions to general rules are worked out via manipulations of the underlier, rather than questioning the rule formulation. While it is impossible to deny that there are many morphophonological subregularities in the lexicon of most any language, the claim that morphophonological patterns is a fundamental organizing principle of the lexicon ignores the many more accessible patterning principles (inflectional, derivational, semantic, syntactic) that are logically prior to phonology, even a phonology with an embassy in the lexicon.

Archangeli, Diana. 1987. An overview of the theory of Lexical Phonology and Morphology. *MIT Working Papers in Linguistics* 7.1-14.

Booij, Geert, and Jerzy Rubach. 1985. Postcyclic versus postlexical rules in Lexical Phonology. *Vrije Universiteit [Amsterdam] Working Papers in Linguistics* 14.

Kiparsky, Paul. 1982a. Lexical Morphology and Phonology. *Linguistics in the Morning Calm*, ed. by Linguistic Society of Korea, 3-90. Seoul: Hanshin.

Kiparsky, Paul. 1982b. From Cyclic to Lexical Phonology. *The Structure of Phonological Representations* [part 1], ed. by Harry van der Hulst and Norval Smith, 131-75. Dordrecht: Foris.

Kiparsky, Paul. 1985. Some consequences of Lexical Phonology. *Phonology Yearbook* 2.85-138.

Mohanan, K. P. 1986. *The Theory of Lexical Phonology*. Dordrecht: Reidel.

10. Natural Morphology

Morpheme-based		<input checked="" type="checkbox"/>				Word/Lexeme-based
Formalist					<input checked="" type="checkbox"/>	Functionalist
In grammar		<input checked="" type="checkbox"/>				In lexicon
Phonological formalism		<input checked="" type="checkbox"/>				Syntactic formalism
Incremental		<input checked="" type="checkbox"/>				Realizational

Motivated in large part by the school of Natural Phonology (Donegan and Stampe 1977, 1979), Natural Morphology (NM) is a functionally-oriented call for more precise distinctions among sound-structural rule types and components of grammar. This may seem somewhat odd, however, when considered in light of the gradient model of grammar which NM ultimately proposes. Just as Natural Phonology had distinguished the automatic from the non-automatic in phonology, so too does NM seek to distinguish rules of morpho(pho)nology from both automatic phonology and morphology proper. Dressler (1985b:3-4) holds the view that there is an interface between morphology and phonology, namely *morphonology*, which is not in itself a component, yet does not belong to either of its neighbors. He distinguishes *morphonological rules* (MPRs) from *allomorphic rules* (AMRs) on a rather vaguely defined criterion of *productivity*. Dressler clearly distinguishes the segments involved in morphonological alternations from their domain of application, and attempts to separate rule types according to phonological, morphological, “lexical,” stylistic, and other conditions on application. His diagnostics result in dense taxonomy of rule types, and for that reason if for no other, Dressler’s (1985b) scheme has the feel of a flock of pigeons clamoring for their pigeonholes. A sound structural rule in this framework can have many sorts of conditions beyond the phonological, and this poses no formal or logical problem, because the wide range of linguistic and extra-linguistic constraints are “in the model.” There is an attempt to counter this expressive power, however, in a rather arcane and arbitrarily demarcated system of “demerits” (scores of 1-5) that are assigned to a rule as a mark of its relative “naturalness,” according to generality of application, phonetic distance between alternants, and so on.

As an introduction to the theory of NM, however, Dressler’s (1985b:260ff) chapter 10, “Towards an explanatory model of morphonology: On the interaction of Natural Phonology and Natural Morphology within a semiotic framework,” constitutes a belated but helpful sketch. Dismissing the Chomskyan goal of describing grammatical competence as reductionist, as incapable of accounting for “facts of language change, acquisition, impairment, variation, etc.” (261), Dressler turns to the business of establishing a “counter-model” (NP/NM) to the formalist paradigm, rather than quixotically hurling isolated counterexamples at it with no real hope of falsification.

NM is avowedly functionalist in its orientation, considering not only the description of language data, but also the purpose of each element in the context of its use. Dressler wisely puts forward some of the logical pitfalls of functionalist argumentation⁷:

⁷ So as to keep the focus on morphology and off of metatheory in general, the reader is referred to Dressler (1985b:270-71, §10.3.13) for counterarguments.

- (1) circularity (markedness, naturalness),
- (2) *ad hoc* devices (unboundedly many goals to be served simultaneously by language use in a finite context), and
- (3) teleology in variation and change (quasi-mystical ‘group-minds’ or ‘community grammars’).

Two driving assumptions shape the entire NM system of morphological description, prediction, and explanation:

- (1) The goal of language use is effective communication, and
- (2) Language is a semiotic system in the sense of Peirce (1965).

Words are primary signs in NM, morphemes are secondary signs (“signs on signs”), and phonemes are tertiary sign. With signs as an organizing principle in the service of communication, the clear demarcation of the constituent signs in a string best facilitates the interpretation of the signs and the recovery of the primary meaning. It is predicted, therefore, that the more sign-like a morpheme is, the more efficient it is as a means of communication. Segmentability being systematically favored, any process or rule which serves to obscure morpheme boundaries (e.g., much of morphonology) is predicted to be contrary to the goal of clear and efficient communication, and thus there will be pressure from within the system to ‘iron out’ the alternation and thus to converge on a constant form-meaning correspondence, i.e., like a good sign should (e.g., 300-06). Where such convergence does not obtain, the explanation is presumably to be found in a conflicting function which inhibits the (re)unification.

Mayerthaler (1988) leans strongly toward universal functions which all languages must address, e.g., the symbolizing or encoding of semantic concepts. In order to accomplish a meaningful characterization of universal naturalness, he draws most of his supporting data from language change and language typology. In §1.3 (pp. 8-15), Mayerthaler draws a number of broad distinctions concerning the relative markedness of related pairs of semantic concepts regularly expressed in language (e.g., definiteness/indefiniteness, animate/inanimate, present/preterit, etc.) and determines that “prototypical speaker attributes” (including the “here and now,” 1st person pronominals, etc.) are universally less marked, and thus “the more important and constructive its role is for the organization of natural languages” (15). For this to have any empirical content, there must be some translation, some correspondence of semantic naturalness (unmarkedness) in the form of language. This is what Mayerthaler calls *Optimal Symbolizing*. If morphology is sign-based, the more semantically marked a feature to be symbolized is, the more ‘featured’ (essentially, longer) the symbolization will be (“What is semantically ‘more’, should also be constructionally ‘more’” (19)). Since the text of the English translation is of notoriously poor quality, I will extract the useful, though terminologically confounded, scheme of symbolizing types (18):

- A. Featureless (no overt marking)
- B. Featured (some overt marking)
 1. Additive Featured (increased content)
 - a. Particle Additive (affixed)
 - b. Modulator Additive (segmental lengthening)

2. Modulator Featured (segmental substitution)

As signs go, then, the optimal symbolization is B.1.a., or affixation, and the longer the better for the symbolization of a semantically marked element (cf. Latin positive *longus*—comparative *longior*—superlative *longissimus*). Zero-conversions and non-concatenative morphology are of course predicted to be inefficient symbols, so their use, especially in a systematic way, is a puzzle for NM (subtractive morphology is not addressed). Mayerthaler is quick to point out that the predictions of NM are always relative tendencies, rather than categorical statements. This correspondence between markedness and symbolization is a type of (weak) homomorphism, and Mayerthaler terms it *constructional iconism* (17-25). Homomorphism of this sort is a desirable condition from the perspective of NM, but it is admittedly an idealization which must often be disrupted in the service of competing linguistic (and extralinguistic) functions.

Dressler (1985b:301) modifies the simplistic 'bigger is better' sign evaluation metric of Mayerthaler's with an appeal to the practicalities of perception and production—an efficient sign "must be neither too big nor too small." Along with iconicity in the form of a sign, Dressler also stresses the value of a biunique relationship between the signifier and the signified, so that either is readily accessed from the other (301). The combined pressure of iconicity and biuniqueness motivate the prediction that operations which fuse or delete morphemes, whether in part or in total, are diachronically unstable and synchronically rare (306). Ambiguity in the input or output of any rule is a strike against it as a natural rule, and thus homophonous morphemes are to be disfavored ("homophonous zeroes" all the more so!)(313). Dressler lays out the following seven point scale, ranked in descending order of *morphotactic transparency* (=naturalness) (316-17):

- I. Intrinsic allophonic phonological rules (PRs) intervene,
- II. Extrinsic allophonic PRs, resyllabification,
- III. Neutralizing PRs intervene
- IV. Morphological rules (MPRs),
- V. MPRs with fusion,
- VI. Allomorphic rules (AMRs), and
- VII. Suppletion.

Dressler notes that rules often change type over time (cf. Janda 1986), and contrary to all expectations of naturalness, the change tends to be in the direction of decreasing transparency.

Biuniqueness and productivity are thought to go hand in hand, with the former implying the latter (Dressler 1985b:329). In this way, the addition of new words to the lexical stock, which should employ the most productive means available, ought to involve the application of the clearest (i.e., unique, and perhaps transparent, too) signifier for the signified in question. This reasoning involves a vicious circle of course, but through an appeal to the diachronic loss of transparency in rules, NM can allow for, if not actually account for the development of polysemous morphemes and the rise of new productive morphemes displacing the old.

Almost coextensive with, but inversely related to, the scale of morphotactic transparency (excluding suppletion) is the scale of *indexicality*—as a rule becomes more context sensitive, the presence of the output ‘points’ more clearly to the presence of its conditioning environment, and the greater the phonetic distance between input and output, i.e., the greater the change the rule effects, the more indexical the rule is (thus intrinsic allophonic rules have almost no indexical value). Although NM assumes fuzzy transitions from one rule type to another, it is nevertheless a modular theory, such that the application of PRs presupposes the application of MRs. A subtle consequence of this modularity is the quantum leap in the indexicality of a rule once it becomes morphologized. MRs ‘precede’ PRs, and thus they have a certain priority over PRs. MRs furthermore have semanticity, which phonemes and allophones (in themselves) do not. For these reasons, it is suddenly much less troubling that morphotactic opacity increases over time, since indexicality and semanticity increase correspondingly (Dressler 1985b:309-11, 333-34).

Wurzel (1989) turns the focus specifically on inflectional morphology, from the perspective of systems as coherent and consistent wholes. Not to dismiss the role of language typology, but rather to take individual languages as extensions of types, Wurzel refers to *System Defining Structural Properties* (SDSPs), which organize and lend stability to inflectional systems. Since inflectional classes are based on paradigms, and paradigms are based on inflectional markers, and markers in a given language “are not part of any universal inventory of markers” (63), introducing inflectional classes into a discussion of morphological naturalness is inevitably challenging. Wurzel speaks of morphological norms at the language-specific level, rather than in terms of naturalness in general, e.g., in Modern German, because the weak verb formation is increasingly common and the only productive rule for new verbs in the language, the weak pattern is (currently) the norm for German (64-65). He couches the range of SDSPs as parameters (75):

- a. an inventory of categorial complexes and categories assigned to them,
- b. the occurrence of basic-form inflection or stem inflection,
- c. the separate as opposed to combined symbolization of categories of different categorial complexes,
- d. the number and distribution of formally distinct inflectional forms in a paradigm,
- e. the types of markers occurring, and their relations to the categorial complexes concerned, and
- f. the existence or nonexistence of inflectional classes.

Given these SDSPs, one may construct a “typological characterization and classification of inflectional systems” (75). In very congruent systems, the SDSPs act almost as laws, while in more mixed systems, the SDSPs stand more as defaults, i.e., as what happens when no extraordinary circumstances come into play (82; cf. Zwicky 1986). System congruence (=congruity in Wurzel) is not something that can necessarily be assessed through cursory inspection. Rather, it involves extensive and exhaustive comparisons, e.g. (83):

1. of (abstract) marker types (e.g., suffixes),

2. of particular markers,
3. of the number of distinct inflectional forms in different paradigms,
4. of co-occurrence of various markers, and
5. of all the different markers realizing particular inflectional categories.

Given the SDSPs and the mass of empirical data that one would collect in discerning a particular language's set of parameter settings, it is not hard to imagine that a system-internal pressure toward increased congruence is proposed as a motivator of morphological change. It is also not surprising, given the focus in NM on conflicting functional motivations, that these SDSPs come into conflict with system-independent considerations, i.e., the more universally oriented issues identified by Mayerthaler (1988).

In summary, NM predicts that the most efficient morphological system will exhibit iconicity and biuniqueness to the highest degree possible, avoiding syncretism and avoiding zero-marking on all but the most basic (semantically least marked) expressions. To the degree that languages do countenance syncretism and zero-derivation, this is claimed to be the result of conflict with other systematic pressures, and further that such language states are rare, unstable, and subject to change at the earliest opportunity. Although the testing ground for these intuitively plausible hypotheses is based on the description of synchronic morphological systems, the methodological focus is always on comparison with some other language state, to evaluate the relative naturalness of the states. Indeed, as a theory of synchronic morphology, there seems to be something missing in NM. Mayerthaler himself states (1988:4) "[W]e do not believe in the possibility of a synchronic linguistics in the sense that it would be possible to write an adequate grammar excluding the dimension of time." It is perhaps not an accident that a theory that holds multiple gradient scales as central organizing principles focuses on language variation and change. As a tool of the typologist, the historical linguist, or even the dialectologist, NM would surely have an appeal in its functionalist and system-wide ("macro") orientation.

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Dressler, Wolfgang U. 1985b. *Morphonology: The Dynamics of Derivation* [Linguistica Extranea, Studia 12]. Ann Arbor, MI: Karoma.

Dressler, Wolfgang U. 1985c. On the predictiveness of Natural Morphology. *Journal of Linguistics* 21.321-37.

Dressler, Wolfgang U. (ed.), Willi Mayerthaler, Oswald Panagl, and Wolfgang U. Wurzel. 1987. *Leitmotifs in Natural Morphology* [Studies in Language Companion Series, vol. 10]. Amsterdam/Philadelphia: John Benjamins.

Mayerthaler, Willi. 1981/1988. *Morphologische Natürlichkeit/ Morphological Naturalness* [Linguistica Extranea, Studia 17]. Ann Arbor, MI: Karoma.

Wheeler, Max W. 1993. On the hierarchy of naturalness principles in inflectional morphology. *Journal of Linguistics* 29(1).95-111.

Wurzel, Wolfgang Ullrich. 1989. *Inflectional Morphology and Naturalness*. Dordrecht: Kluwer.

11. “Network Model”

Morpheme-based			<input checked="" type="checkbox"/>			Word/Lexeme-based
Formalist					<input checked="" type="checkbox"/>	Functionalist
In grammar					<input checked="" type="checkbox"/>	In lexicon
Phonological formalism			<input checked="" type="checkbox"/>			Syntactic formalism
Incremental		<input checked="" type="checkbox"/>				Realizational

Joan Bybee, who was a driving force in the Natural Generative Phonology (Hooper 1976, 1979) movement, has proposed the “Network Model”, a functionally-oriented view of morphology, seen first and foremost as an organized system. In the preface to her (1985) book, Bybee observes that it might appear strange to some that her attention had moved from a very concrete approach to phonology to settle on “a different set of issues” (v). On the contrary, an approach to morphology follows naturally from the careful division of morphophonemics from articulatory- and perceptual-based phonology (‘phonology proper’). By emphasizing that morphophonology is morphologically conditioned, and therefore part of the domain of morphology, Bybee likens the arbitrary nature of much of morphophonology to the arbitrariness found throughout morphemics, *l’arbitraire du signe*.

As a functionalist theory, the concern is not with descriptive segmentation of morphemes, because there are simply too many deviations from a one-to-one form-meaning correspondence. Bybee’s goal is “to propose certain principles in a theory of morphology whose goal is to explain the recurrent properties of morphological systems, including fusion and allomorphy, which are traditionally viewed as problems [many-to-one and one-to-many meaning–form connections, respectively], in terms of the general cognitive and psychological characteristics of human language users” (3). With cognition as a concern, psycholinguistic experimentation is an important source of evidence for the claims of the Network Model. Similarly, because the goal is to explain recurrent patterns, cross-linguistic data from linguistic typology is also of importance. Many formalist theories, by contrast, tend to de-emphasize evidence of these sorts, because they introduce gradient patterning, rather than neat categorical behavior.

