

# Research Paper I

Henry Beecher

May 14, 2004

## Derivational Paradigm in Word Formation

Main Reader: Farrell Ackerman

Ancillary Reader: Sharon Rose

Ancillary Reader: Chris Barker

### Abstract

The morphological paradigm as a theoretical construct has a central role in explaining inflectional word formation, particularly in Word & Paradigm approaches to morphology. In contrast, research into the role of paradigm in derivation has been programmatic as well as fragmentary. In this paper I investigate the extent to which patterns of relationships among derived words constitute a derivational paradigm. A more comprehensive and precise characterization of derivational paradigm is provided based on a unified treatment of inflection and derivation. Previous diachronic-oriented research (van Marle, 1984; Pounder, 2000) is complemented by a dynamic model I propose for representing the role of derivational paradigms in synchronic word-formation. The proposed model captures local vs. non-local derivational associations as identified via what I refer to as the Paradigmatic Derivate Generalization (PDG). Using the model and a generalized notion of paradigm derived from the rule-patterns of Bochner (1993), a variety of derivational processes in English, French, Tigre and Lithuanian are analyzed to identify the paradigmatic relationships upon which word formation in those languages is dependent. The suitability of the model for implementation using word-formation rules is also demonstrated through an analysis of a fragment of the Lithuanian data using a novel adaptation of Paradigm Function Morphology (Stump, 2001). While inflectional and derivational paradigms are not parallel in function and may differ in their range of applicability, they do share many of the same characteristics. Furthermore, these findings indicate that generalizing the notion of paradigm as a theoretical construct to derivational word formation is supported by cross-linguistic evidence.

# Derivational Paradigm in Word Formation\*

## 0. INTRODUCTION.

In the domain of morphology the regularities associated with the participation of words in paradigms has a long and venerable tradition originating with classical Latin, Greek and Sanskrit grammarians. The concept of paradigm is generally restricted to representing patterns of relationships among inflected words such as depicted for the French verb *finir* ‘to finish’ in figure (1)a. In contrast, patterns of relationships among derived words like the French examples in 1(b) are generally not considered to be a paradigm.

a. <u>Present forms of <i>finir</i> ‘to finish’</u>		b. <u>Adj (m) / Adj (f) / Adverb</u>			<u>‘gloss’</u>
Je finis	Nous finissons	beau	/ belle	/ bellement	‘beautifully’
Tu finis	Vous finissez	certain	/ certaine	/ certainement	‘certainly’
Il finit	Ils finissent	franc	/ franche	/ franchement	‘frankly’

Figure (1) Inflectional vs. derivational paradigm.

It is my claim that the concept of an inflectional paradigm is deservedly generalizable to derivational morphology; that is, patterns of relationships among derived words constitute a derivational paradigm. While inflectional and derivational paradigms are not parallel in function, I show how both share many of the same characteristics. Based on a unified treatment of inflection and derivation, I formulate a more comprehensive and precise characterization for derivational paradigm as well as a model appropriate for the requirements of synchronic word-formation and suitable for implementation using word-formation rules (WFR).

Recognizing a central role for paradigm in lexeme formation, Hockett (1954) coined the label ‘Word and Paradigm’ (WP) to distinguish word-based morphology from morpheme-based ‘Item and Process’ (IP) or ‘Item and Arrangement’ (IA) models. In WP as further elaborated by

---

\* To Jan, my second mom, and the only person I know of Lithuanian descent. I am also indebted to all in the Linguistics Dept at UCSD for their valuable comments and assistance. Any errors or inaccuracies remain my own.

Robins (1959), Matthews (1972, 1994), Anderson (1992), Aronoff (1994) and Stump (2001 among others, the paradigm is generally restricted to inflectional processes. Van Marle (1985), Bochner (1993), Pounder (2000) and ongoing work by Bauer (1997), Booij (1996, 1997, 2002) and Stump (2001), in viewing the distinction between inflection and derivation as a cline rather than a categorical break, suggest an equal role for paradigm in derivational processes. Derivational paradigm in much prior research is focused on diachronic aspects of word formation. I complement this paradigm-oriented research with additional cross-linguistic evidence bearing on the synchronic analysis of derivational morphology. Bochner's concept of a rule-pattern network is used to formulate a generalized notion of paradigm which together with the dynamic model I propose are applied to derivational processes in several languages to capture the paradigmatic relationships upon which word formation in those languages is dependent.

Several criteria for distinguishing inflection and derivation are examined in §1, as differentiating them is critical to generalizing a notion of paradigm for derivation on analogy with inflection. Using an example of derivational phenomena entailing paradigm, key advantages of adopting a WP framework for generalizing paradigm are also identified. My proposed model for representing derivational paradigm and some related research by Bochner are presented in §2. A generalized notion of paradigm based on a set of features common to both inflection and derivation is formulated in §3. Cross-linguistic data representing a variety of derivational processes in English, French, Tigre and Lithuanian are presented and analyzed in §4. Some merits of Paradigm Function Morphology (PFM) over Finite State Morphology (FSM) are shown in §5, and a formal implementation of the proposed model demonstrated through an adaptation of PFM. To conclude, a summary of the findings and some future directions are discussed in §6.