In contrast with the Word Syntax approach (below), the Network Model suggests that the lexicon is not merely structured, it is richly structured, with connections at many levels. Phonological connections, syntactic (categorical and subcategorical) connections, and semantic connections link words and parts of words simultaneously. Multiple links constitute lexical associations of differing strength and character, and generalizations about lexical subclasses can refer to constellations of links, including links from different grammatical domains (cf. Jackendoff 1975). For example, much of the exposition of the

network model in Bybee and Moder (1983) is done in terms of the ablauting strong verbs in English, such as *sing/sung* and *string/strung*. Bybee and Moder show that the oldest members of this class were monosyllables ending in a velar nasal. Later additions to the class have diversified this condition, allowing for a final velar and/or nasal, as in *dig/dug* and *spin/spun*, respectively. Rather than deriving morphologically complex words by rules *per se*, Bybee's model appeals to patterns among the various links in the lexicon to identify morphological patterns. Thus, morphological analysis is radically not about Items and Arrangements or Items and Processes, nor is it about Words and Paradigms. Morphological analyses are implicit in the lexical connections that individual speakers make in their own lexicons. Patterns defined by links can be referred to as *schemata*, either *source-oriented* or *product-oriented*, as conditions guiding the coining and interpretation of novel forms (Bybee 1985:129; Bybee and Moder 1983:255). The individualization of morphological analysis is not a surrender to chaos and unpredictability, however, since the empirical experience of speakers acquiring and processing their language, especially within the same community, is very likely to be comparable. With comparable experience, the reasoning goes, will come motivation for largely coinciding lexical structure. In this way, quite contrary to the 'ideal speaker-hearer' approach often appealed to in (Chomskyan) linguistic theorizing, the Network Model is based in the experience and general cognitive processes of natural language users.

Bybee (1985) claims that derivational and inflectional morphology are not qualitatively distinct phenomena, but rather "a gradual...distinction, the basis of which is *relevance...*" (5). Not only, then, is morphology restricted to the lexicon, but also form and function are distinguished quite clearly, although in practical terms, each dimension on its own is gradient. "The semantic relevance of an affix to a stem is the extent to which the meaning of the affix directly affects the meaning of the stem" (4). This is potentially a vague and variable gradient, but Bybee purports to avoid "ethnocentrism" by drawing claims about relative relevance from a cross-linguistic comparison of fifty languages in widely different language families and geographic regions, thereby escaping (to the greatest degree possible) genetic or contact confounds (8). From this typological evidence, Bybee claims support not only for the categories which she posits along the continuum, but also for the relative ranking of each grammatical meaning.. Specifically, with reference to verb morphology, "the categories of valence, voice, aspect, tense, mood and agreement are ranked for relevance to verbs in that order" (4-5). Part II of Bybee (1985:137-205) discusses in depth what is understood by "aspect," "tense," and "mood" in her model, in order to clarify the categories for further testing and to pre-empt spurious counterexamples which might follow from differing definitions of what constitutes a tense, for example.

Bybee's assumption of a cline of relevance allows her to make predictions about exponent form, on the one hand, and sequencing on the other. Bybee (1985:4-5) claims that exponents of more relevant grammatical meanings will be found closer to the verb stem than will those of less relevant meanings, and more relevant exponents are more likely to involve morphophonological alternations in the affix, the stem, or both (Bybee 1985, 33-43).

The Network Model has a variety of independently proposed solutions to problematic issues in deviations from one-to-one form-meaning matching (Carstairs 1987). Morphophonology is considered a historical relic of earlier phonetically-motivated alternation now housed in the morphology, rather than something to be processually recapitulated in putatively synchronic phonological rules. Fusional morphology is similar, and is claimed to follow from frequent cooccurrence of morpheme pairs. Affix genesis is rooted in semantic bleaching and phonetic erosion (without calling this by the name “grammatic(al)ization”). These explanations, in their broadest senses at least, are generally agreed upon in historical circles.

Perhaps surprisingly, Bybee (1985:50-58) finds a place for the basic-derived distinction in the lexicon, the natural occasion to appeal to a scale of relative (un)markedness. Unmarked (i.e., zero-marked) word forms are predicted to be semantically unmarked, or at least no less semantically marked than the most unmarked word form in the paradigm. Markedness is of course a concept which is frequently criticized for cross-investigator inconsistencies, but the typological and psycholinguistic bases for Bybee’s analysis, including for example, the sequence of acquisition of forms, do manage to add some weight to her argumentation.

Claims in this area are not without difficulty, however. Bybee claims considerable support for the claim that semantically unmarked forms are “morphophonemically simpler” than more marked forms (6). Certain stem allomorphy facts from Sanskrit would seem to deviate from this prediction, in that for those paradigms with weak and strong stems, and especially for those with three grades of stem, the weak(est) stems (in white) are found in oblique cases to the exclusion or near-exclusion of the direct cases, where the strong stem (in gray) generally predominates, e.g., in the masculine forms of the possessive adjective *bhagavant*, ‘fortunate’ (Stump, 2001: 170):

	Singular	Dual	Plural
Nominative	<i>bhagava:n</i>	<i>bhagavant-a:u</i>	<i>bhagavant-as</i>
Accusative	<i>bhagavant-am</i>	<i>bhagavant-a:u</i>	<i>bhagavat-as</i>
Instrumental	<i>bhagavat-a:</i>	<i>bhagavad-bhya:m</i>	<i>bhagavad-bhis</i>
Dative	<i>bhagavat-a:</i>	<i>bhagavad-bhya:m</i>	<i>bhagavad-bhyas</i>
Ablative	<i>bhagavat-e</i>	<i>bhagavad-bhya:m</i>	<i>bhagavad-bhyas</i>
Genitive	<i>bhagavat-as</i>	<i>bhagavat-os</i>	<i>bhagavat-a:m</i>
Locative	<i>bhagavat-i</i>	<i>bhagavat-os</i>	<i>bhagavat-su</i>

Even though it would appear that the nominative singular is the only “zero-marked” form in the paradigm, the weak stem, which is always “morphophonemically simpler” is used in the oblique forms, and never in the nominative singular. This is primarily a suggestion for a redefinition of *basic* versus *derived*, however, since on grounds of predictability, the weak stem is usually predictable from the strong stem, but the reverse is less reliable, meaning that “morpho-phonemically simpler” can be a misleading diagnostic for the directionality of derivation. It would seem, therefore, that in the Network Model, the interlexical connections might more reliably point to a basic form than a guideline framed in terms of the relative number of phonemes.

A complex perspective has emerged from Bybee’s particular program. This involves the difference between regular and irregular, productive and nonproductive, and

type versus token frequencies of words. In Bybee and Moder (1983:251), irregular inflectional forms, particularly those involving morphophonological alternations, are claimed to be “scheduled for leveling, since they disrupt the one-to-one correspondence between sound and meaning.” In Bybee (1995), however, an explanation for the endurance of certain disruptive alternations is explained with reference to token frequency (*lexical strength*, in Bybee’s terminology): “irregulars will tend to regularise unless they are sufficiently available in the input to create a strong lexical representation. Thus if the irregular past has low token frequency and is thus more difficult to access, a regular form might be created” (428). The more frequently a verb is used, the more able it is to sustain irregularity in its paradigm, should any such irregularity exist. The verb *to be* is cross-linguistically very likely to show some irregularity in its paradigm, and Bybee’s claim is that the reason is the frequency with which forms of the verb *to be* are used in everyday speech. The pressure of conventional usage ‘outweighs’ the pressure of regularity.

The sometimes elusive notion of *productivity* is also a function of frequency in the Network Model, but in this case it is type frequency, the proportion of the vocabulary in the relevant grammatical category which participates in a particular pattern. The higher the type frequency, the more likely the class is to act as a default, and consequently the more likely it is to be employed for analogy, as in cases of doubt, neologism, and language acquisition. The chances for the expansion of the pattern’s input set increase as a result, and this means an increase in the pattern’s productivity. Formalist theories, on the other hand, tend not to worry as much about pattern frequencies overall, with the exception of theories such as Network Morphology and PFM, in which default patterns play a central role in rule application.

The many parallels between the Network Model and the concerns of Natural Morphology (for which see above), just as there are parallels in the perspectives of Natural Generative Phonology and Natural Phonology, their respective inspirations include the types of evidence that each allows, the larger systemic questions which each seeks to address, and the focus on the isomorphic sign as a driving influence in change. For these reasons, it seems a little strange that two schools cite each other’s work almost not at all (with the exception of Dressler 1985b, who offers three Bybee references). Bybee offers “Network Model” as a tentative theory-name, but not until Bybee (1995:428). Since similarities with the Network Morphology program (named in 1992/93; see next section) are very limited, perhaps the Network Model may need another title. As for the appeal of the Network Model as it stands, however, its attention to cognition and typology make it a likely stimulus for new research programs in psycholinguistics, and its clear and falsifiable predictions make it a standing challenge to those engaged in the description of synchronic systems and diachronic changes.

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Bybee, Joan L. 1988. Morphology as lexical organization. *Theoretical Morphology*, ed. by Michael Hammond and Michael Noonan, 119-41. San Diego: Academic Press.

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Bybee, Joan L., and Carol Lynn Moder. 1983. Morphological classes as natural categories. *Language* 59(2).251-70.

12. Network Morphology

Morpheme-based				<input checked="" type="checkbox"/>		Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar					<input checked="" type="checkbox"/>	In lexicon
Phonological formalism				<input checked="" type="checkbox"/>		Syntactic formalism
Incremental					<input checked="" type="checkbox"/>	Realizational

Network Morphology has been developed by the (University of) Surrey Morphology Group. An integral part of the theory is the computer language DATR (Evans and Gazdar 1996), which was designed with lexicon modeling in mind. The lexical knowledge modeled in Network Morphology is based on the common computational principles of hierarchy and inheritance. Network Morphology lexica are strongly hierarchical, and individual lexical entries are typed feature matrices, analogous to representations in Head-Driven Phrase Structure Grammar (HPSG; Pollard and Sag 1994) and Generalized Phrase Structure Grammar (GPSG; Gazdar et al. 1985), adjusted for direct computational implementation as lines of programming code. The authors of articles in Network Morphology move frequently between feature notation and tree diagrams, which is helpful to a reader who may not always be able to picture the dependency relations in the compressed featural format.

Based on the concept of feature inheritance, the Network Morphology lexicon begins at the very top with the type *word*, which branches into subtypes according to syntactic categories. New subtypes are motivated each time there is a subset of lexemes which differs from the default feature set in some systematic way. A subtype must have some specific feature value which differs from the larger class; this feature value overrides the feature value the subtype would inherit by default from the supertype. In this way, dependent types largely cohere with their parent types, and sister types cohere in the defaults they jointly inherit from a common parent node. Lexical classes and subclasses are thus defined, and this allows generalizations to refer to individual nodes or hierarchically related nodes. Simultaneously, this suggests that generalizations will not hold over disparate classes, i.e., those not so related in the hierarchy (this suggestion is not exactly true, but there is a systematic way proposed to handle it, discussed below).

Corbett and Fraser (1993:126, 136) provide a more concrete example. The declension classes in Russian are generally claimed to number three or four. An example paradigm for four typical nouns will show the reason for the ambivalence (Corbett and Fraser 1993:115).

	I <i>zakon</i> 'law'	II <i>komnata</i> 'room'	III <i>kost</i> 'bone'	IV <i>v'ino</i> 'wine'
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nom sg	<i>zakon</i>	<i>komnata</i>	<i>kost'</i>	<i>v'ino</i>
acc sg	<i>zakon</i>	<i>komnatu</i>	<i>kost'</i>	<i>v'ino</i>
gen sg	<i>zakona</i>	<i>komnati</i>	<i>kost'i</i>	<i>v'ina</i>
dat sg	<i>zakonu</i>	<i>komnate</i>	<i>kost'i</i>	<i>v'inu</i>
inst sg	<i>zakonom</i>	<i>komnatoj</i>	<i>kost'ju</i>	<i>v'inom</i>
loc sg	<i>zakone</i>	<i>komnate</i>	<i>kost'i</i>	<i>v'ine</i>
nom pl	<i>zakoni</i>	<i>komnati</i>	<i>kost'i</i>	<i>v'ina</i>
acc pl	<i>zakoni</i>	<i>komnati</i>	<i>kost'i</i>	<i>v'ina</i>
gen pl	<i>zakonov</i>	<i>komnat</i>	<i>kost'ej</i>	<i>v'in</i>
dat pl	<i>zakonam</i>	<i>komnatam</i>	<i>kost'am</i>	<i>v'inam</i>
inst pl	<i>zakonam'i</i>	<i>komnatam'i</i>	<i>kost'am'i</i>	<i>v'inam'i</i>
loc pl	<i>zakonax</i>	<i>komnatax</i>	<i>kost'ax</i>	<i>v'inax</i>

It has been noted that declensions I and IV are formally quite similar, contrasting clearly with both II and III (Corbett 1982). Network Morphology allows for the capturing of gradient similarities with a hierarchical approach to the lexicon. The following hierarchy (adapted from a tree diagram in Corbett and Fraser 1993:126) shows the formal affiliation of Russian declension classes:

I. Nominal

A. Adjective

B. Noun

1. N_O (traditional o-stems)
 - a. N_I, e.g., *zakon*
 - b. N_IV, e.g., *v'ino*
2. N_II, e.g., *komnata*
3. N_III, e.g., *kost'*

This hierarchy captures “the fact that there are four main declension classes [in Russian], but that the differences between N_I and N_IV are not as great as those between either of them and the other declensional classes” (127). N_O is a “super-node” from which N_I and N_IV inherit their shared properties (127).

Since Network Morphology revolves around type hierarchies, it is important to note that each *node* in the network corresponds to a class of lexemes, characterized by common attribute-value pairs, called *facts*. Facts are inheritable downward in the network, unless overridden by specific facts listed at an intervening node in the *path*, down to and including the node in question. For this reason, facts about inflectional classes are composites of inherited facts and stipulated sub-class-specific facts. In order for a declension class to be ‘well-typed’, the composite of facts must constitute a complete set of rules of inference (i.e., facts) for a full inflectional paradigm appropriate to the lexeme-class⁸.

⁸ Parallels to HPSG are many here. The work of Riehemann (1997) is also compatible in its hierarchical approach to derivational patterns.

To turn this hierarchy briefly and (somewhat) simplistically into a DATR representation (adapted from Corbett and Fraser 1993:135-36):

```

NOMINAL: <stem> == "<infl_root>"           1
          <phon stem hardness> == hard      2
          <mor stem hardness> == "<phon stem
          hardness>"                        3
          <mor acc> == "<mor nom>"           4
          <mor acc pl animate> == "<mor gen pl>" 5
          <mor acc sg animate masc> == "<mor gen sg>" 6
          <mor dat pl> == ("<stem pl>" "<mor
          theme_vowel>" "_m)                7
          <mor inst pl> == ("<stem pl>" "<mor
          theme_vowel>" "_m'i)              8
          <mor loc pl> == ("<stem pl>" "<mor
          theme_vowel>" "_x).               9

NOUN:    < > == NOMINAL                    10
          <mor loc sg> == ("<stem sg>" "_e)  11
          <mor nom pl> == ("<stem sg>" "_i)  12
          <mor gen pl> == "< " <mor stem hardness>"
          mor gen pl>"                      13
          <soft mor gen pl> == ("<stem pl>" "_ej) 14
          <mor theme vowel> == _a           15
          <syn cat> == n.                   16

N_O:    < > == NOUN % traditional o-stems  17
          <mor gen sg> == ("<stem sg>" "_a)  18
          <mor dat sg> == ("<stem sg>" "_u)  19
          <mor inst sg> == ("<stem sg>" "_om). 20

N_I:    < > == N_O                         21
          <formal gender> == masc           22
          <mor nom sg> == "<stem sg>"       23
          <hard mor gen pl> == ("<stem pl>" "_ov). 24

```

This fragment (of a fragment) of a grammar is designed to show both default inheritance (< > == X) and the node specific facts which introduce new information (<formal gender> == masc)⁹. Using fact-indices (the line numbers at right, above), and given the following lexical entry for the noun *zakon* 'law':

```

zakon    < > == N_I
          <gloss> == law
          <infl_root> == zakon           25
          <sem animacy> == inanimate

```

the rules of inference used in the inflected forms in a paradigm of class N_I are as follows:

	I <i>zakon</i> 'law'	Rules used
nom sg	<i>zakon</i>	1, 23, 25
acc sg	<i>zakon</i>	1, 4, 23, 25
gen sg	<i>zakona</i>	1, 18, 25
dat sg	<i>zakonu</i>	1, 19, 25

⁹ Feature values stipulated at a node can also override default values, e.g., for N_IV (not shown), <mor nom pl> == ("<stem pl>" "_a), which overrides the value ("<stem pl>" "_i) it would otherwise inherit from NOUN (Corbett and Fraser 1993:137).

inst sg	<i>zakonom</i>	1, 20, 25
loc sg	<i>zakone</i>	1, 11, 25
nom pl	<i>zakoni</i>	1, 12, 25
acc pl	<i>zakoni</i>	1, 4, 12, 25
gen pl	<i>zakonov</i>	1, 2, 3, 13, 24, 25
dat pl	<i>zakonam</i>	1, 7, 15, 25
inst pl	<i>zakonam'i</i>	1, 8, 15, 25
loc pl	<i>zakonax</i>	1, 8, 15, 25

Network Morphology also permits *rules of referral* (Zwicky 1985, 1992; Stump 1993a), whereby systematic formal parallelisms not handled by defaults are formalized as a stipulated referral to another form in an analogous paradigm, e.g., for N_III, the value for <mor nom sg> is referred to the corresponding value under N_I, whereas the value for N_III's <mor gen sg> is referred to that of N_II. These referrals are ways of expressing parallelisms not predicted by hierarchical inheritance patterns.

Network Morphology offers a rich formal system for the representation of lexical patterns. It was designed with computational implementation in mind, and so there is a practical advantage for choosing this framework. It is clear from the above examples and from the hierarchical lexicon approach in general that all morphology is handled in the lexicon—derivation mapping from one lexeme to another, and inflectional patterns handled through defaults and overrides as one moves down the path from the most general lexical class to specific lexical entries. This clearly implies that Network Morphology is realizational in its approach, since the formal markings are values for abstract attributes in the feature representation. Once a large enough grammatical fragment is built and particular lexical entries are introduced into the model, the program's output is the full inflectional paradigm of each lexeme, marked with <syn gender> and <syn animacy> values (see Corbett and Fraser 1993:139-41).

The formalism and level of detail needed for computational implementation might be off-putting or even irrelevant for some potential consumers of morphological theory. Some might also question the license to split subtypes of subtypes with no defined limit. The inheritance metaphor, however, makes clear predictions, and the possibility of computational implementation of grammars compiled using this model make for a very appealing (virtually) empirical check on the correctness of predictions. Since correct output does not necessarily guarantee the optimal description, Network Morphology's reliance on default inheritance supplies the impulse to minimize redundancy in the lexical representations. As a descriptive tool and as a computational input, Network Morphology is designed with the future of linguistic research in mind.

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Fraser, Norman M., and Greville G. Corbett. 1995. "Gender, animacy, and declensional class assignment: A unified account for Russian." In Geert Booij and Jaap van Marle, eds. *Yearbook of Morphology 1994*. Dordrecht: Kluwer. pp. 123-50.

http://www.surrey.ac.uk/LIS/SMG/surrey_morphology_group.

13. Paradigm Function Morphology

Morpheme-based					<input checked="" type="checkbox"/>	Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar					<input checked="" type="checkbox"/>	In lexicon
Phonological formalism			<input checked="" type="checkbox"/>			Syntactic formalism
Incremental					<input checked="" type="checkbox"/>	Realizational

Paradigm Function Morphology (PFM) is a lexeme-based realizational theory of inflectional morphology. Stump's work owes much to the theory and metatheory of Arnold Zwicky, and PFM spells out in detail some of the leading ideas of Zwicky's (e.g., 1987b) Interface Program. Although PFM's introduction in the literature is generally taken to be Stump (1991), some important precursors may be gleaned in his less formally-oriented (1990) article:

The proposed framework embodies a conception of the boundary between inflection and derivation that is wholly at odds with the split morphology hypothesis. In particular, this framework does not treat inflection as an extralexical phenomenon but instead presupposes that all morphological processes operate in the lexicon. It does not presume that all rules of derivation inherently precede all rules of inflection but instead allows some intermixture of inflection with derivation ... inflectional and derivational processes are distinguished according to the kinds of expressions that they produce.... (116-17)

With the exception of Matthews (esp. 1972) and Carstairs (e.g., 1983, 1987), PFM gives unusual prominence to the paradigm as an organizing principle in morphology. Many theories have a nodding acquaintance with the paradigm, but treat it as an epiphenomenon, something with pedagogical or perhaps only curiosity value (e.g., Anderson 1992:79-80). This does not mean that PFM treats the paradigm as a primitive, however.

The *paradigm* is a set of cells defined by the universal and language-specific co-occurrence restrictions on morphosyntactic features and their permissible values. Every *cell* in the paradigm, therefore, corresponds to a complete well-formed set σ of

morphosyntactic *properties* (i.e., feature-value pairs). For the paradigm of a lexeme **L**, the form **Y** which occupies a given cell is the realization of the corresponding set σ on the root **X** of **L**. The eponymous *paradigm function* (PF) is a mapping from a root-pairing $\langle X, \sigma \rangle$ to a (word-)pairing $\langle Y, \sigma \rangle$, that is, to an inflected word with the property set appropriate to the cell it appears in. A paradigm function is in turn “defined in terms of more specific *realization rules*”—the individual rules of morphology realizing the language’s morphosyntactic properties” (Stump 2001:33).

The formalism of PFM is both rigorous and interpretable within the traditions of formal linguistics. That said, however, there are a few barriers to clear interpretation. Each and every realization rule, for example, bears a triple subscript: the rule block *n* that the rule belongs to, the proper subset τ of σ that the rule participates in realizing, and the lexeme class **C** whose paradigm function the rule participates in defining.

Rule format: $RR_{n, \{\tau\}, [C]}(\langle X, \sigma \rangle) =_{\text{def}} \langle Y', \sigma \rangle$

All of this appears before the root-pair $\langle X, \sigma \rangle$ is encountered, and well before the effect of the rule on the root **X**, i.e., **Y'**, is encountered. If strict attention is not paid to a sometimes quite long string of subscripted shorthand abbreviations, it can be difficult to keep track of the point being made in each rule (Stewart 2000).

For example, from Old Norse:

$RR_{2, \{\text{MOOD:indic, VOI:act, TNS:past, PER:3, NUM:pl}\}, [V]}(\langle X, \sigma \rangle) =_{\text{def}} \langle Xu, \sigma \rangle$

Stump (2001) has made the articles which preceded it more accessible.

In PFM, rules of all sorts, and consequently PFs as well, are seen as static well-formedness conditions holding between lexical roots and stems, between stems and inflected words. This is in keeping with other non-derivational approaches to linguistics, e.g., HPSG, but the different perspective can be misleading if one takes the descriptive model to represent a derivation in the traditional sense of the word. The step-by-step demonstration of rule evaluation is therefore more on the lines of a logical proof, but the fact that a proof generally looks not unlike an incremental building up of complex morphological structure (at least in the horizontal dimension) certainly renders it an ‘apparent derivation’.

A key concept in PFM is that of the *rule block*, mentioned in passing above. Stump (2001:33) likens the block to Anderson’s (1992:129) use of the same term. An important difference exists, however, between the two conceptualizations. A-Morphous-type blocks were motivated as a response to cases of disjunctive rule application; there is no independent motivation or principle which allowed the rule block to cohere. PFM blocks, by contrast, correspond to the traditional notion of a *position class*, whereby “rules belonging to the same block compete for the same position in the sequence of rules determining a word’s inflectional exponence” (Stump 2001:33). “Same position” here is more literally construed than the disjunctions in Anderson (1986, 1992), such that a PFM block of realization rules corresponds to a “slot” in a word’s sequence of inflectional affixes. PFM rule blocks, therefore, are organized according to the

distributional facts of exponence, and not of the more abstract notion of disjunctive rule application. PFM gets disjunctive application for free, as it were—since no more than one exponent can appear in a given slot, no more than one rule from the same block may apply in the definition of a given PF.

Reference to slots while at the same time eschewing morphemes as objects opens PFM for some criticism, because (as happened to the MSRs in A-Morphous Morphology, above) zeroes can take up residence in vacant positions. To counter this possibility, and in keeping with the “function” mentality, absolutely no structural zeroes are allowed for in PFM. Where no rule in a block is applicable to $\langle X, \sigma \rangle$, a universal realization rule applies, the Identity Function Default, mapping the input onto itself (Stump 2001:53, 143):

Identity Function Default (IFD):

$$RR_{n, \{ \}, U}(\langle X, \sigma \rangle) =_{\text{def}} \langle X, \sigma \rangle$$

Here, n ranges over all rule blocks, $\{ \}$ is the empty set of morphosyntactic properties, and U is the class of all lexemes. The IFD, therefore, is effectively the last rule in every rule block, guaranteeing that a proof never fails because some slot in the PF was undefined for lack of an applicable rule. There is no question of “adding \emptyset ”—the IFD evaluation of the block is “no change.”

On the issue of rule ordering, PFM denies the need for extrinsic rule ordering. By Pāṇini’s Principle (no disjunctivity rider required, cf. A-Morphous Morphology, above): given any complete set s of morphosyntactic properties appropriate to a particular lexeme class and any lexeme in that class, “the value of the ... PF for the root-pairing $\langle X, \sigma \rangle$ is always the result of applying the NARROWEST APPLICABLE RULE” in each of the blocks mentioned in the PF schema (Stump 2001:52). A PF schema identifies which rule blocks are involved in the definition of the form realizing the set σ on the root X of lexeme L , e.g.:

$$PF(\langle X, \sigma \rangle) =_{\text{def}} \text{Nar}_3(\text{Nar}_2(\text{Nar}_1(\text{Nar}_0(\langle X, \sigma \rangle)))$$

Narrowness, then, is evaluated between realization rules in terms of the relative specificity of the set of morphosyntactic properties realized by each rule. This is the method for enforcing the Pāṇinian Principle, i.e. proper subset precedence.

The Identity Function Default is, for PFM, the “default default,” meaning that where no special case is called for, the IFD takes over. The default-override relation is crucial in PFM, as it is in Network Morphology (above). Defaults are what lexemes in a particular class ‘inherit’ by virtue of class membership, provided that they are not simultaneously members of a more select class (a proper subset of the larger class, of course) which is subject to a special override rule. The Narrowness relation is simply a principled (rather than extrinsic or arbitrary) and formal way of deciding, between two realization rules, both of which are applicable in a given case, which would override the other (subject to further override by some third rule, narrower still than either of them). Defaults are therefore layered, and the prediction is that the Pāṇinian Principle will always be adequate for the unique determination of the narrowest applicable rule, given

the joint assumptions that blocks are position classes and that no block is ever undefined thanks to the IFD (Stump 2001:21-25).

Lexemes each possess a *stem set* consistent in number of stems at least with the other members of the same lexeme class. In the general (non-suppletive) case, stems will be related to the root or another stem by rules of *stem formation*, purely formal operations (Stump 2001: 183-86). If stems occupying corresponding positions in the stem sets of comparable lexemes in distinct inflectional classes are not characterized by parallels in general phonological shape, purely morphological (*morphomic*, in the sense of Aronoff (1994:22-29)) rules of *index assignment* come into play, marking stems as 'strong' versus 'weak', e.g., or assigning arbitrary numerical indices (Stump 2001: 190-194)¹⁰. Rule block 0 in any given language is a block of *stem selection* rules that identify the morphosyntactic properties each stem may (partially or wholly) realize (Stump 2001: 175-79). In this way, regular (and/or productive) stem-internal non-concatenative marking may be handled by stem formation rules, and the Separation Hypothesis is still respected, since rules of selection and formation are in principle independent.

The evaluation of particular realization rules is stated as a default phonological entity, which implies that the default shape of the exponent may be overridden under specific circumstances. An unordered set of morphophonological rules constrains the evaluation of each realization rule in any instance of its application. For any given application of a randomly chosen rule, any number of morphophonological rules (including none) may affect the phonological shape of the rule's evaluation. Where whole blocks of realization rules or an identifiable subset of rules in a block is subject to one or more particular morphophonological rules, a *morphological metageneralization* may be stated concerning those rules to account for this subregularity (cf. *meta-templates/meta-redundancy-rules* in Janda and Joseph (1992a and b, 1999)).

PFM is more limited in its scope than many of the other theories considered here, for example, in that only the barest intimations of how to handle derivation and compounding, let alone cliticization, have appeared to this point (Stump 1995; but see Spencer 2004 for a proposed extension). No particular theory of syntax has been assumed as an input to PFM, although it has been identified as a promising interface for HPSG by Kathol (1999). Although PFM has been compared to A-Morphous Morphology as coming from a similar theoretical perspective, a much closer affiliation is to be found with Network Morphology (above) in the shared reliance on features, defaults, lexical classes and subclasses, and the paradigm as an organizing principle. One clear distinction there is PFM's tying rule blocks to position classes directly, whereas this does not seem to be captured in the Network Morphology approach. An empirical examination in this area might well prove a useful line of study to determine the necessity/redundancy of such an assumption.

¹⁰ If a stem is used in the realization of all and only the occurrences of some morphosyntactic property, say {TNS:past}, it may be (mnemonically) useful to use an index which reflects this use, i.e., identify a "past stem." This does not, of course, entail that all indices for the particular stem set must bear functionally-defined indices. From a realizational perspective, function-based names can give a (misleadingly) morphemic cast to an element of form.

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14. Prosodic Morphology

Morpheme-based	<input checked="" type="checkbox"/>					Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar		<input checked="" type="checkbox"/>				In lexicon
Phonological formalism	<input checked="" type="checkbox"/>					Syntactic formalism
Incremental	<input checked="" type="checkbox"/>					Realizational

Prosodic Morphology is an outgrowth of Autosegmental Phonology (Goldsmith 1976). Proposals made in McCarthy's (1979) analysis of Classical Arabic, and distilled somewhat in McCarthy (1981), gave rise to an approach that escapes the limitations of the two-dimensional trees of Word Syntax (see below). In McCarthy (1981) the task is to accommodate non-concatenative morphology into the same basic scheme as concatenative morphology. In order to accomplish this, McCarthy invokes the abstract multidimensional representations, or tiers, found in Autosegmental theory. If every morpheme is represented on its own tier, root and non-root morphemes are more parallel

at the formal level. The asymmetry comes in the form of a prosodic skeleton, to which the segmental and/or featural content of the morphemes is mapped on an independent basis. This allows for the retention of discrete morphemes, while allowing the parts of these morphemes to appear discontinuously in the output string, a result not readily permitted in representations of two dimensions (or fewer). Thus, e.g., the Classical Arabic form *kattab* “cause to write (perfective active), the morphemes are /k-t-b/ “write”, /-a-a-/ (reducible to /a/ under assumptions of spreading) [perf. act.], and CVCCVC [causative]. McCarthy (1981:385) exemplifies fifteen abstract morphological classes for the (majority) triconsonantal roots of Classical Arabic, choosing to refer to the classes by the established Hebrew term, *binyan(im)*.

The analysis in McCarthy (1981) requires a number of stipulative exceptions to “unmarked” patterns of association between segments and the skeletal slots, e.g., in cases where the middle of three consonants spreads, rather than the more usual “one-to-one, then spread from the last attached segment to fill the remainder of appropriate slots” (which would give **katbab* instead of attested *kattab*, mentioned above). The device of *preassociation* allows for certain overrides of the unmarked association patterns, whereby one could say “attach edge segments, then fill remainder by spreading as yet unattached segments.” McCarthy proposes this, with the functional explanation that failing to ensure that at least edge elements are attached before spreading may have the consequence of obscuring the root’s identity (a foreshadowing, perhaps, of faithfulness and opacity concerns in his later Optimality Theory work)(McCarthy 1982:204-05, 213-14, 221).

Marantz (1982) capitalizes on the descriptive success of McCarthy’s framework, testing it on reduplication data from several languages. Whereas McCarthy (1981) used the skeletal tier as a sort of output template to be filled in, Marantz (1982:437) suggests that affixes as well as stems can be segmentally underspecified, that “most reduplication processes are best analyzed as the affixation of a consonant–vowel (C–V) skeleton, itself a morpheme, to a stem. The entire phonemic melody of the stem is copied over the affixed C–V skeleton and linked to C and V ‘slots’.” Defining a complete copying operation from which ‘leftovers’ can be ‘stray-erased’, and the segments or features within which can be overridden by preattached values (Marantz 1982:444), perhaps excessively powerful, but given that there are languages which use total reduplication, a single universal operation based on the limiting case is actually conceptually simpler. The fact that other languages reduplicate no more than one or two segments in all cases undercuts the universal appeal somewhat, but there is a case to be made either way (cf. the l-reduction approach to reduplication in Hoeksema and Janda (1988:221-25)).