## 1. BACKGROUND ISSUES.

### 1.1 *Differentiating inflection and derivation.*

Any effort to develop a generalized notion of derivational paradigm as a theoretical construct on analogy with inflectional paradigms must provide criteria for distinguishing between inflectional and derivational phenomena, despite the admittedly problematic nature of a sharp division between them. Inflection is conventionally construed as the production of a word form suitable for use in a

particular syntactic context. In English the forms *takes*, *took*, and *taken* are inflected forms of the verb *take* associated with a particular set of morphosyntactic properties restricting their grammatical distribution. Thus, *took* may be used with any subject to express the simple past tense; whereas *takes* is restricted to use with 3<sup>rd</sup> person singular subjects only to express the present tense. In each case the lexical meaning of the verb, noun or adjective<sup>1</sup> is not changed. In other words, the inflected forms of *take* represent particular values assigned to syntactically relevant properties of the verb such as tense or agreement *without* modifying or altering the lexical semantic meaning associated with the verb.

In contrast, derivation is described as the creation of one word from another in which the lexical meaning of the created word is in some way distinct from that of the base word. For instance *singer* is a word derived from *sing* in which the original meaning of *sing* is altered in *singer* to become “one who sings”. Moreover, in the case of *sing~singer* the change in meaning also entails a change in word class, namely from verb to noun. The derived noun *singer* is subsequently subject to any inflection which may be imposed on nominal forms by the morphology of the language. In this sense, while derivation can be said to feed inflection, it is claimed inflection cannot feed derivation<sup>2</sup>.

Table (1) Common criteria used to distinguish inflection and derivation with counter-examples.

<i>Criteria</i>	<i>Inflection</i>	<i>Counter-example</i>	<i>Derivation</i>	<i>Counter-example</i>
Lexical meaning	Never changed	<i>leaving~leavings</i> 'I rejected his leaving' 'I rejected his leavings'	Always changed	<i>cyclic~cyclical</i> or <i>derivate~derivative</i>
Syncategorematicity	No change in grammatical category	Past participles functioning as adjectives	Change in grammatical category	Prefixation uniformly category preserving in English

<sup>1</sup> In languages with richer inflectional morphology nouns and adjectives are similarly inflected for case. The only remnants of case inflection in English are found in the pronominal system as in the nominal form *he*, possessive *his* and accusative *him*.

<sup>2</sup> Booij (1993) argues that this claim is actually more nuanced and points to a distinction between ‘inherent’ versus ‘contextual’ inflection. Also, Kiparsky (1982) proposes incorporating a derivational/inflectional distinction into levels in Lexical Phonology.

<i>Criteria</i>	<i>Inflection</i>	<i>Counter-example</i>	<i>Derivation</i>	<i>Counter-example</i>
Productivity <sup>3</sup>	Complete	Defective verbs like French <i>frire</i> 'to fry' lacks simple past, imperfect, subjunctive	Incomplete	Formation of gerunds as deverbal nouns is exceptionless in English
Semantic regularity	Maintained	Breton <i>merc'h-ed</i> 'girls' (simple plural) vs. <i>merc'h-ed-ou</i> 'girls' (double plural) conveying affectionate scorn <sup>4</sup> (Trépos, 1957)	Not maintained	Deverbal verbs formed by <i>re-</i> are extremely regular semantically in English
Closure	No further inflection or derivation	Inherent inflection can feed derivation (Booij, 1993)	Further inflection or derivation possible	'double plurals' in Breton

Based on these descriptive generalizations, it might be assumed that this is a categorical distinction confirmable with sufficient evidence. However, table (1) summarizes several findings showing any such distinction to be equivocal at best. While not an exhaustive examination, these facts do provide a compelling argument against positing any single criterion as both sufficient and necessary. Consequently, rather than rely on some arbitrary combination of criteria, a unified treatment (described in §1.2) is adopted in which inflection and derivation are both considered modes of word-formation differing only in their respective roles in the grammar.

### 1.2 *A unified treatment of inflection and derivation.*

The lack of any single dimension along which to categorically divide inflection and derivation has suggested to some linguists (Plank 1994) that their separation is more appropriately characterized as different ends of single continuum or cline. Along these lines, a central premise for treating both in a unified fashion, as argued by Bochner (1993), lies in the fact that they involve the same sorts of formal operations such as prefixation, suffixation, infixation, circumfixation, reduplication, *etc.* These are all attested cross-linguistically for both inflection and derivation as well as other non-affixal processes involving apophony, metathesis, or tone. Languages use these strategies to mark property-exponence (*i.e.* content to form) pairings, with some form of affixation the most common. In addition numerous deviations in the property-exponence pairing found in inflectional markings

<sup>3</sup> For present purposes productivity may be understood as the ability to generalize a process of inflection or derivation to all members of a given lexical category.