A real advantage of Marantz’s (1982) presentation is the involvement of a richer and independently motivated prosodic hierarchy (also developed in Halle and Vergnaud 1980) in the description of the different abstract shapes that affixes can take. The limiting case, “normal affixation” is the addition to a stem of a morpheme which is fully specified, all the way to the segmental level, borrowing nothing from the content of the stem (Marantz 1982:456). Yidin^y reduplication copies the first two syllables of the stem, regardless of their segmental (C–V) composition (453). The more frequently encountered reduplication types are somewhere in the middle, then, with a specific C–V skeleton, and perhaps some limited segmental and/or featural preassociation (449). From this

perspective, morphological operations and different morpheme types are formally united in a plausible way. Perhaps the start from nonconcatenative processes led to this more evenhanded treatment of the two types, concatenative and non-concatenative. The skewed relative frequency of “normal affixation” versus the much less common reduplication cross-linguistically is unpredicted, however.

Akinlabi (1996) gives an indication of the survival of the approach into the Optimality Theory paradigm. Akinlabi, although dealing with putative morphemes which are no larger than features or sets of features, hopes to account for these as edge-oriented affixes. In the constraint-based framework of Optimality Theory (McCarthy and Prince 1993, 1994), constraints which align prosodically-defined elements such as syllables, feet, and (prosodic) words are commonly employed to describe positional affinities between one level of the prosodic hierarchy and another when, all else being equal, independent positioning might be assumed. Akinlabi seeks to adjust the terrain, positing constraints which ALIGN particular morphemes to particular prosodic constituent edges (243):

Featural Alignment

ALIGN (PFeat, GCat)

A prosodic feature is aligned with some grammatical category.

What this fails to take into consideration, and what McCarthy (1981, 1982), Marantz (1982) and Halle and Vergnaud (1980) before them failed to emphasize, is that *morpheme* is not part of the prosodic hierarchy. Because the phonological material in a given word owes its existence, in the general case, to some element of meaning or grammatical function, and there is therefore some dependency between a morpheme and its spell-out (“Pfeat is the featural spellout (or content) of the morphological category in question” (Akinlabi 1996:243), Prosodic Morphology sees no obstacle to positing a hierarchy:

root > morpheme > syllable > C–V skeleton > segment > feature

The comparability of morphemes and syllables is limited, since meaning attends the one but not the other. The question of where (or whether) to place ‘foot’ in the above shows the grafting of one dimension into another. To base an analysis on correspondences between the phonological and the morphological, especially when one is presuming to propose universal constraints (as OT analyses explicitly presume), is to open oneself up to criticism of allowing too liberal a formal representation. Because these levels are not always spelled out exhaustively in the examples given in Prosodic Morphology (although McCarthy 1982:213, e.g., comes close), it is easy to ignore the questionable telescoping that is going on.

For Akinlabi, the placement of a featural affix is part of the lexical entry of that morpheme; determining whether it is a prefix (i.e., placed relative to the left edge of the stem) or a suffix (relative to the right) is based on evidence for directionality of autosegmental association. A featural suffix, for example, will tend to have its effect at the right edge of the stem, but depending on the relative strength of feature cooccurrence constraints and faithfulness constraints, the suffix may be forced further in from the

edge, or else be blocked from applying. Within the formalism of OT this is fairly ingenious, despite some of the questionable underlying assumptions. As a brief example, Chaha labialization is claimed to be a featural suffix, realized on the rightmost stem consonant which may be labialized (coronal consonants may not be labialized, although labial and velar consonants can). The feature links once only, to the rightmost licensing consonant, potentially linking to an initial consonant if there are only coronals after it in the word. In case of a stem with only coronal consonants, the feature does not link and thus is not phonetically realized. Given these details, a constraint hierarchy of *COR/LAB>>PARSE>>ALIGNR (249). A particular coup for this approach is the factorial typology given and exemplified in an appendix to the article (283):

Co-occurrence	>>α>>	Alignment	>>β>>	Parse	<i>Nuer continuancy</i>
Co-occurrence		Parse		Alignment	<i>Chaha labialization</i>
Parse		Co-occurrence		Alignment	<i>Japanese mimetics</i>
Parse		Alignment		Co-occurrence	<i>Aka voicing</i>
Alignment		Co-occurrence		Parse	<i>Athapaskan [-continuant]</i>
Alignment		Parse		Co-occurrence	<i>Aka voicing, Zoque palatalization</i>

Except for the Japanese mimetics, however, one would hardly know this was a morphological analysis. The categories realized by the various featural affixes are backgrounded throughout the article, in an effort, it would seem, to cast this as nothing other than phonological theory. Simultaneously, therefore, Akinlabi (1996) displays the inheritance from the earlier work in Prosodic Morphology and regresses theoretically to a more concatenative ideology.

Prosodic Morphology, although undergoing some significant transformations in its transition into constraint-based (OT) analyses, is an approach that the phonologically-minded may take to readily. Despite the several caveats in the above, there is clearly something of value in this method of representing the phonological aspect of morphology. One must remember, however, that the insights of multi-tiered representations can collapse into the same plane if viewed from a different angle.

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15. Word-Syntax

Morpheme-based	<input checked="" type="checkbox"/>					Word/Lexeme-based
Formalist	<input checked="" type="checkbox"/>					Functionalist
In grammar	<input checked="" type="checkbox"/>					In lexicon
Phonological formalism					<input checked="" type="checkbox"/>	Syntactic formalism
Incremental	<input checked="" type="checkbox"/>					Realizational

The approach to morphology called Word Syntax has a special position in linguistic theory, especially in the area of GB-style syntax and its descendants. It owes much to the classic Item-and-Arrangement (IA) approach (Hockett (1954)). In Word Syntax, morphemes are the essential building blocks of words. Bound morphemes differ from free morphemes solely in that the bound morphemes subcategorize for a stem of a certain category to attach to. The name Word Syntax is an obvious choice for this approach, because one need only glance at an analysis to see the overt parallels being drawn between words and phrases. Lieber's (1981) dissertation is held up as an example of the Word Syntax movement in its crystallizing phase. Morphology from this perspective is first and foremost about the concatenation of discrete meaningful units, namely morphemes, and the binary-branching tree-structures constitute an account of how a morphologically complex expression comes to have the meaning and morphosyntactic features it does.

In Lieber (1981) and in Williams (1981), much attention is paid to the notion of headedness in morphologically complex words. Williams (1981:248) proposes that the rightmost morpheme at any level of morphological concatenation is the 'head' of the construction (his Righthand Head Rule, or RHR), i.e., that for any concatenation of two morphological elements, the element on the right determines the category and attributes of the resulting expression.

Lieber (1981) proposed the mechanism of feature percolation as the means of transmitting attributes from a constituent morpheme upward to a larger construct. Williams's RHR "works" for much of English derivational morphology and compounding, since English endocentric compounds are almost invariably right-headed, and since nearly all category-changing affixes in English are suffixes. One need not search too far to discover languages with systematic left-headed compounding (Italian,

Gaelic, Vietnamese) and even within English there are a few category-changing prefixes ([*en-[noble]_A]_V). Inflectional affixes in English are invariably suffixal, but part of the definition of inflection is that it cannot change the category of the word it applies to. The Spanish diminutive suffix *-ito/-ita* can attach to nouns, adjectives and adverbs, producing in each case a semantic change only, crucially being 'transparent to the category of the word it attaches to, quite unlike a head is predicted to behave (Di Sciullo and Williams 1987:26).*

The RHR is clearly not adequate as a general principle of morphology, but perhaps a revision could redeem it? Lieber (1981) and Selkirk (1982) both reject the RHR as originally defined as simply being too strong. They both suggest alternatives to strict right-hand percolation, allowing for so-called "back-up percolation" in cases where the whole expression has attributed present in some non-head morpheme but not present in the head (Selkirk (1982:76):

Percolation (revised)

- a. If a head has a feature specification [aF_i], $a \neq u$ [nspecified], its mother node must be specified [aF_i], and vice versa.
- b. If a nonhead has a feature specification [bF_j], and the head has the feature specification [uF_j], then the mother node must have the feature [bF_j].

This allows nonhead features to be percolated to the construct, but only if the head has no non-null specification of its own to contribute for the feature in question. Prefixation is still a potential problem if multiple prefixes were to have conflicting specifications for the same feature. It may be that this situation never arises, especially if we assume strict binary branching, but there is nothing to rule it out in principle.

In Di Sciullo and Williams (1987:26), acknowledging some serious empirical problems for the RHR as originally defined, a relativized notion of head is put forward:

"The head_F of a word is the rightmost element of the word marked for the feature F."

This permits a multiply affixed word to have several heads simultaneously, effectively allowing any morpheme to determine some categorial quality of the derivative. Prefixes cannot determine category, however, because the root is always to the right of them, and the root is always marked for at least grammatical category. Thus the facts like *ennoble* still are unexplained, and the predictiveness of the original hypothesis is severely weakened. As for left-headed compounds, Di Sciullo and Williams claim that such constructions in Romance languages aren't really compounds, but rather they are "phrases reanalyzed as words" (83, contra Selkirk 1982:21). The argumentation is less than conclusive, given the semantic idiosyncrasy of some of the expressions and the failure of agreement in at least some cases. The bottom line for Di Sciullo and Williams's proposed amendments to those of Lieber (1981), Williams (1981), and Selkirk (1982) is a weaker model overall and a smaller but remaining empirical problem.

Fabb (1988) proposes doing almost all word formation in the syntax (at least all productive affixation), with separate affixal nodes in the phrase marker, and concatenation via head movement. Di Sciullo and Williams (1987:87) disapprove of such intermingling of syntax and morphology as engendering a loss of generality in both

morphological and syntactic rules. Developments in GB syntax converged with the idea of inflection in syntax, such that verb inflection (and sometime noun inflection as well) is performed (or, alternatively, ‘checked’) by the movement of lexical heads through a sequence of functional heads, each of which contains a morphosyntactic value appropriate to the clause in question, and often associated with overt inflectional morphology. Once head movement is complete, an inflected lexical head appears in S-structure as input to PF.

Whether the affixes are actually represented in the tree structure under the appropriate functional heads is a decision not without implications. The Lexicalist Hypothesis (Chomsky 1970) makes a qualitative distinction between syntax and the internal structure of words. Despite some formal similarities including apparent hierarchical relations among at least the derivational morphemes in a morphologically complex word, syntax does not have access to, and therefore cannot make reference to, any internal structure of the words which might appear in syntactic constructions. This point is recast in Selkirk (1982:2), “The category Word lies at the interface in syntactic representation of two varieties of structure, which must be defined by two discrete sets of principles in the grammar.” “Doing affixation in the GB syntax” as Fabb (1988) would have it, is clearly contrary to the Lexicalist position.

In 1992, Lieber re-entered the fray with an overtly syntactic approach to word formation, *Deconstructing Morphology*. Specifically in response to lexicalized phrases (which Di Sciullo and Williams (1987) looked to as a safety net against the falsification of the RHR), Lieber sees a need to intermingle principles of phrase-building and principles of word-building (21). Again it is claimed that all morphemes have lexical entries, and most, if not all, have syntactic categories of their own. Morphemes are thus X^0 elements to be inserted in syntactic tree structures. Allowing for unlimited recursion at the X^0 level, Lieber can concatenate any number of morphemes into a complex X^0 without untoward results in the X-bar syntax (37). The assimilation of morphology to syntax is fairly completed by the introduction of the notions of complement, specifier, and modifier morphemes, alongside the existing notion of head; Lieber assumes that parallel terms mean parallel behavior “above and below the word level” (39). She modifies some conventional parameter settings found in syntax and dubs them *Licensing Conditions* (38):

- a. $X^n \rightarrow \dots X^{(n-1, n)} \dots$, where recursion is allowed for $n=0$.
- b. Licensing Conditions
 - i. Heads are initial/final with respect to complements.
 - Theta-roles are assigned to left/right.
 - Case is assigned to left/right.
 - ii. Heads are initial/final with respect to specifiers.
 - iii. Heads are initial/final with respect to modifiers.
- c. Pre- or post-head modifiers may be X^{\max} or X^0 .

With the above as general conditions holding of morphemes as well as words in this expanded view of syntax, the onus is on Lieber to demonstrate that full parallelism obtains. The cost of maintaining this assumption, however, is a series of *ad hoc* replies to empirical problems:

1. English synthetic compounds are left-headed because the construction is a holdover from Old English, when the parameter-settings were different (62-63);
2. Right-headed compounds in French (the only kind that matter, according to Di Sciullo and Williams (1987:83-86)), such as *radioactivité*, are dismissed as non-productive, learned, neo-classical vocabulary, with no import for the parameter-settings (66); and
3. Variable adposition patterning in Dutch is the result of treating the parameters as defaults rather than as true parameters (70-71).

The resulting correspondence between phrasal and word syntax is rough at best. The predictions which follow from Lieber's assumptions are quite strong, if we permit the specifier and complement morphemes, according to her unexpectedly brief presentation of the topic.

The Word Syntax approach to morphology has the formal advantage of making morphology similar or identical to the independently motivated syntactic component. The greater the insistence on assimilation, however, the more adjustments and riders there are to be included in the statement of syntactic rules and principles. Giving each morpheme a lexical entry, but at the same time suggesting that the lexicon is no more structured than a random collection of such entries (Lieber 1992:21)¹¹ makes one wonder what the lexicon is really good for, other than standing as a legitimizer for the putative equivalence of all morphemes, bound or free¹². As was mentioned in the introduction to this section, the Word Syntax framework has had considerable influence on the treatment of morphology within the GB syntactic framework. If one is working in the GB/Minimalist framework, Word Syntax might be the most natural choice (but compare DM, above).

Di Sciullo, Anna Maria, and Edwin Williams. 1987. *On the Definition of Word* [Linguistic Inquiry Monograph 14]. Cambridge, MA: MIT Press.

Fabb, Nigel. 1988. Doing affixation in the GB syntax. *Morphology and Modularity* [Publications in Language Sciences 30], ed. by Martin Everaert, Arnold Evers, Riny Huybregts, and Mieke Trommelen, 129-45. Dordrecht: Foris.

Julien, Marit. 2007. On the relation between morphology and syntax. *The Oxford Handbook of Linguistic Interfaces*, ed. by Gillian Ramchand and Charles Reiss, 209-38. Oxford/New York: Oxford University Press.

¹¹ This atom-oriented lexicon stands in contrast to Lieber (1981) and its decidedly more organized contents (complete with stems as well as roots). The agenda there was to move all morphology into the lexicon, and although the tree structures of Word Syntax may be taken more benignly as generalizations about lexical structures, those practitioners taking their cue from Fabb or the functional head movement (no pun intended) are taking a more literally syntactic view.

¹² Somewhat ironically, the strongest form of Word Syntax implies that lexicalization is not real, since only single morphemes are inserted at terminal nodes, in keeping with proposals dating back at least to the *Sound Pattern of English* (Chomsky and Halle 1968).

Lieber, Rochelle. 1981. *On the Organization of the Lexicon*. Bloomington, IN: Indiana University Linguistics Club. [1980. MIT dissertation].

Lieber, Rochelle. 1992. *Deconstructing Morphology: Word Formation in Syntactic Theory*. Chicago: University of Chicago Press.

Selkirk, Elisabeth O. 1982. *The Syntax of Words* [Linguistic Inquiry Monograph 7]. Cambridge, MA: MIT Press.

Toman, Jindřich. 1998. Word Syntax. *Handbook of Morphology*, ed. by Andrew Spencer and Arnold M. Zwicky, 306-21. Oxford/Malden, MA: Blackwell.

Williams, Edwin. 1981. On the notions “lexically related” and “head of a word”. *Linguistic Inquiry* 12(2).245-74.

APPENDIX A

A.1—Introduction: Scottish Gaelic Nouns (Stewart 2004)

I. *doras* (m.) ‘door’

	SINGULAR	PLURAL
NOM.	<i>doras</i> /tɔrəs/	<i>dorais</i> /tɔriʃ/
GEN.	<i>dorais</i> /tɔriʃ/	<i>dhoras</i> /ɣɔrəs/
DAT.	<i>doras</i> /tɔrəs/	<i>dorais</i> /tɔriʃ/
VOC.	<i>a dhorais!</i> /əɣɔriʃ/	

II. *balach* (m.) ‘boy, lad’

	SINGULAR	PLURAL
NOM.	<i>balach</i> /palax/	<i>balaich</i> /paleç/
GEN.	<i>balaich</i> /paleç/	<i>bhalach</i> /valax/
DAT.	<i>balach</i> /palax/	<i>balaich</i> /paleç/
VOC.	<i>a bhalaich!</i> /əvaleç/	

III. *sgoil* (f.) ‘school’

	SINGULAR	PLURAL
NOM.	<i>sgoil</i> /skɔl/	<i>sgoiltean</i> /skɔltʃən/
GEN.	<i>sgoile</i> /skɔlə/	<i>sgoiltean</i> /skɔltʃən/
DAT.	<i>sgoil</i> /skɔl/	<i>sgoiltean</i> /skɔltʃən/
VOC.	<i>a sgoil!</i> /əskɔl/	

IV. *clach* (f.) ‘stone’

	SINGULAR	PLURAL
NOM.	<i>clach</i> /kʰlax/	<i>clachan</i> /kʰlaxən/
GEN.	<i>cloiche</i> /kʰlɔjçə/	<i>chlach</i> /xlax/
DAT.	<i>cloich</i> /kʰlɔjç/	<i>clachan</i> /kʰlaxən/
VOC.	<i>a clach!</i> /əkʰlax/	

General facts of initial mutation (specifically “Lenition”):

$p^h \sim f$ $t^h \sim h$ $s \sim h^*$ $tʃ \sim ʦ$ $k^h \sim x$
 $p \sim v$ $t \sim \gamma$ $dʒ \sim j$ $k \sim \gamma$
 $m \sim \tilde{v}$ n^{**}
 l^{**}

* $/s/$ is immune to initial mutation before stops (including $/m/$), e.g., *sgoil*, above.