<sup>4</sup> The double plural does not have this connotation with all Breton nouns.

also occur in derivation. To illustrate, table (2) provides both inflectional and derivational examples of various deviations in four different categories. Although property-exponence deviations occur more frequently in connection with inflection, these facts nevertheless support the claim that inflection and derivation are alike in their morphotactic properties.

Table (2) Deviations in the marking of property-exponence pairings.

<i>Deviation</i>	<i>Inflectional Example</i>	<i>Exponence</i>	<i>Derivational Example</i>	<i>Exponence</i>	<i>Comment</i>
Cumulation	Latin /re:ksisti:/ <i>rēxisti</i> ‘you had ruled’ <sup>5</sup>	/ti:/ realizes 2 <sup>nd</sup> person and sing. num.	<i>waitress</i>	-ress realizes female gender and agentivity	one marking realizes two or more properties
Extended Exponence	Latin /re:ksisti:/ <i>rēxisti</i> ‘you had ruled’	/s/, /is/, /ti:/ all realize perfectivity	<i>elongate</i>	-e and -ate both realize transitivity	two or more markings realize one property
Syncretism	Latin <i>cornu</i> ‘horn’ or <i>cornua</i> ‘horns’	-u and -ua realize either nominative or accusative case	<i>cleaner</i>	-er realizes either agentivity or degree comparison	Homonymy
Suppletion	English <i>to be</i>	<i>am</i> realizes 1 <sup>st</sup> p. singular and <i>is</i> realizes 3 <sup>rd</sup> p. singular	<i>gubernatorial</i>	realizes adjectival form of <i>governor</i>	Idiosyncrasy

In summary, a unified treatment of inflection and derivation recognizes that morphological processes of either sort make the same contribution, namely the formation of words. Crucially, any formal operations available to one are equally available to the other, as attested cross-linguistically. Where their respective roles in the grammar differ is with respect to what each serves to functionally encode. Inflection encodes morphosyntactic properties such as plurality or non-finiteness. These are phrase-level properties to which syntactic relations like agreement are sensitive. Derivation encodes lexicosemantic properties such as agentivity or stativity. These are word-level properties which determine how a word enters into the semantic composition of larger constituents. Languages do not necessarily treat all the same properties as either phrasal-level or word-level in a uniform fashion. Consequently, as some properties may be encoded inflectionally in one language versus derivationally in another, the particular status of specific phenomena is not always clear. Following Anderson (1992), the data examined in §4 is considered to be derivational

<sup>5</sup> Both inflectional examples using *rēxisti* originate with Matthews (1972).

in the absence of any evidence that the syntax is sensitive to the particular processes or forms involved.

### 1.3 Dutch toponyms: an archetype for derivational paradigm.

To demonstrate empirical phenomena supporting derivational paradigm, this section briefly looks at the derivation of adjectives and terms for inhabitants corresponding to some Dutch toponyms. In originally presenting this data and analysis, Booij (1997) argues that a paradigmatic perspective is paramount to achieving an adequately explanatory account of the facts and relevant generalizations. This exemplary case also identifies several key issues which any theoretical framework must address. Table (3) illustrates the particular forms involved and their relationships to each other.

Table (3) Dutch toponyms, inhabitant terms and toponymic adjectives.

<i>Toponym</i>	<i>Inhabitant</i>	<i>Adjective</i>	<i>Female Inhabitant</i>
België	Belg	Belg-isch	Belg-isch-e
Drente	Drent	Drent-s	Drent-s-e
Finland	Fin	Fin-s	Fin-s-e
Hongarije	Hongaar	Hongaar-s	Hongaar-s-e
Noorwegen	Noor	Noor-s	Noor-s-e
Rusland	Rus	Russ-isch	Russ-isch-e
Zeeland	Zeeuw	Zeeuw-s	Zeeuw-s-e

The significant generalizations regarding these forms are 1) in each case the four forms are formally and semantically related to each other; 2) the form of an inhabitant term is not predictable from the corresponding toponym; 3) inhabitant terms serve as a base to which either *-isch* or *-s* is suffixed to form toponymic adjectives; 4) toponymic adjectives serve as a base to which *-e* is suffixed to form female inhabitant terms; and 5) there is no single form which can serve as a common base from which all the other forms may be directly derived. The processes involved are also clearly derivational since each creates one word from another in which the lexical meaning of the created word is distinct from that of the base word. Furthermore, nothing in the syntax is sensitive to the nouns or adjectives so formed. That is to say, any inhabitant term may be used syntactically anywhere any other noun may be used and the same is true *ceteris paribus* for any toponymic adjective.