** $/n, l/$ are immune to initial mutation in most modern dialects.

A.2: A-Morphous Morphology's response

Inflectional rules take as input pairs $\{S, M\}$ consisting of a lexically-specified stem and a (contextually appropriate) morphosyntactic representation (*MSR*). The stems in the stem set of a given lexeme are those not characterizable by (partial) suppletion, that is, alternating in ways that are lexically specific and not representative of systematically part of a lexical class. Since initial mutation is regular and productive in terms of its mapping between alternant pairs, it is preferable to capture that as an inflectional word-formation rule. For at least the *doras–balach* class (henceforth class $N\alpha$), i-Ablaut will similarly be (part of) a WFR.

Stem sets

Class $N\alpha$ Doras: $\{/t\alpha r\alpha s/\}$
 Balach: $\{/p\alpha l\alpha x/\}$
 Class $N\beta$ Sgoil: $\{/sk\alpha l/\}$
 Class $N\gamma$ Clach: $\{/k\lambda o j\zeta/ [gen/dat, sg.]; /k\lambda a x/\}$

Since none of the forms in the set has multiple specifications for the same feature(s), there is no call for layering in the MSR's.

WFRs (all are +N)

- (1) $[\{+Nom, +Dat\}, +sg]$
 $/X/ \rightarrow /X/$
- (2) $[+Gen, +sg]$
 $/YVC/ \rightarrow /YV [+high] C/ \quad (N\alpha)$
 $/X/ \rightarrow /X\alpha/$

Rule (1) states that the bare stem will be used in the nominative and dative singular. In the case of *clach*, the lexically specified $[+Dat]$ stem will be selected, owing to its greater specificity, and will be used as-is for the dative. In (2), disjunctivity is to be invoked twice:

- a. the more specific clause will apply to $N\alpha$ nouns only, and the second clause will apply elsewhere, and
- b. the lexically specified $[+Gen]$ stem will be selected for *clach*.

- (3) [+Gen, +pl]
/CY/ → /C'Y/
- (4) [+pl]
/YVC/ → /YV [+high] C/ (N α)
/X/ → /Xtʃən/ (N β)
/X/ → /Xən/ (N γ)

The Elsewhere Condition is in play here, since rule (3) will precede and pre-empt rule (4). Within rule (4), where it does apply, the different clauses are indexed to the lexical class of the input stem, and thus apply disjunctively.

- (5) [+Voc]
/CYVC/ → /əC'YV [+high] C/ (N α)
/X/ → /əX/

In (5) the first clause precedes and pre-empts the second clause. C' is used to indicate the mutated alternant of the corresponding C in the input stem.

A.3: Articulated Morphology's response

It requires some formal ingenuity to represent non-concatenative, non-zero morphology in the AM framework. The following, however, is in keeping with the spirit of what AM rules do.

As for morphological objects in Scottish Gaelic, it seems clear that there are roots, different stems, and words. Case and Number are often marked jointly, and may also be marked in multiple ways on the same inflected word. Defining the morphological objects by means of content is problematic, therefore. Taking the root as the starting point, and since every rule must be information-increasing, the following rules are a significant subset of those required for the paradigms given.

- (1) Singular in class N:
X X
[] → [N: sg]
- (2) Nominative in class N:
X X
[] → [Case: nom]
- (3) Dative in class N:
X X
[] → [Case: dat]
- (4) Plural in class N α :
[...VC] [... V [+high]C]
[] → [N: pl]
- (5) Genitive singular in class N α :
[...VC] [... V [+high] C]
[N: sg] → [N: sg, Case: gen]
- (6) Genitive plural in classes N α and N γ :
[C...] [C'...]

[] → [N: pl, Case: gen]

(7) Genitive singular in classes Nβ and Nγ:

X Xe
[N: sg] → [N: sg, Case: gen]

(8) Vocative singular in class Nα:

[C...V C] a [C' ...V [+high] C]
[] → [N: sg, Case: voc]

(9) Vocative singular in classes Nβ and Nγ:

X aX
[] → [N: sg, Case: voc]

(10) Plural in class Nβ:

X Xtean
[] → [N: pl]

(11) Plural in class Nγ:

X Xan
[] → [N: pl]

In the above rules, C' is used to indicate the mutated alternant of the initial C in the input expression. Class Nβ almost motivates a distinct singular versus plural stem, but Nα and Nγ are not consistent with such a step. The Gen/Dat singular stem for *clach* would seem to be a lexical matter, rather than the stuff of rules.

A.4: Autolexical Syntax's response

Mutation and i-Ablaut are consigned them to the principles of Prosodic Phonology (McCarthy 1981, Marantz 1982), as was proposed in Sadock (1991:26). The remaining few "lexemes" have the following lexical representations:

	-e		-tean
Syntax	nil		nil
Semantics	nil		nil
Morphology	N[fem]\N[gen,sg]		N[Nβ]\N[pl]
	-an		a-
Syntax	nil		nil
Semantics	nil		nil
Morphology	N[Nγ]\N[pl, {nom,dat}]		N[voc,sg]/N

The Morphology describes appropriate insertion contexts, using Categorical Grammar formalism.

In Autolexical Syntax, stems are considered to be the head of inflected words. Inflections (Y) are introduced by the following general rule (X = N, for the present data set), and then placed with respect to the stem (X[-0]) depending on whether they are prefixes or suffixes:

$X[-1] \rightarrow X[-0], Y$

The Case and Number properties would be assigned based on context, whereas declension class would be a lexical property of the noun. All four example lexemes are simple nouns (N[0]), and therefore semantically intransitive predicates (F[-1]) (Sadock 1991:31).

	<i>doras</i>	<i>balach</i>	<i>sgoil</i>	<i>clach</i>
Syntax	N[0]	N[0]	N[0]	N[0]
Semantics	F[-1]	F[-1]	F[-1]	F[-1]
	'door'	'boy'	'school'	'stone'
Morphology	N[-0]	N[-0]	N[-0]	N[-0]

The combination of the affixes and the stems give N[-1], i.e., inflected words in the morphology, once all appropriate inflections are introduced. These are N[0] elements in the syntax, and examples of such inflected words would be the following:

	<i>doras</i>	<i>bhalach</i>	<i>sgoile</i>	<i>cloich</i>
Syntax	N	N	N	N
	[1, nom, sg]	[1, gen, pl]	[1, gen, sg]	[1, dat, sg]
Morphology	N[-1]	N[-1]	N[-1]	N[-1]

Semantics are assumed to be unchanged under inflection.

A.5: Categorial Morphology's response

Whereas affixation is accounted for in Categorial Morphology by addition operations, non-concatenative morphology is effected by means of substitution operations (Hoeksema and Janda (1988)).

First the two-place operations, definable in terms of lexical entry triples on the morphologically context-sensitive affixes.

-*tean* <Nstem\N β \, N, Suff>
 -*an* <Nstem\N γ \, N, Suff>
 -*e* <Nstem\N x \, N, Suff> Where $x \in \{\beta, \gamma\}$

The Vocative prefix applies in all classes, and so does not require the subcategory specification in its input requirements.

a </Nstem, N, Pref>

These affixes will be added via a cancellation operation—left-cancellation for the suffixes, right cancellation for the prefix.

Initial mutation would have a lexical entry <Nbasic, Nmut, *fmut*>, and its effect, i.e., the operation *fmut*, should be treated with a rule of replacement.

$$fmut (C[-strident, -continuant, \alpha \text{ spread glottis}]X) = C[+continuant, -\alpha \text{ voice}]X$$

The i-Ablaut would parallel mutation to some degree, with an entry $\langle N_{\text{basic}}, N_{\text{ablaut}}, f_{\text{ablaut}} \rangle$, where application is limited to $N\alpha$ (the class of *doras* and *balach*), and the operation defined as follows:

$$f_{\text{ablaut}} (XVC) = XV[+high]C$$

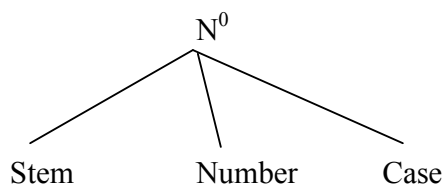
The alternation $a \sim oi$ in *clach* seems to be separate from this, and so should probably be handled in the lexicon, rather than with a rule that would imply more general applicability. More data would make clear the (lack of) motivation for a separate synchronic ablauting rule.

(Note: Because of the multifunctionality of mutation and i-Ablaut, the entries given above contain purely formal second members, N_{mut} and N_{ablaut} . Categorical Morphology would typically give more content-specific second members, such as $N[+Nom]$ or the like, and so the above lexical entry formulations are rather more like schemata, containing a variable as the second member, thereby abbreviating (part or all of) several distinct morphological rules. The operations f_{mut} and f_{ablaut} , however, are defined over strings, and so are phrased appropriately without reference to input and output categories.)

These affixes and operations may be applied singly or jointly to bases, according to the rules of Categorical Grammar.


A.6: Distributed Morphology's response

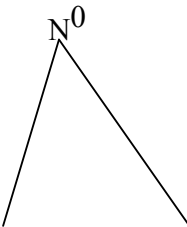
In each case, Morphological Structure takes the terminal nodes of Surface Structure and creates morphosyntactic feature nodes (plus one for the stem). In order to consider larger structures involving agreement, a Gender node would be created as well.

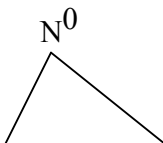


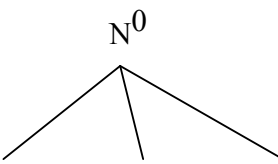
From this point, morphological operations of Fission and/or Fusion will join or split nodes, depending on the nature of the morphemes to be inserted, e.g., are there multiple exponents (redundantly) marking the same category (fission), or are there morphemes which carry multiple feature specifications (fusion)?

Let's look at the various configurations needed for correct vocabulary insertion.

1. N^0

 [Stem, Case, Num.]
- doras, balach*: [Nom, Sg.], [Dat., Sg.]
sgoil: [Nom., Sg.],[Dat., Sg.]
clach: [Nom., Sg.]
- STEM IS USED 'AS-IS'.

2. N^0

 [Stem] [Case, Num.]
- doras, balach*: [Gen.,Sg.],[Nom., Pl.], [Dat., Pl.]
sgoil: [Gen.,Sg.],[Nom.,Pl.],
 [Gen.,Pl.],[Dat.,Pl.]
clach: [Gen.,Sg.], [Dat., Sg.],
 [Nom., Pl.], [Dat., Pl.]
- NULL OR OVERT SUFFIX, MAY TRIGGER I-ABLAUT IN STEM.

3. N^0

 [Case, Num.] [Stem]
- doras, balach*: [Gen., Pl.]
sgoil: [Voc., Sg.]
clach: [Gen., Pl.][Voc., Sg.]
- NULL OR OVERT PREFIX, MAY TRIGGER MUTATION IN STEM.

4. N^0

 [Case, Num.] [Stem] [Case, Num.]
- doras, balach*: [Voc., Sg.]
- OVERT PREFIX TRIGGERS MUTATION, NULL SUFFIX TRIGGERS I-ABLAUT IN STEM.

In this analysis, structures 1, 2, and 3 presuppose the operation of Fusion, whereas structure 4 requires Fusion, and the Fission of the fused node (these operations are crucially ordered, so as to minimize the number of morphological operations in the derivation).

The analysis above entails the following set of listed affixes:

Affix	MP rules	Meaning	Restrictions
Ø-X	[+mutating]	[+Gen., +Pl.]	Where X = <i>doras</i> , <i>balach</i> , <i>clach</i> ...
ə-X	[+mutating]	[+Voc., +Sg.]	Where X = <i>doras</i> , <i>balach</i> , <i>clach</i> ...
ə-X		[+Voc., +Sg.]	Where X = <i>sgoil</i> ...
X-ə	[+i-Ablaut]	[+Gen., +Sg.]	Where X = <i>clach</i> ,

			<i>sgoil</i> (vacuous)...
X-Ø	[+i-Ablaut]	[+Gen., +Sg.]	Where X = <i>doras</i> , <i>balach</i> ...
X-Ø	[+i-Ablaut]	[+Nom., +Pl.]	Where X = <i>doras</i> , <i>balach</i> ...
X-Ø	[+i-Ablaut]	[+Dat., +Pl.]	Where X = <i>doras</i> , <i>balach</i> ...
X-ən		[+Nom., Pl.]	Where X = <i>clach</i> ...
X-ən		[+Dat., +Pl.]	Where X = <i>clach</i> ...
X-tʃən		[+Nom., +Pl.]	Where X = <i>sgoil</i> ...
X- tʃən		[+Gen., +Pl.]	Where X = <i>sgoil</i> ...
X- tʃən		[+Dat., +Pl.]	Where X = <i>sgoil</i> ...

A further morphological operation of feature Deletion would allow a unified [+Pl.] morpheme in the case of *sgoil*, since Case is apparently not distinguished in the plural for that class. Alternatively, one might avoid Case-Number Fusion for the *sgoil* class and unify [+Pl.] that way, but at the cost of a special full set of (homophonous) null case markers. (Note: More data would show that initial <sg-> clusters are impervious to mutation, and so the [+Voc.] prefix can be unified as well.)

This analysis is a fairly conservative, in that a unitary stem is assumed for each “lexeme.” It is for this reason that stem alternations are “projected” into the stem’s phonological representation from without (cf. Pyatt (1997) for an extended DM analysis of Celtic Initial Mutation, largely consistent with the above methodology).

A.7: Lexeme-Morpheme Base Morphology’s response

The analysis here needs to consider only I[nflectional]-derivation and Morphological Spelling, i.e., the realization of the inflectional categories Case, Number, and the inherent category of inflectional class (which may or may not correspond one-to-one with Gender). The grammatical functions for which the various inflected forms may be used are beside the point here.

The Separation Hypothesis permits the treatment of the relationship between inflectional categories and their exponents as a mapping. The evidence given supports treating I and II as instances of the same lexeme-class (call it $N\alpha$), and III and IV should provisionally be classes unto themselves ($N\beta$ and $N\gamma$, respectively).

Let us assume that the initial mutations are formally parallel (Note: more data would confirm this), despite some divergence in phonetic detail. All operations on the stem, whether affixations or alternations, are to be considered elements of Morphological Spelling. The lexeme contributes its phonetic representation as an input to MS, and depending on inflectional class, Case, and Number, different MS operations are selected.

Class	Case	Number	Mutation	i-Ablaut	-ə	-ən	- tʃən	
N α	Nom.	Sing.						
		Plur.		⇒				
	Gen.	Sing.			⇒			
		Plur.	⇒					
	Dat.	Sing.						
		Plur.			⇒			
Voc.	Sing.	⇒		⇒				
N β	Nom.	Sing.						
		Plur.					⇒	
	Gen.	Sing.				⇒		
		Plur.						⇒
	Dat.	Sing.						
		Plur.						⇒
Voc.	Sing.							
N γ	Nom.	Sing.						
		Plur.				⇒		
	Gen.	Sing.			⇒	⇒		
		Plur.	⇒					
	Dat.	Sing.						
		Plur.					⇒	
Voc.	Sing.							

Two dimensions are unable to capture the complex mapping fully, but the matrix above does make clear the usefulness of a separation between inflectional categories and their exponents, in combination with lexical declension class.

A.8: Lexical Morphology and Phonology's response

Mutation and i-Ablaut in LM&P are level-one phenomena, despite their regularity and productivity, by virtue of the locus of their effects, i.e., the stem. It is difficult to say whether the Vocative prefix triggers initial mutation or not, since the mutation is motivated independently for the Genitive Plural. The plural suffixes do not interact with i-Ablaut (synchronically, anyway), and they do not pile up in the data here, so a precise level assignment for the suffixes is not possible here. To say that they must not apply before level one (the mutation and Ablaut) is not insightful.