Capturing and adequately accounting for these generalizations raises several non-trivial issues. A theory assigning inherent lexical meaning<sup>6</sup> to affixes is faced with explaining why the term for female inhabitant should incorporate an adjectival notion like the ‘quality/characteristics of being from toponym X’ unlike the term for inhabitants, who are simply ‘from X’. Alternatively –*ische* or –*se* might be a sort of single ‘synaffix’, however that would still not explain why specifically each adjective with –*isch* or with –*s* (coincidentally) has a corresponding female inhabitant term with –*ische* or –*se*, respectively. In contrast, a theory which recognizes and uses inter-relationships among the four categories as a regular means of deriving all the forms would not be confronted by the limitations of accounting for forms in a strictly compositional fashion. Such a paradigmatic approach would also predict the generalizability of the observable patterns to other Dutch toponyms. Attention is given in the next section to evaluating and adopting an appropriate framework for formulating a generalized notion of paradigm which is able to suitably address these issues.

#### 1.4 *Adopting a word-based over a morpheme-based theoretical framework.*

In formulating a generalized notion of paradigm I assume a WP approach to morphology. In WP the whole word as opposed to any constituent part is the fundamental unit of analysis and the minimal unit with which meaning is associated. Thus only whole words and not individual morphemes are listed in the lexicon. Notions of ‘root’, ‘stem’ or ‘affix’ are referenced, however only in the context of the relationships between and among individual words. For example in the Dutch terms *Belgie*, *Belg*, *Belgisch*, *Belgische* from table (3), *Belg-* is identifiable as the root or minimal portion which they have in common. Portions exclusive of the root such as *-isch* may be identifiable as affixes. Whether recognizable as derivational or inflectional, affixes themselves are crucially not meaning-bearing units. It is only in being suffixed to a nominal stem that the adjectival property ‘quality of X’ is associated with (*i.e.* ‘realized by’) the affix –*isch* in Dutch. Consequently, a WP account is not confronted with reconciling any particular ‘meaning’ associated with –*isch* when it appears in a term such as *Belgische*.

This same example of Dutch *Belgische* is much more problematic in an IA or IP framework. The primary object of morphological description in these frameworks is the

---

<sup>6</sup> For example, –*isch* or –*s* mean the ‘quality of being from X’ because they convert some toponym X into an adjective.

Bloomfieldian concept of *morpheme*, or the smallest morphological unit establishing a one-to-one Saussurean association between form (*signifiant*) and meaning (*signifié*). Consequently, the Dutch word *Belgische* is viewed as decomposable into the individual segments, *Belg-isch-e*, where the form of each segment is a ‘morph’ bearing a unique meaning or ‘morpheme’. Word formation in IA/IP is the structured concatenation of these segments beginning with a base form to which in some ordered fashion are added any prefixes and/or suffixes. So, the root, *Belg-*, is a base for the suffixation of *-isch* which in turn produces another stem for the further suffixation of *-e*. Crucially each morpheme has its own entry in the lexicon containing such information as its form, meaning, and in the case of derivational affixes placement restrictions and possibly grammatical category<sup>7</sup>. Thus the lexical entry *-ISCH* identifies it as a denominal suffix in Dutch creating an adjective, having the semantics ‘quality/characteristics of X’ where X is the base noun. This then creates a problem when an affix like *-isch* appears as part of noun such as *Belgische*, the semantics of which do not support its inclusion.

In addition to the occurrence of ‘unmotivated’ affixes, so called ‘zero morphology’ is yet another challenge confronting IA/IP. Zero morphology refers to the absence of any overt realization for one or more properties associated with a word. This is illustrated by the unaffixed inhabitant terms such as *Belg* in table (3). An even more striking example of this phenomenon is found in the plural forms of some toponyms in Tigre<sup>8</sup> as shown in table (4).

Table(4) Some toponymic plurals in Tigre.

<i>Masculine Singular</i>	<i>Feminine Singular</i>	<i>Gender-neutral Plural</i>	<i>Gloss</i>
bəlenay	bəlenayt	bəlen	‘Bilin speaker’
hämäsenay	hämäsenayt	hämäsen	‘Hamasien speaker’
hübäsay	hübäsayt	hübäs	‘Tigrinya speaker’

In accounting for either the unaffixed Dutch inhabitant terms or the plural Tigre forms, IA has no choice but to posit affixing a null or ‘zero’ morph to the form in question with which to associate the relative property of gender or number. Not to do so would deprive a form like *hämäsen* from being plural at all, as it lacks any morphemes with which the property of plural number may be associated. IP on the other hand could associate the property of plural number to truncation, in

<sup>7</sup> Complex words (both form and meaning) are assembled from their constituent morphemes and so are not individually listed in the lexicon.

<sup>8</sup> Tigre is a Semitic language in Eritrea. Plural formation in Tigre is described by Palmer (1962).

which *hämäsen* is formed by an anti-iconic process arbitrarily removing either the masculine or feminine suffix. To avoid being *ad hoc* this would require independently motivated evidence, especially as cross-linguistically truncation is an infrequently attested morphological phenomenon, particularly in regards to the formation of plurals.

WP is distinguished from morpheme-based frameworks by two central tenets: 1) the separation of form and content, also referred to as the Separation Hypothesis (SH) of Beard (1986); and 2) the association of meaning exclusively with whole words. A further distinction, shared by many lexicalist theories including the variant of WP I assume, is the premise that all word formation, both inflectional and derivational, occurs only in the lexicon. This is claimed under the Strong Lexical Hypothesis (SLH) and specifically denies that derivation is restricted to the lexicon while inflection occurs in the syntax.

Given the primacy of words in WP, having an operational characterization of ‘word’ is most important. *Per* the Separation Hypothesis, two theoretical notions of ‘word’ need to be differentiated: 1) *lexeme* representing all morphosyntactic property sets or ‘content’ with which a word may be underlyingly associated (*e.g.* {1<sup>st</sup> person, singular, present, indicative} versus {3<sup>rd</sup> person, plural, imperfect, subjunctive}); 2) *grammatical word* referring to the ‘form’ realized by the combination of a lexeme and any exponence (*e.g.* French *finis* versus *finissent* which realize the above two feature sets, respectively).

Using these distinct senses for the term word, an *inflectional* paradigm within WP is defined as the full set of grammatical words realizing a particular lexeme. Moreover, the structure of such a paradigm is determined by the inventory of morphosyntactic properties inflectionally encoded in a given language. Less abstractly, part of the paradigm for the future tense of French *finir* ‘to finish’ may be schematically represented by a table having six cells as depicted in figure (2).

{1 <sup>st</sup> sg, future} finirai	{1 <sup>st</sup> pl, future} finirons
{2 <sup>nd</sup> sg, future} finiras	{2 <sup>nd</sup> pl, future} finirez
{3 <sup>rd</sup> sg, future} finira	{3 <sup>rd</sup> pl, future} finiront

Figure (2) Partial schema for inflectional paradigm of French *finir*

In this way a paradigm captures the formal and semantic relationships among inflected forms representing a particular class of lexemes (*i.e.* conjugation or declension) and is generalizable to all

members of that class. A paradigm for a given class of lexemes also participates in relationships with other paradigms representing different (possible) classes of lexemes of the same grammatical category.

In WP the form of a grammatical word is inferred from the inflectional properties (*i.e.* content) with which it is associated in the paradigm, and realizes those properties through a set of realizational rules specific to the morphology of the language.

- (1)  $\mathfrak{R}([\text{FINIR}, \text{V}, \text{II}]) = \textit{finir}$
- (2)  $\mathfrak{R}([1^{\text{ST}} \text{ SG}, \text{FUTURE}]) = \textit{Xai}$

Figure (3) Example of Realizational rules for French *finir*

Figure (3) shows two rules realizing French *finirai* ‘I will finish’. Rule (1) identifies the stem of this 2<sup>nd</sup> conjugation verb, and rule (2) realizes the properties [1<sup>ST</sup> SG, FUTURE] by affixation of *-ai*. These rules simply express the property-exponence pairings organized in the paradigm. Realizational rules are purely morphotactic and do not add, delete or otherwise alter properties in any way. Crucially, they are “non-resource based” (Blevins 2002) in that properties are in not ‘consumed’ during spell-out, nor are required to be. So a single property can be realized by more than one rule, or a property might not be realized by any rule. Taking full advantage of the separation of form and function, realizational rules are unhindered by the limitations of IA/IP. For instance Tigre toponymic plurals in table (4) could be formed by the following ordered rules.

- (1)  $\mathfrak{R}([\text{HÄBÄS}, \text{N}]) = \textit{hübäs}$
- (2)  $\mathfrak{R}([\text{PLURAL}]) = \text{X}$
- (3)  $\mathfrak{R}([\text{MASC}, \text{SING}]) = \textit{Xay}$
- (4)  $\mathfrak{R}([\text{FEM}, \text{SING}]) = \textit{Xt}$

Figure (4) Example of Realizational rules of Tigre *hübäs*

The first rule identifies the stem. The second realizes the property [PLURAL] which is co-extensive with the stem and involves no affixation. The third realizes the properties [MASC, SING] by affixing *-ay* to the output of rule (2) producing *hübäsay*. The fourth realizes the properties [FEM, SING] by affixing *-t* to the output of rule (3) producing *hübäsayt*.