The Blocking phenomenon has some interesting implications here, especially in the *sgoil* class, since neither initial mutation nor i-Ablaut is evident. It cannot reliably be determined whether the Plural suffix and the Genitive Singular suffix are applied in addition to level 1 inflection, or whether they apply as a back-up to the non-application of the level 1 inflection.

The identical Genitive Singular suffix is used in addition to a stem alternation in the case of *clach*, i.e., *cloiche*, and so this appears to simply be the Genitive Singular suffix used with Feminine nouns. If, on the other hand, the Plural marker in *sgoiltean* is a backup to initial mutation, the prediction would be that plural nouns which begin with /sp/, /st/, or /sk/ should mark the plural categorically with some affix, *-tean* or otherwise. To verify this prediction, it is necessary to go beyond the given data, and even then the facts are unclear. If the suffix is motivated by blocking, however, one is hard pressed to

explain the suffix used in addition to mutation, in attested cases like *ghillean* ‘of young men’ (cf. *gille* ‘young man’). The Elsewhere Condition and the related Blocking effect would not predict this multiple marking.

A.9: Natural Morphology’s response:

In every case no form is less ‘marked’ (*merkiert*, a.k.a. ‘featured’) than the Nominative Singular, which is unmarked for case and number. In I, II, and III, the Dative is syncretic with the Nominative, and syncretism is considered to be bad semiotically in NM (it is not biunique). If you had to pick a form that was next in line in markedness to the Nominative, however, it would have to be the Dative, so the syncretism could be worse.

For the masculine nouns (I and II), the Plural is more marked than the corresponding singular, and that is in line with iconicity. Also in I and II, the Genitive is more marked than the Nom./Dat., but less marked than the Vocative, which is surely the most marked case of all in these paradigms.

In III, we observe neutralization of case within number, excepting the Genitive Singular. This is unusual in comparison to the other three examples, but chances are that *sgoil* may have been influenced by the cognate word in English English. Some morphological anomaly is less worrisome on that assumption. That the Genitive Plural is not distinguished formally from the other Plural forms is particularly unusual, however, given the other three examples.

As for IV, the syncretism between Nominative and Dative Singular is lost, which is good from a biuniqueness standpoint, but there is a new syncretism with the (marked) Vocative—very unusual on the markedness/iconicity dimension.

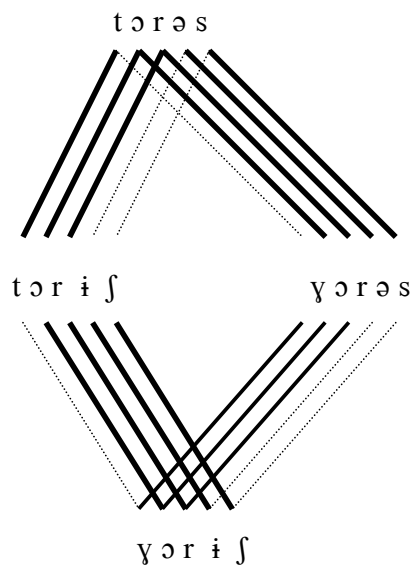
It is true, although perhaps merely by coincidence, that III exhibits the same Nom./Voc. syncretism as IV, so perhaps paradigm III is not as anomalous as it looks. The Genitive Singular in IV is just like the Dative Singular, but with a final /ə/, and the same is true in III, although again less strikingly than the facts in IV.

Although there are some affixes in use here, these paradigms rely to a remarkable degree on Modulator Featured symbolizing, the least optimal symbol type (other than no marker at all). The fact that there is at least one syncretic pair in each number column of each paradigm here would suggest that the case system is under pressure to collapse or to attract a new marker morpheme in one Case (more likely the Dative for I and II, on markedness grounds). It seems the Nom./Dat. distinction is being kept alive by patterns like IV. If IV is a(n unproductive) minority pattern in the language, the pressure to regularize forms like *cloich* to *clach* is quite high, and the Natural Morphology prediction is that Dative case will collapse in time, all else being equal.

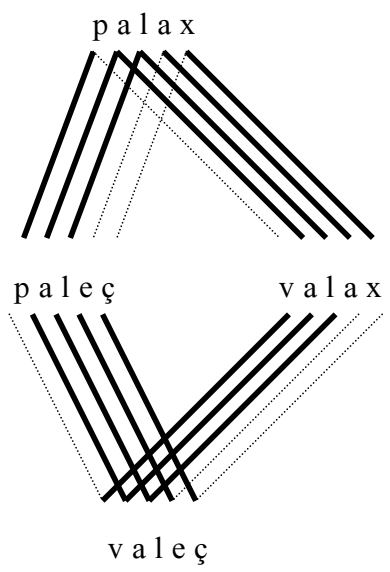
A.10: “Network Model”’s response

Since these are nouns, the relevance hierarchy doesn’t really help out here. The first thing to do is to draw networks, and see how they compare:

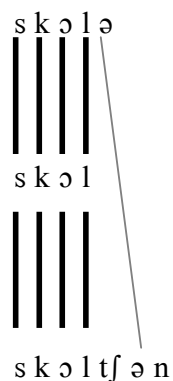
I.



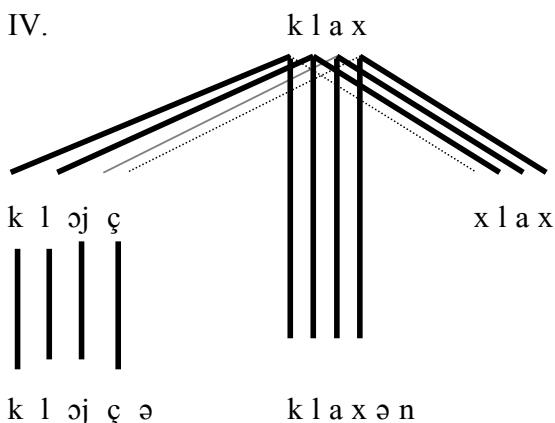
II.



III.



IV.



I and II show a nicely closed network, indicating that there is an element of regularity in these related forms. The fact that the corresponding forms also fill parallel grammatical functions is a sure sign of a paradigmatic pattern. The stronger versus weaker links are even in the same positions with respect to the phonemic sequences. This pattern is predicted to be stable and should be relatively productive.

The alternation of the initial consonant in I (changing place, manner, and voicing) is more distant in phonetic terms than in II (manner and voicing), which is still greater than in IV (manner only). The less the phonetic distance between alternants, the more recoverable the correspondence, and the easier will be lexical access. Class I, therefore, stands out in language independent terms, although if the alternation is productive, that may support the pattern's continued existence.

III shows a simpler pattern of identity of the stem across the board with suffixal inflection. The regularity here makes this an even more readily detectable morpheme than the patterns we observe in I and II, but the one-to-many form-meaning mappings undercuts the value of the stem's consistency.

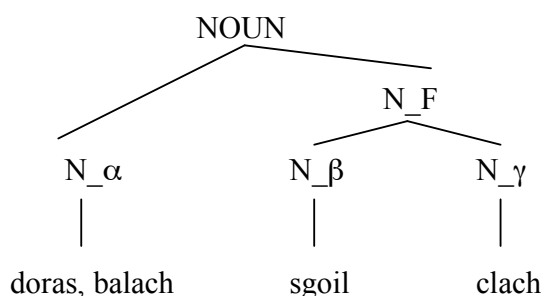
As sets of related forms go, the pattern in IV is quite remarkable. There should be a lot of pressure on this paradigm to regularize at least the vowel quality of the stem. The lexical strength of the word for "stone," however, might be quite high for Gaelic

speakers, given the frequency of occurrence of physical stones in the relevant parts of the world. That might explain the irregularity's ability to endure to this point.

It is also important to find out just how productive the vowel quality alternation is in Gaelic nouns more generally, since that may affect the degree to which the alternation may be considered an irregularity. In this limited data set, IV stands out. It would be premature to assume that this sample was representative of the language as a whole or that type and token frequencies can be reliably projected without more evidence.

A.11: Network Morphology's response

The situation here is remarkably similar to the Russian example discussed in the presentation of Network Morphology (above). The four paradigms under discussion here may be seen as belonging to two or three declension classes.



Since the phonology of the mutated and/or ablauted stem clearly depends on the phonology of the root, lexical items will be assumed to have up to four formally distinct yet relatable stems for use in the statement of particular morphological facts. There's more redundancy in the stem set at the phonological level, but this follows from a limitation in the formalism. There ought to be a way to capture the formal correspondences among stems with the First/Last/Rest convention (as used in Hoeksema and Janda (1988) and as used for argument structure in Evans and Gazdar (1995)). Brown (1999:216-17) offers a tentative hierarchical representation of morphophonological selection, but the system is not readily transferable to this case. This will not be pursued here.

Doras: < > == N _α	Balach: < > == N _α
<infl_root> == tɔrəs	<infl_root> == palax
<mut_stem> == ɣɔrəs	<mut_stem> == valax
<i_stem> == tɔrɪʃ	<i_stem> == paleç
<mut_i_stem> == ɣɔrɪʃ.	<mut_i_stem> == valeç.

Sgoil: < > == N _β	Clach: < > == N _γ
<infl_root> == skɔl	<infl_root> == klax
<stem> == "<basic_stem>".	<mut_stem> == xlax
	<stem sg> == klojç.

NOUN: <basic_stem> == "<infl_root>"
 <mor dat> == "<mor nom>"
 <mor nom sg> == "<basic_stem>"
 <mor gen pl> == "<mut_stem>".

N_α: < > == NOUN % masculine nouns
 <mor nom pl> == "<i_stem>"
 <mor voc sg> == "a_<mut_i_stem>"
 <mor gen sg> == "<mor nom pl>".

N_F: < > == NOUN % feminine nouns
 <mor gen sg> == "<mor dat sg>_e"
 <mor voc sg> == "a_<mor nom sg>".

N_β: < > == N_F
 <mor pl> == "<mor nom sg>_tean".

N_γ: < > == N_F
 <mor dat sg> == "<stem sg>"
 <mor nom pl> == "<mor nom sg>_an".

Inheritance principles together with the default/override relation and rules of referral will map the above lexical entries into the paradigms in question. In this way, generalizations between and across declensions are captured, and the fact that N_β is more similar to N_γ than either is to N_α is captured without making sameness or difference a simple binary choice. Carstairs's (1987) notion of a *macro-paradigm* might therefore cover the relationship between N_β and N_γ.

A.12: Paradigm Function Morphology's response

The given data show seven paradigm cells for Gaelic nouns. We are dealing, therefore with two morphosyntactic features, {CASE} and {NUM}. The former is an *n*-ary feature with four permissible values: *nom*, *gen*, *dat*, and *voc*. The latter is also *n*-ary, but since the feature has only two permissible values, it is effectively binary. There is only one co-occurrence restriction to mention here, and that is the (apparent) limitation of {CASE:voc} to extensions of {NUM:sg}. Thus the seven cells are defined ($4 \times 2 - 1 = 7$).

Regular and productive stem-internal alternations are to be described as stem formation-rules, and since the formally most differentiated paradigms, *doras* and *balach* (class N_α), show four distinct but related stems, four stems are posited for the class N in general. Since initial mutation is unified from a conditioning perspective but not from a form perspective, it is misleading to render mutation as a quasi-phonological rule. The stated alternations as given below the data set are adequate for the present purpose. I-Ablaut can be simply formulated as a feature changing rule, but even this must be clearly recognized as a morphologically conditioned rule.

The alternation patterns, therefore, are assumed to be static relationships between alternants, Basic-C and Mutant-C for initial consonants, and Basic-V and Ablaut-V for stem-final vowels. Stem-formation rules will be as follows:

Where L is a masculine (=N_α) noun with root C₁YV_nC, each of (a)-(d) implies the other three:

- (a) The Basic stem is identical to the root
- (b) The Mutant stem has Mutant-C for C₁
- (c) The Ablaut stem has Ablaut-V for V_n
- (d) The Combo stem has Mutant-C for C₁ and

Ablaut-V for V_n

Where L is a feminine ($=N\beta$ or $N\gamma$) noun with root C_1Y , each of (a)-(c) implies the other two:

- (a) The Basic stem is identical to the root
- (b) The Mutant stem has Mutant-C for C_1
- (c) Refer other stems to Basic stem

Lexically-specified stems such as *cloich* for *clach* override the application of more generally applicable stem formation and selection rules.

Given the limited data set, there is distributional evidence for exactly three rule blocks: a stem selection block (Block 0), a suffixing block (Block 1), and a prefixing block (Block 2). A general paradigm function for Gaelic nouns can be posited as follows:

Where σ is a complete set of morphosyntactic properties for lexemes of category N,

- (i) $PF \langle X, \sigma \rangle =_{\text{def}} \text{Nar}_2(\text{Nar}_1(\text{Nar}_0(\langle X, \sigma \rangle)))$

The rule blocks are the following:

Block 0

- (ii) $RR_{0, \{ \text{CASE:voc} \}, [N]} \langle X, \sigma \rangle =_{\text{def}} \langle Y, \sigma \rangle$, where Y is X's Combo stem
- (iii) $RR_{0, \{ \text{CASE:gen, NUM:pl} \}, [N]} \langle X, \sigma \rangle =_{\text{def}} \langle Y, \sigma \rangle$, where Y is X's Mutant stem
- (iv) $RR_{0, \{ \text{CASE:gen} \}, [N]} \langle X, \sigma \rangle =_{\text{def}} \langle Y, \sigma \rangle$, where Y is X's Ablaut stem
- (v) $RR_{0, \{ \text{NUM:pl} \}, [N]} \langle X, \sigma \rangle =_{\text{def}} \langle Y, \sigma \rangle$, where Y is X's Ablaut stem
- (vi) $RR_{0, \{ \}, [N]} \langle X, \sigma \rangle =_{\text{def}} \langle Y, \sigma \rangle$, where Y is X's Basic stem

Block 1

- (vii) $RR_{1, \{ \text{NUM:pl} \}, [N\beta]} \langle X, \sigma \rangle =_{\text{def}} \langle X\text{tean}, \sigma \rangle$
- (viii) $RR_{1, \{ \text{CASE:gen, NUM:pl} \}, [N\gamma]} \langle X, \sigma \rangle =_{\text{def}} \langle X, \sigma \rangle$
- (ix) $RR_{1, \{ \text{CASE:gen, NUM:sg} \}, [N\beta]} \langle X, \sigma \rangle =_{\text{def}} \langle X\text{e}, \sigma \rangle$
- (x) $RR_{1, \{ \text{NUM:pl} \}, [N\gamma]} \langle X, \sigma \rangle =_{\text{def}} \langle X\text{an}, \sigma \rangle$

Block 2

- (xi) $RR_{2, \{ \text{CASE:voc} \}, [N]} \langle X, \sigma \rangle =_{\text{def}} \langle aX, \sigma \rangle$

According to PFM's paradigmatic interpretation of the Pāṇinian Principle, as represented in the formalization of the paradigm function (PF) above, the narrowest applicable rule in each block will apply in defining the evaluation of the PF for any given pair $\langle X, \sigma \rangle$ (the Pāṇinian Determinism Hypothesis). No rules in block 1 are applicable to lexemes of class $N\alpha$; inflection in that class is accomplished without suffixation. The distinct stem formation rules for masculine versus feminine noun lexemes allow the rules of stem selection to be stated generally across the category N. The following proofs exemplify the preceding analysis:

Where $\sigma = \{\text{CASE:nom, NUM:pl}\}$,

$$\begin{aligned} \text{PF}(\langle \text{clach}, \sigma \rangle) & \\ &= \text{Nar}_2(\text{Nar}_1(\text{Nar}_0(\langle \text{clach}, \sigma \rangle))) && \text{[by (i)]} \\ &= \text{RR}_{2, \{\}, [\text{N}]}(\text{RR}_{1, \{\text{NUM:pl}\}, [\text{N}_\gamma]}(\text{RR}_{0, \{\text{NUM:pl}\}, [\text{N}]}(\langle \text{clach}, \sigma \rangle))) && \text{[by Nar}_n \text{ notation]} \\ &= \langle \text{clachan}, \sigma \rangle && \text{[by IFD, (x), and (v)]} \end{aligned}$$

Where $\sigma = \{\text{CASE:gen, NUM:sg}\}$,

$$\begin{aligned} \text{PF}(\langle \text{sgoil}, \sigma \rangle) & \\ &= \text{Nar}_2(\text{Nar}_1(\text{Nar}_0(\langle \text{sgoil}, \sigma \rangle))) && \text{[by (i)]} \\ &= \text{RR}_{2, \{\}, [\text{N}]}(\text{RR}_{1, \{\text{CASE:gen, NUM:sg}\}, [\text{N}_\beta]}(\text{RR}_{0, \{\text{CASE:gen}\}, [\text{N}]}(\langle \text{sgoil}, \sigma \rangle))) && \text{[by Nar}_n \text{ notation]} \\ &= \langle \text{sgoile}, \sigma \rangle && \text{[by IFD, (ix), and (iv)]} \end{aligned}$$

Where $\sigma = \{\text{CASE:voc, NUM:sg}\}$,

$$\begin{aligned} \text{PF}(\langle \text{balach}, \sigma \rangle) & \\ &= \text{Nar}_2(\text{Nar}_1(\text{Nar}_0(\langle \text{balach}, \sigma \rangle))) && \text{[by (i)]} \\ &= \text{RR}_{2, \{\text{CASE:voc}\}, [\text{N}]}(\text{RR}_{1, \{\}, [\text{N}]}(\text{RR}_{0, \{\text{CASE:voc}\}, [\text{N}]}(\langle \text{balach}, \sigma \rangle))) && \text{[by Nar}_n \text{ notation]} \\ &= \langle \text{a bhalaich}, \sigma \rangle && \text{[by (xi), IFD, and (ii)]} \end{aligned}$$

Recall that IDF—the *Identity Function Default*—serves, where no more specific rule is applicable within a rule block, to map the input to itself. Thus the block is evaluated, the form is definable, and no formal change to the input is effected, i.e., there are no zero-morphs involved in this analysis. Note that rule (viii) above is an identity function, but it is a separate stipulated override, not a default, partially realizing the properties $\{\text{CASE:gen, NUM:pl}\}$ on lexemes of class N_γ .