## 2. PERSPECTIVES ON PARADIGMATIC DERIVATION<sup>9</sup>.

### 2.1 Bochner (1993): *Simplicity in Generative Morphology*.

Bochner provides a well articulated, conceptual blueprint for instantiating a notion of paradigm, yet many details about how it might be formalized and implemented through word-formation rules are left unaddressed. Compared to other research (*e.g.* van Marle, 1985 or Pounder, 2000), Bochner's proposals have greater ramifications for substantiating the indispensability of paradigm in word formation as well as for obtaining a generalized characterization of its role in both inflection and derivation. Bochner develops his ideas within a framework he calls Lexical Relatedness Morphology. In his words LRM is a distinct form of word-based lexicalism, yet in spirit it is compatible with WP (*cf.* §1.4) and in most respects the two share the same premises<sup>10</sup>.

Like WP, LRM posits the word as the sole locus of meaning. There is a clear separation of form and content, individual morphemes whether affixes, stems or roots have no fixed meaning outside of the context of the entire word. Ergo, only whole words have entries in the lexicon. Bochner argues that redundancy in the lexicon resulting from whole-word entries need not increase the complexity of the grammar. The efficacy of the argument is illustrated by considering two related lexical representations such as /red/ and /redness/. Their co-existence in the lexicon does not add to the complexity of the grammar so long as the grammar also has independent access to the relationship pattern holding between them. As long as the items conform to an available relationship pattern, the existence of either one logically predicts the existence of the other *without* adding any additional complexity. Bochner further argues that independent access to 'relationship patterns' is available to the grammar if word-formation rules themselves are conceived as patterns for sets of lexical items. The particular morphological rule-patterns developed in LRM are a further refinement and elaboration of the lexical 'redundancy rules' originally suggested by Jackendoff (1975).

In addition to justifying the plausibility of restricting lexical entries to whole words (an achievement in itself), treating word-formation rules as 'relationship patterns' has several other

---

<sup>9</sup> The discussion is limited to the contributions of Bochner; however, see van Marle (1985), and Pounder (2000) for additional related research upon which some of my proposal builds.

<sup>10</sup> This is not to suggest LRM and WP are identical, just that I am not aware of any essential claim in one which would refute an essential premise of the other.

virtues. Rule patterns are expressible in various degrees of specificity and are thus able to capture a wide range of generalizations. So, while the content of a rule may be highly specific, its structure remains abstract enough to be applicable to either inflectional or derivational word-formation. This is illustrated by the two examples in figures (5) and (6).

$$\left\{ \begin{array}{l} /Xis/ \quad /Xis/ \quad /Xit/ \quad /Xissons/ \quad /Xissez/ \quad /Xissent/ \\ V \quad , \quad V \quad , \quad V \quad , \quad V \quad , \quad V \quad , \quad V \\ Z \text{ 1sg} \quad Z \text{ 2sg} \quad Z \text{ 3sg} \quad Z \text{ 1pl} \quad Z \text{ 2pl} \quad Z \text{ 3pl} \end{array} \right\} \left\{ \begin{array}{l} /Xir/ \quad /FINir/^{11} \\ V \quad , \quad V \\ \text{TO Z} \quad \text{FINISH} \end{array} \right\}$$

Figure (5) Bochnerian rule pattern for a portion of the inflectional paradigm of French *finir*

$$\left\{ \begin{array}{l} /Xous/ \quad /Xate/ \quad /Xist/ \quad /Xism/ \quad /Xace/ \\ Adj \quad , \quad V \quad , \quad N \quad , \quad N \quad , \quad N \\ \text{HAVING Z} \quad \text{SUPPLY with Z} \quad \text{FOLLOWER of Z} \quad \text{DOCTRINE of Z} \quad \text{SET of Z} \end{array} \right\} \left\{ \begin{array}{l} /X/ \quad /POPULAR/ \\ B^{12} \quad , \quad Adj \\ Z \quad \text{for most PEOPLE}^{13} \end{array} \right\}$$

Figure (6) Bochnerian rule pattern for a portion of the derivational paradigm of bound root *popul*-<sup>13</sup>

The notation in these figures represents a phonological string within slashes, a syntactic category like V for verb and a semantic representation. Bochner makes a further distinction between simple, pair-wise pattern sets like {red, redness} and the cumulative pattern sets in Figures (5) and (6). The distinction is important because only simple, pair-wise patterns are posited to comprise lexical entries. The cumulative sets are notational conveniences for representing all possible pair combinations among the items in the set. The only objective at this point is to illustrate how rule patterns may apply to either inflectional or derivational word-formation and how the resulting whole word entries in the lexicon do not increase the complexity of the grammar. Subsequent sections will address other important distinctions such as the ability to generalize the pattern in figure (5) to all French *-ir* verbs in contrast to the inability to generalize the particular pattern in figure (6) to all other bound roots.