Note also that (full or partial) syncretism in these paradigms is handled through the application of defaults, rather than through special rules of referral in the rule blocks. See Stump (1993a) for a discussion of criteria related to the decision ‘to refer or not to refer’.

A.13: Prosodic Morphology's response

Assuming that part of the lexical entry for any root is a segmental tier, the mutation effects can be represented as features which are associated to the initial C position in the skeleton, adding or altering features so as to convert the initial C to its mutated counterpart. The same morpheme does not condition a uniform phonological effect on the initial C of the stem, so the Structural Description and Structural Change must be somewhat complex.

The morpheme contains at least the feature specification [+continuant], which overrides the lexical specification for the C_1 slot (vacuously where the stem is continuant initial). Since the stop contrast is one of aspiration rather than voicing, but the fricative contrast is one of voicing, [− α voice] can be a part of the morpheme, sensitive to the setting of [spread glottis] in the root. Since the mutation never results in a change from [+voice] to [−voice], an analysis in which [Voice] is a privative feature is also possible.

Since i-Ablaut seems to be assigned right to left, given its effect on C_n , morphemes triggering i-Ablaut can be formalized so as to attach to V_n of the stem, rather than to a V numbered left to right. Such morphemes will consist of a feature [+high], which will override the lexical specification for V_n 's height. This could also be done as a spreading of palatality from C_n of the root, but palatalization of C next to front vowels is general enough in Scottish Gaelic that it needn't be handled in the morphology, separate from phonology.

Since mutation is a matter of changing specifications in roots, rather than filling empty slots in the C–V skeleton, the Prosodic Morphology analysis of mutation is different from Arabic interdigitation or spreading and prespecification in reduplication. This is a more powerful sort of operation than Prosodic Morphology was originally designed to handle.

Using the OT style (Prince and Smolensky 1993), however, the formalism is undaunted. Three constraints could be posited:

ALIGN (Mutation-L, Stem-L)

A mutated segment must be at the left edge of a stem.

*hC[+stop]

The sequence /h/ followed by a stop consonant is ill-formed.

PARSE

An element in the underlying representation must appear in the surface form.

With the constraint ranking ALIGN (Mutation-L, Stem-L) >> *hC[+stop] >> PARSE, ALIGN keeps the mutation at the left edge of the stem. If the co-occurrence constraint were ranked higher than ALIGN, the mutation would be allowed to move in from the left edge just in case it would violate *hC[+stop].

Because underlying s-stop clusters do not license mutation, and because this co-occurrence constraint outranks PARSE, it is better to leave mutation unparsed than to force the /s/ to mutate before a stop.

Even though the mutated alternants are not phonetically parallel, and even though the conditioning for mutation in the data is completely morphological, this formulation within OT makes it seem as though it were driven primarily (if not purely) by segmental and prosodic phonology.

Since i-Ablaut is more restricted in its application than initial mutation, the restriction to the *doras–balach* class might have to be a condition on the Parse constraint, i.e.,

PARSE [Dat., Pl.]_{Class1}.

This mixes general morphological conditioning and particular lexical-class conditioning, but the OT formalism could handle it. The claim that constraints must be universal seems to be at odds with such an idiosyncratic constraint, but the usual counterargument in such

cases is that in languages where there is no direct evidence for the constraint, it is assumed to be ranked very low.

As for the “normal affixation” cases, Prosodic Morphology doesn't differ fundamentally from a concatenation account, except that the morphemes are represented as belonging to distinct morpheme-tiers.

A.14: Word Syntax's response

Lieber (e.g., 1992:165-71) has dealt most directly with mutation and Umlaut in the Word Syntactic framework. Lieber's examples of mutation involve a complex affixation whereby an overt affix (a “mutation trigger”) attaches to the stem at one point and an empty timing slot is attached adjacent to the segment to be mutated. On analogy with the Fula analysis in Lieber (1992:167-69), the empty timing slot attaches autosegmentally to the stem's initial segment, forming a geminate. The resulting initial geminate is assumed to meet the structural description of a phonological process of “lenition” which produces the observed mutation effects. The fact that no overt affix correlates with the mutation in Genitive Plural forms in Scottish Gaelic means simply that there is a zero affix meaning [+Gen, +Pl] which associates the empty timing slot in initial position. Perhaps both could be handled at once if we assume that the empty timing slot “is” the [+Gen, +Pl] affix, a prefix, although this move is an innovation here, not suggested in Lieber (1992) or elsewhere.

If we claim that the Vocative prefix *a* similarly contributes an empty timing slot just after it, this could add some indirect support for the empty Genitive Plural prefix. In classes $N\alpha$ and $N\gamma$ (but not $N\beta$), a null [+Gen, +Pl] affix could explain the failure of additional [+Pl] marking, since that would be featurally redundant. If we assume further that the null [+Gen, +Pl] does not apply to $N\beta$ instead of applying with no perceptible effect on the initial, this could explain the application of the [+Pl] suffix in *sgoiltean* [+Gen, +Pl]. (Note: See LM&P's response, however, for discouraging counterevidence from data beyond the set given in this Appendix.)

The analysis of Umlaut is similar to that of initial mutation, since Umlaut strictly speaking is triggered by a vowel in a following morpheme. Lieber (1992:170) appeals to a floating feature ([–Back], for German), which is part of the lexical entry of triggering suffixes. Stems, on this analysis, are underspecified, with only marked values present underlyingly. The floating feature, once associated to the last vowel in the stem, pre-empts the later association of the unmarked value ([+Back], for German). To accommodate the productive (e.g., *dorais* and *balaich*) Gaelic i-Ablaut facts, however, the triggering suffix must be null itself, but carrying a floating [+High], since we observe both /a/ and /ə/ raising (but not fronting) to /i/.

Other affixes in the data contribute inflectional features to the stems they attach to by means of the unexceptional application of affixation and percolation.

APPENDIX B

B.1—Introduction: Georgian Verbs— Agreement Marker Disjunctivity

Georgian verb agreement has provoked much discussion in both morphological and syntactic theory. Co-occurrence facts have resisted principled explanation in just those cases where multiple arguments are present and (apparently) compete for control of agreement marking.

The facts relevant to underived transitive verbs in Georgian are the following:

(1)	1sg.	2sg.	3sg.	1pl.	2pl.	3pl.
“Subject”	v-	—	-s	v-...-t	-t	-en
“Dir.Obj.”	m-	g-	—	gv-	g-...-t	—

In combination, however, the facts are as follows (Stewart 2001, corrected from Cherchi 1999:42):

(2) **The present tense of XEDAV, ‘see’** (*shaded cells are reflexives, expressed periphrastically*)

DO Subj.	1sg.	2sg.	3sg.	1pl.	2pl.	3pl.
1sg.		<i>gxedav</i>	<i>vxedav</i>		<i>gxedavt</i>	<i>vxedav</i>
2sg.	<i>mxedav</i>		<i>xedav</i>	<i>gvxedav</i>		<i>xedav</i>
3sg.	<i>mxedavs</i>	<i>gxedavs</i>	<i>xedavs</i>	<i>gvxedavs</i>	<i>gxedavt</i>	<i>xedavs</i>
1pl.		<i>gxedavt</i>	<i>vxedavt</i>		<i>gxedavt</i>	<i>vxedavt</i>
2pl.	<i>mxedavt</i>		<i>xedavt</i>	<i>gvxedavt</i>		<i>xedavt</i>
3pl.	<i>mxedaven</i>	<i>gxedaven</i>	<i>xedaven</i>	<i>gvxedaven</i>	<i>gxedaven</i>	<i>xedaven</i>

To see which forms really require explanation, it is helpful to consider the “what-if” paradigm based on the above, but ignoring the apparent cases of disjunctive application/insertion. All else being equal, and assuming somewhat arbitrarily that subject markers would appear outside of object markers, one would expect the following affixes to appear (\emptyset stands as a place-holder; predicted but non-appearing affixes are given as capitals):

(3) An idealized paradigm for the present tense of XEDAV, ‘see’

DO Subj.	1sg.	2sg.	3sg.	1pl.	2pl.	3pl.
1sg.		<i>V-gxedav†</i>	<i>vxedav</i>		<i>V-gxedavt†</i>	<i>vxedav-\emptyset</i>
2sg.	<i>\emptyset-mxedav</i>		<i>\emptyset-xedav</i>	<i>\emptyset-gvxedav</i>		<i>\emptyset-xedav-\emptyset</i>
3sg.	<i>mxedavs</i>	<i>gxedavs</i>	<i>xedavs</i>	<i>gvxedavs</i>	<i>gxedavt-S†</i>	<i>xedav-\emptyset-s</i>
1pl.		<i>V-gxedavt†</i>	<i>vxedavt</i>		<i>V-gxedav-T-t†</i>	<i>vxedavt</i>
2pl.	<i>\emptyset-mxedavt</i>		<i>\emptyset-xedavt</i>	<i>\emptyset-gvxedavt</i>		<i>\emptyset-xedav-\emptyset-t</i>
3pl.	<i>mxedaven</i>	<i>gxedaven</i>	<i>xedaven</i>	<i>gvxedaven</i>	<i>gxedav-T-en†</i>	<i>xedaven</i>

Thus there are six forms (marked † above) out of 28 which are demonstrably not as expected. Every one of the six would otherwise have two consecutive overt prefixes or two consecutive overt suffixes. In the form **V-g-xedav-T-t*, it is obviously questionable which of two consecutive /t/ segments is deleted. Geminates are outlawed generally in Georgian, so the disjunctivity is a moot point in this case. The disjunctivity otherwise,

however, is not a matter of phonotactic violations (Anderson 1992:87, fn. 13), but is rather entirely a matter of morphological distribution.

B.2: A-Morphous Morphology's response

Anderson (1984, 1986, 1992) has written extensively about Georgian agreement, and he considers it strong support for the positing of disjunctive rule blocks. Rules which apply disjunctively, by circular definition, belong to the same rule block. The rule which actually applies precedes the others in an ordered block, sequenced by the Elsewhere Condition if one realizes a proper subset of the features contained in the MSR of the others. If this subset relation does not hold, then the appeal is to extrinsic ordering, a brute force preferential application of the rule needed to match the surface facts. In the Georgian case, the 2nd person object prefix preempts the 1st person subject marker where both are applicable, e.g., *g-xedav*, and not *v-xedav*, *v-g-xedav*, or *g-v-xedav*. There is no attempt to motivate a principled precedence relation of *g-* over *v-*.

Anderson (1984) also casts the *-t* suffixes as a unified non-3rd person marker, and claims that the fact that a 1st person plural object is realized by *gv-* but not *-t* is the result of disjunctive ordering and the prefix's precedence in the block. Thus blocks are tied to MSRs, and not to position classes (cf. PFM). Because a subject marker and an object marker are keyed to different MSR layers, according to A-Morphous Morphology, the disjunctivity cannot even be explained by an MSR conflict. A-Morphous Morphology's tolerance of extrinsic ordering within rule blocks seriously compromises the predictive power of the theory in this area.

B.3: Articulated Morphology's response

Since representations in AM are informationally impoverished, a surface form may obtain its morphosyntactic specifications only through the application of rules. This means that for AM, apparent disjunctivity is actually allomorphy of affixes, i.e., in the ordinary case:

(1) 1st person subject

$$\begin{array}{ccc} X & & vX \\ [] & \rightarrow & [P:1] \end{array}$$

but just in case:

(2) 1st person subject

$$\begin{array}{ccc} X & & X \\ [P:2] & \rightarrow & [P:1][P:2] \end{array}$$

The rule format of AM allows the full details of the input to be part of a rule's domain. There is no limit on access to previously applied rules, in principle (cf. LM&P), and so this sort of broad contextual sensitivity is not a formal problem for AM. Whether this power is theoretically desirable and what its practical constraints are are separate but important issues, however.

B.4: Autolexical Syntax's response

As far as the syntax knows, so to speak, the forms given in the attested Georgian paradigm are fully specified verbs. Any problematic aspects are to be dealt with entirely within the morphological component. Autolexical Syntax is in a worse position to account for disjunctivity of apparently comparable inflectional affixes than AM is, however.

	<i>v-</i>	<i>g-</i>	<i>-xedav-</i>
Syntax	nil	nil	V[0]
Semantics	nil	nil	F[-2]
Morphology	V[-1]/V[-0]	V[-1]/V[-0]	V[-0]

Since *vxedav* and *gxedav* are both V[-1] forms, i.e., acceptable as fully inflected words, the autolexical specification of the prefixes puts them into competition. This gains the disjunctive application, but it does not explain the precedence of *g-* insertion over *v-* insertion where both are equally motivated in the sentence.

Although word order at the sentence level in Georgian is claimed to be free, the canonical order is S-O-V. Under the assumptions of Autolexical Syntax, since there is a default mapping between abstract syntactic structure and morphological structure, it is possible to derive the needed S-O-V prefix ordering “for free” from the syntax, with no need to appeal to separate linear precedence rules specific to the morphology. Thus it is possible to capture both the paradigmatic and syntagmatic aspects of the Georgian agreement prefix disjunction without extraordinary maneuvers (cf. Singer’s (1999) dissertation, which relies heavily on Optimality Theory constraints on top of Autolexical theory in the analysis of every Georgian morphological phenomenon except the present question.)

B.5: Categorical Morphology's response

If both *v-* and *g-* take ‘verb stems’ as input, and a ‘verb stem’ as a formal unit crucially has no agreement markers already in place, then the competition between *v-* and *g-* is predicted.

v- </Vstem, V, Pref> *g-* </Vstem, V, Pref>

The dominance of {OB:2} over {SU:1} is not explained, however, and therefore must be stipulated. The analogous analysis is available for the suffixes—each one <Vroot\, Vstem, Suff>. This assumes, somewhat arbitrarily, that agreement suffixes are applied ‘before’ agreement prefixes. The order could be reversed, *mutatis mutandis*, with no ill effects, it would seem. It is again questionable whether the precedence relation could be captured in a natural way in this framework. (This solution is similar in most regards to that offered by Autolexical Syntax, above.)

B.6: Distributed Morphology's response

In Halle and Marantz (1993:117ff.) the Georgian agreement affixes are explicitly assumed to be clitics, rather than prefixes and suffixes *per se*, and so their morphosyntactic properties are fused into one proclitic, with the possibility of [+pl] fission, allowing the *-t* to be inserted at the right edge of the stem. The *v-/g-* issue is handled as a fusional clitic, but the competition of *-t* with *-s* and *-en* is ignored completely. Although the data are given in examples (2e-i, k, l and 4g, h), there is no discussion of *-s* and *-en* in the text, nor are they given as part of the clitic Vocabulary. It seems safe to assume that a more complete analysis would handle all three suffixes as part of the clitic cluster, subject to fission as the *-t* is, but there may come a point when the morphological operations would be fewer if a separate proclitic cluster and enclitic cluster were generated, fused, and then supplied with phonological features.

The clitic analysis allows DM a space apart from the rest of inflection to carry out clearly morphological operations without reference to the host. In a language like Georgian, which has little to no stem allomorphy conditioned by particular affixes, the clitic analysis is not obviously in error. In other languages, however, where more morphophonological operations accompany affixation, a comparable appeal to cliticization might be subject to the possibility of falsification. The fact that the markers do not show the distributional independence of clitics as opposed to affixes is a first indication that the choice of a clitic-based analysis is motivated by theoretical rather than empirical motivations.

B.7: Lexeme-Morpheme Base Morphology's response

Verbs receive their agreement specification in the syntax in LMBM and the abstractly inflected verb is submitted to the Morphological Spelling component for the (incremental) spell-out of features, operating "outward" from the phonological representation of the verb lexeme. The operation of the MS component in LMBM is described as a spelling mechanism which interprets inflectional features individually or in small groups (in the case of fusional exponents), executes the modification of the stem appropriate to the feature (set) in question—informed by the inflectional class of the lexeme at hand—and then immediately erasing the working read-only memory, beginning the process again with the next feature (set) as yet uninterpreted. This mechanism iterates exhaustively, and so disjunction between independently motivated affixes is not immediately predicted. Where *g-* precludes *v-* in a surface form, the most natural analysis is that the spelling mechanism has interpreted both arguments together and has spelled them as the canonical exponent of the object, presumably the first argument encountered in the set of inflectional features. The fact that the putative fused morpheme is phonologically identical to the 2nd person object marker, while not exactly portrayed as an accident, does not follow from anything else in the grammar. Georgian is otherwise quite agglutinative—why this particular formal economizing? This solution describes the fusion without really explaining it.

An alternative view, also permitted within LMBM, is the MS component's ability to selectively 'erase' features it finds in the output of inflection. Inflectional features are ordered by syntactic structure, but no internal sub-bracketing of the features is available to the spelling mechanism. In other words, the MS component can 'see' the full set of features that an inflected lexeme bears, and it can act on those features in groups of up to

five at a time (a presumed constraint on working memory). From this perspective, it is certainly possible to conceive of a language specific spelling rule that said: “on encountering both {SU:1st} and {OB:2nd} in the same feature set, erase {SU:1st} (i.e., perform no modification to the stem) and spell {OB:2nd} as usual.” The power of such a rule, and of this broad perspective for the spelling mechanism, is open to criticism, of course, but again it points up the ability of a theory which assumes the Separation Hypothesis to allow features to go unexpressed in the phonology, yet still be present in the representation, in a way that ‘morpheme-as-sign’ theories cannot.

B.8: Lexical Morphology and Phonology’s response

The *v*-morpheme can attach to a verb root, but just not to a 2nd person object prefix. This could be taken to suggest that the 2nd person *g*- belongs to a later stratum than the *v*-, and so the presence of the *g*- precludes the further addition of the *v*- from a previous stratum. The question is, if *g*- belongs to a later stratum, why should it get to apply first in the first place?

On the different-strata analysis, we would be forced to say that *g*- has to apply first for some language-specific reason, perhaps that object markers must be inserted first. In this case, then, *g*- would apply and preclude the insertion of *v*-. This is, of course, begging the question.

An appeal to a template **subj | obj | root ...** is really just another way of saying the same thing, that moving out from the root, the object marker is inserted closer to the stem. We still have to assume the stratum explanation to get disjunction rather than simple S-O-V patterning in the morphology (cf. Autolexical Syntax’s response, above). The weakening assumption of a ‘loop’ sometimes invoked in LM&P can be avoided in this account, however.

Since there is no apparent morphophonology to account for in these data, it is questionable whether any independent justification would be forthcoming for the different-strata account.

B.9: Natural Morphology’s response:

It seems that there is a certain irreducible amount of un-sign-like behavior in the Georgian facts, whether the analysis involves zero-morphemes or syncretism between unitary and fused morphemes. Zero-marking of 3rd person is not exceptional on general markedness grounds, but for 1st person, this is less expected. The approach of Mayerthaler (1988:8ff.), however, allows for a more sophisticated picture of markedness calculation. Typical attributes of the speaker are to be taken as background in a discourse context, not requiring especially salient marking in contrast with non-speaker attributes, which are to be interpreted as ‘figures’ in the foreground.

With these two perspectives in place, then, the motivation for maintaining a marker for 2nd person even at the expense of a 1st or 3rd person marker is clear. Second person is more marked than 3rd, since there are indefinitely many 3rd person referents available in any given discourse situation. Second person is more marked than 1st, as

well, since 2nd person is part of the non-speaker class. First and 3rd person do not conflict in the Georgian system, so no further hierarchical relationship is determinable. With an explanation for the dominance of 2nd person over 1st in hand, however, the motivation for pre-emption rather than closer linear proximity to the stem (i.e., *gxedav* rather than **vgxedav*) is not evident.

Natural Morphology, therefore, would seem to have the piece of the puzzle that more formalist theories are forced to simply stipulate. It is not, however, in a position to account for the disjunction, which would seem to be a purely formal matter (a perhaps arbitrarily limited amount of available 'real estate' in which agreement markers can appear).

B.10: "Network Model"'s response

The idea of a *schema* in the Network Model is thought to represent the connections which exist between words in the mental lexicon. Schemas can be defined phonologically, morphologically, syntactically, semantically, and in other ways as well. Prototypes or "best exemplars" are thought, therefore, to serve as an organizing principle for lexical categories. Based on the observed Georgian forms in (2), one could posit an abstract schema for inflected verbs:

Pref – Stem – Suff

This schema is instantiated in the inflection of transitive and intransitive verbs in Georgian, since some arguments are realized partially by a prefix and partially by a suffix, e.g., {SU:1st-pl} corresponds to a *v-* prefix and a *-t* suffix, all on its own. It could be assumed therefore, that the simple schema is used as a guide in determining "acceptable Georgian verbs," and hypothetical verbs which bear more than one agreement prefix or more than one agreement suffix will be judged as unacceptable. While this may work as a synchronic generalization, of course, it offers no insight into how such an arbitrary limitation could come into being. Iconicity would predict at least one marker per argument, but this does not always happen, e.g., *g-xedav* 'I see you'.

At the same time, patterns as regular and productive as this, i.e., agreement marking on verbs of all sorts, are predicted (albeit with some reservation in Bybee (1988)) to have a degree of independence from the words which instantiate them, since they are used freely in neologistic formations, etc. The extremely high frequency of the marking system, however, may yet have explanatory value if it is recalled that frequent forms more readily sustain idiosyncrasies, whereas rarer forms are subject to regularization (i.e., replacing zero-expression with something overt). There is no competing system of markers in Georgian, however, so perhaps at present there is no viable regularizing pressure outside of the observed pattern, and thus it is firmly and indefinitely entrenched, despite its (regular) quirks.

B.11: Network Morphology's response

In order to get the paradigmatic facts right, it seems that all subject-object combinations would have to be treated as units, sometimes realized as two bound

morphs, sometimes one (and in the case of reflexives, partially periphrastically). When a combination of arguments is realized by a single morph, the marker would be a *de facto* fusional morpheme.

`<mor su 1 ob 2> == g_ "<stem>"`

An unfortunate side-effect of this analysis is that the homophony of the putative fusional morphemes with the canonical exponents of one of the arguments so combined is portrayed as an accident. The possibility of casting the above fact (in the technical sense) as a rule of referral is but a slight improvement:

`<mor su 1 ob 2> == "<mor ob 2>"`

for there is no *a priori* reason to expect that any correspondence would exist, let alone such a close one, between a fusional and a non-fusional exponent.

The rules of inference in the DATR format state facts about the realization of morphosyntactic features without reference to the broader context of other rules applying in a given form. There is no ready way to capture disjunctivity here without a notion of competition between applicable rules. Since Network Morphology does not formalize a notion of slots or position classes, there is no natural way of inducing competition, or of predicting a “winner,” should such competition occur.

B.12: Paradigm Function Morphology’s response

Georgian agreement is taken up in Stump (2001: ch. 3), partly in response to Anderson’s (1986, 1992) analysis, and in particular because of the challenge the facts pose for the *Pāṇinian Determinism Hypothesis*: the assumption that for a given rule block, the narrowest applicable realization rule is always uniquely identifiable, and this rule applies to the exclusion of all competitors.

There are four agreement prefixes, *v-*, *m-*, *gv-*, and *g-*, and the realization rules introducing these markers are the following, respectively:

- | | | |
|----|--|---------------------------------|
| a. | $RR_{\text{pref}, \{AGR(\text{su}); \{PER:1\}\}, [V]} (<X, \sigma>)$ | $=_{\text{def}} <vX', \sigma>$ |
| b. | $RR_{\text{pref}, \{AGR(\text{ob}); \{PER:1\}\}, [V]} (<X, \sigma>)$ | $=_{\text{def}} <mX', \sigma>$ |
| c. | $RR_{\text{pref}, \{AGR(\text{ob}); \{PER:1, NUM:pl\}\}, [V]} (<X, \sigma>)$ | $=_{\text{def}} <gvX', \sigma>$ |
| d. | $RR_{\text{pref}, \{AGR(\text{ob}); \{PER:2\}\}, [V]} (<X, \sigma>)$ | $=_{\text{def}} <gX', \sigma>$ |

These rules embody several assumptions:

- (1) they are all introduced by a single rule block (RR_{pref} is not qualitatively different from RR_2 , or any arbitrarily indexed rule block), and so constitute a position class;
- (2) there are distinct morphosyntactic features for subject and object agreement, identified diacritically, rather than structurally (cf. A-Morphous Morphology’s layered MSR’s); and

- (3) {AGR} features are set-valued features, rather than atomic-valued features (i.e., {AGR} takes feature-value pairs as its value).

For evaluation purposes, it is important to compare the rules for narrowness and applicability. Rules (b), (c), and (d) are paradigmatically related, and so cannot co-occur for practical reasons. Rules (a), (b), and (c) all realize {PER:1}, and so, should they co-occur in a particular context, would be realized periphrastically as a reflexive construction, according to Georgian grammar. The only possible competition scenario, therefore, is between rules (a) and (d), the *v-/g-* conflict exactly.

Rules (a) and (d) are apparently equally narrow, and both are applicable in extensions of {AGR(su):{PER:1}}, AGR(ob):{PER:2}}. Stump's response to this is to posit two modes of rule application, *expanded* and *unexpanded*. Rules generally apply in unexpanded mode, realizing a particular morphosyntactic property set. Certain rules, however, are defined as applying in expanded mode, "realizing EVERY WELL-FORMED EXTENSION of a particular property set" (Stump 2001:72). Rules applying in expanded mode are actually rule schemata, instantiated by each member of a class of rules applying in unexpanded mode. In the present case, the dominance and categorical applicability of rule (d) is assumed to be evidence of expanded application:

$$d'. \quad RR_{\text{pref}, \leftarrow \{AGR(\text{ob}): \{PER:2\}\} \rightarrow, [V]} (\langle X, \sigma \rangle) =_{\text{def}} \langle gX', \sigma \rangle$$

The arrows surrounding the second subscripted rule-index are the formal means of indicating expanded application. The effect of (d') in Georgian will be to realize every well-formed extension of {AGR(ob):{PER:2}} with the *g-* prefix in the prefix slot, i.e., every inflected form which realizes a 2nd person object will have a *g-* prefix, and never any other agreement prefix.

This approach is more restrictive than a theory which allows for the possibility of fully extrinsic rule ordering, because the constitution of rule blocks in PFM is fundamentally tied to distribution and position classes, whereas A-Morphous Morphology, for example, permits exponents which are realized in linearly distant positions to be part of the same rule block. PFM insists on localized competition. The rule schema approach also predicts that a schema cannot be preempted by another rule applying in expanded mode by definition. Schemata are therefore constrained, and can only be invoked where the "every well-formed extension" criterion is met.

The suffix *-t* which realizes only—but not all—extensions of {NUM:pl}, by contrast, cannot be handled with an expansion schema:

- e. Where $\alpha \neq 3$,
 $RR_{\text{suff}, \{AGR(\text{su}): \{PER:\alpha, NUM:\text{pl}\}\}, [V]} (\langle X, \sigma \rangle) =_{\text{def}} \langle X't, \sigma \rangle$
 f. $RR_{\text{suff}, \{AGR(\text{ob}): \{PER:2, NUM:\text{pl}\}\}, [V]} (\langle X, \sigma \rangle) =_{\text{def}} \langle X't, \sigma \rangle$
 g. $RR_{\text{suff}, \{AGR(\text{su}): \{PER:3, NUM:\text{pl}\}\}, [V]} (\langle X, \sigma \rangle) =_{\text{def}} \langle X'en, \sigma \rangle$
 h. $RR_{\text{suff}, \{AGR(\text{su}): \{PER:3\}\}, [V]} (\langle X, \sigma \rangle) =_{\text{def}} \langle X's, \sigma \rangle$

Again, to evaluate narrowness and applicability, rules (e), (g), and (h) are in a paradigmatic relation and cannot conflict. Conflicts between (e) and (f) are resolved in two ways: where $\alpha = 1$, both subject and object are realized by a $-t$ suffix, and so the resolution is vacuous (degemination or no); where $\alpha = 2$, the combination entails a periphrastic reflexive construction. The remaining conflicts are between (f) and each of (g) and (h): (f) trumps (h) by narrowness, but this is not so for the relation between (f) and (g), which are apparently equally narrow. The effect of (g) is never overridden, and so the criterion of “every well-formed extension” would seem to be met. Recasting (g) as an expansion schema:

$$g'. \text{RR}_{\text{suff}, \leftarrow \{ \text{AGR}(\text{su}): \{ \text{PER}:3, \text{NUM}: \text{pl} \} \} \rightarrow, [\text{V}]} (\langle X, \sigma \rangle) =_{\text{def}} \langle X' \text{en}, \sigma \rangle$$

This analysis predicts very simply that every extension of $\{ \text{AGR}(\text{su}): \{ \text{PER}:3, \text{NUM}: \text{pl} \} \}$ will show the $-en$ suffix, and this is indeed the case. The phonetic realization of (e) and (f) are distinct in some dialects, and so the splitting of the $-t$ suffixes is diachronically and dialectologically supported, and not simply a theoretical expedient.

The expansion schema as a theoretical construct preserves the Pāṇinian Determinism Hypothesis, but there is no formally based explanation for why only those rules defined as expansion schemata are so defined. That part of the explanation may well be extralinguistic.

Stewart (2001) focuses attention on lexeme class, rather than property set, as an alternative in the evaluation of the relative narrowness of competing rules in a block. Since the set of verb lexemes that may have two arguments is a subset of the set of verbs, a rule that is defined as applying to two-argument verbs is narrower than one defined as applying to the category of verbs as a whole. Thus it is the domain of applicability, not the range of properties realized, that is decisive in the case of Georgian, and the Pāṇinian Determinism Hypothesis may be upheld without an appeal to a second mode of application after all.

B.13: Prosodic Morphology’s response

The special devices of prosodic morphology are actually superfluous here, since there is no copying or nonconcatenative operation to perform. Since there is no phonological motivation for the g -/ v - disjunction, there is nothing to say here that would be different from what Word Syntax (see below) could offer.

B.14: Word Syntax’s response

Overt and phonetically null affixes are no problem for Word Syntax, so long as the surface form is consistent, e.g., 2nd person singular subjects are consistently marked with a null prefix, 2nd person objects by (at least) a g - prefix. Since words are built up exhaustively from morphemes in Word Syntax, every element of content (grammatical or lexical/derivational) associated with the inflected word is attributable to at least one constituent morpheme. This entails that in cases like [1pl-subj, 2pl-obj] *gxedavt* there is some element in the morphological structure which contributes the [1pl-subj] specification. Since there is no such readily identifiable overt element, the simplest

answer is to posit a phonetically null allomorph of the *v*- prefix (the *-t* suffix(es) may be a moot issue, given the language's general anti-gemination constraint). The problem is that the distribution of this allomorph is suspiciously specific, i.e., it "appears" just in case the *g*- prefix is also called for.

A language-specific filter could also be posited, reducing the morpheme sequence *v-g-* to *g-*. This filter could hold as a surface condition or as a prohibited structure, but either way the move is a mere stipulation with no explanatory value. Note further that both [gv] and [vg] are attested word initially in Georgian.

A third option is to claim that (as was proposed for Network Morphology, above) a class of fusional morphemes is used, introducing specifications for subject and object at the same time. This would mean that the markers observed in table (2) in the original data set are not combinations of two independent morphemes, but rather are affixes and circumfixes which fuse multiple argument specifications. In fact, every one of the markers in (2) is homophonous with an otherwise existing agreement marker appropriate to one of the arguments in question. Needless to say, this is not very satisfying, and verges on the willful omission of a generalization.

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