A final aspect of Bochner's proposal requiring some discussion is the 'pattern matching' evaluation metric he develops for measuring complexity in a grammar, as this technique plays a role in analyzing synchronic evidence for derivational paradigm in §3 and §4. Bochner proposes that examining a fully specified lexical representation and counting the number of *independent choices* required to distinguish it from other, related representations is an alternative to the IA/IP approach of counting every morpheme as a separate symbol. For instance, the words *nation*, *national* and

<sup>11</sup> by convention the present infinitive is used to represent regular forms in the inflectional paradigm but, in terms of paradigmatic relationships, the choice is arbitrary as any regular form could equally well serve the same purpose.

<sup>12</sup> B represents that X is a bound root.

<sup>13</sup> The status of a bound root as a morpheme as opposed to a word with a lexical entry is discussed in §2.4

*nationality* could be represented by a rule-pattern  $\{X, Xal, Xality\}$ <sup>14</sup>. This is a cumulative set representing all possible pair combinations. However, unlike figures (5) or (6), this set includes a recursive element (*Xality*). Inclusion of recursive elements in a cumulative set is the net result of two operations, ‘set substitution’ and ‘set union’. In other words, the pair {nation, national} is represented by set pair  $P_1=\{X, Xal\}$ . A different set pair  $P_2=\{X, Xity\}$  represents {national, nationality}. The element *Xal* in  $P_1$  is the equivalent of element *X* in  $P_2$ , so ‘set substitution’ of *Xal* for *X* in set pair  $P_2$  yields a new set pair  $P_3=\{Xal, Xality\}$ . Finally, the ‘set union’ of  $P_1 \cup P_3$  is the cumulative pattern  $\{X, Xal, Xality\}$ . Now, using the pattern matching metric, the complexity value of *nation* is 1 because the only choice required is to compare it to *X*. The result is equivalent to the symbol counting metric because there is only one morpheme. Evaluating *national* requires two choices, comparing it to *X* and determining that the difference is *-al*. This too is equivalent to the symbol counting metric. Evaluating *nationality*, however, under the pattern matching metric still only requires the same two choices (comparing it to *X* and determining the difference *-ality*). In contrast, under the symbol counting metric the complexity value is 3 because there are three morphemes.

Both approaches satisfy the goal of an evaluation metric: measuring independent information content. Unlike the morpheme-based approach, though, Bochner’s method does not crucially rely on underspecification to ensure that lexical representations are redundancy-free. The insight behind the concept of underspecification is that features (or components) of representations are not necessarily independent of each other and some features can be inferred from others. Bochner’s analogy in phonology illustrates the point well. Consider a language having a constraint (or pattern) by which any vowel specified as [+BACK] is also specified as [+ROUND] and, conversely, if specified as [-BACK] is also specified as [-ROUND]. In a language having such a constraint, the amount of information a speaker has to learn to acquire vowels with these features is less (*i.e.* specification of a single feature, like [round])<sup>15</sup> than in a language not having this constraint, which would require individually specifying both values for vowels with these features. To put it another way, the symbols associated with a vowel in a language having the constraint

---

<sup>14</sup> Depictions of rule patterns without category or semantic components is only for expository ease.

<sup>15</sup> An associated rule like  $[\alpha\text{ROUND}] = [\alpha\text{BACK}]$  in applying to all vowels does not constitute new information beyond its first application.

might be [ROUND]<sup>16</sup> = +; [BACK] = 0, where the “0” does not count as a symbol. While in a language not having the constraint, the symbols associated with a vowel would be some combination of both such as [ROUND] = + and [BACK] = -. The effect of underspecification is to remove all dependent information from lexical representations leaving only *independent-information* for an evaluation metric to measure. Defining independent-information as the number of independent choices required to determine a particular representation avoids the difficulties associated with either underspecification or the content of “0”, and is a more direct approach as well. In a language having the above constraint, only 1 choice is required to determine both the features [ROUND] and [BACK], because with the constraint, specification of one feature automatically entails specification for the other. Whereas in a language without the constraint 2 choices are required, one for each of the two features. The independent-information content associated with a representation is dependent on regularities holding in a language.

## 2.2 A Proposal for modeling derivational paradigm.

With the aim of making a generalized notion of paradigm less abstract, I propose a novel formulation for modeling derivational paradigm. The model addresses two specific areas in which the contributions of van Marle, Pounder and Bochner are lacking. The first concerns realizing a formulation that is both appropriate and adequate for the requirements of synchronic word formation. The second concerns achieving a formulation that is suitable for implementation using WFR. The particular notions of derivational paradigm of van Marle and Pounder both suffer from conflating the behavior of derivational processes with the structure of the derivational paradigm. The fallacy of this may be better appreciated by first considering the behavior of inflectional processes with regards to the structure of an inflectional paradigm.

Inflectional processes serve to realize the word form associated with each cell in a paradigm. Crucially, however, the number or organization of the cells themselves is *not* determined or altered by the range of inflectional processes available in the language. This follows logically from two facts: 1) inflectional processes do not create new lexemes; and 2) the number and organization of cells in an inflectional paradigm are *only* determined by the set of morphosyntactic properties

---

<sup>16</sup> the choice of which feature to select is arbitrary

inflectionally encoded in the language. Essentially the structure of an inflectional paradigm is static for the class of lexeme it represents.

In many respects the opposite is true of derivational paradigms. The structure of a derivational paradigm is inherently dynamic in so far as a single, underlying static structure does not exist for all derived lexemes of any given base lexeme. This too follows logically from two facts: 1) derivational processes *do* create new lexemes; and 2) the number and organization of cells in a derivational paradigm are determined by both the set of lexicosemantic properties derivationally encoded in the language and the range of ‘competing’ (or parallel) derivational processes corresponding to the particular properties being realized. Competing or parallel processes refers to the fact that a language may employ more than one derivational process of the same type. For instance in English the deadjectival nouns *socialist* and *socialism* are each realized by ‘parallel’ processes, both taking an adjective and deriving a noun. Thus for a given adjective in English its potential set of deadjectival nouns may include both, one or none of these options with the concomitant effect that the derivational paradigm for a particular adjective need not strictly resemble that of another adjective. The option for any lexeme resulting from a derivational process to potentially be the input for further derivation also makes the structure of derivational paradigm inherently dynamic.

In opposition to the inherent dynamicity of derivational paradigm, the range and behavior of possible derivational processes for a given language are logically confined to a restricted set which can be schematically represented as illustrated in figure (7). Denominal processes are represented on the left and deverbal processes on the right. Not depicted are two additional clusters representing deadjectival and deadverbial processes. The two center circles represent base forms and the outer circles represent derived forms. The derived forms are also encircled to

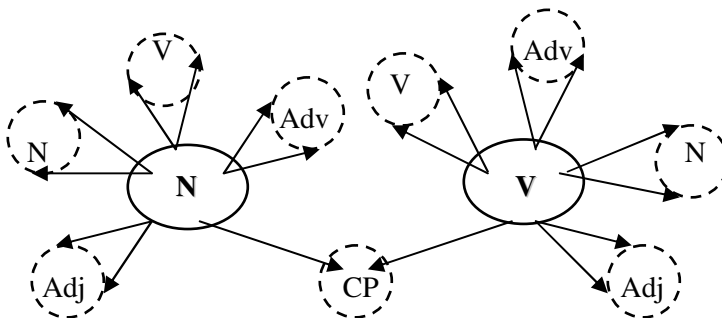


Figure (7) Partial schema for derivational processes

represent the possibility of each being the base for further derivation. The multiple arrows linking the bases to the derived forms represent possible parallel processes. The CP indicates compounding<sup>17</sup>. These figures represent all logical denominal and deverbal possibilities, actual languages would vary as to which are used and in what combination.

Trying to map a representation for derivational paradigm directly onto a logical schema for derivational processes inevitably groups derivatives of a base according to the processes creating them. This is essentially the situation with the models of both van Marle and Pounder. While this approach can be said to ‘preserve’ the derivational composition of a complex lexeme, in the absence of credible evidence that speakers rely on ‘reconstructing’ the derivation of every complex word they utter, the crucial relevance of this information in synchronic word-formation is questionable. The morphological ‘information’ about derived words critical for synchronic word formation lies not with the process(es) by which they are derived, but rather with the regularities (*i.e.* patterns) among complex words sharing a common base. Consequently, a model for derivational paradigm organizing derived words according to the processes deriving them is considerably less suitable for synchronic word formation than one organizing them into subgroups sharing a common base or stem.

The dynamic model for paradigm which I propose crucially organizes complex, derived forms so as to preserve their relationships to other forms having the same stem. In figure (8) is an example using a set of derived forms sharing the English bound root *popul-* as a base. The entire structure comprises a *macroparadigm*. Each boxed horizontal or vertical set comprises a *subparadigm*. Each subparadigm shares a common stem. Except for a subparadigm sharing the (initial) base form, all other subparadigms represent recursive derivation. Except for a bound root, each cell is of equal status in representing a distinct lexeme as a set of lexico-semantic properties (*i.e.* grammatical category and semantic content) with an associated word form. The light versus heavy double lines are only an aid in distinguishing sets of subparadigms. The single cell containing the bound root *popul-* is in wavy lines to indicate that a bound root is *not* equivalent to a lexeme and does not have a lexical entry.

---

<sup>17</sup> The morphological process of compounding, like that of conversion, is not addressed in this paper. Their incorporation into a more comprehensive theory of paradigm is left to future research.

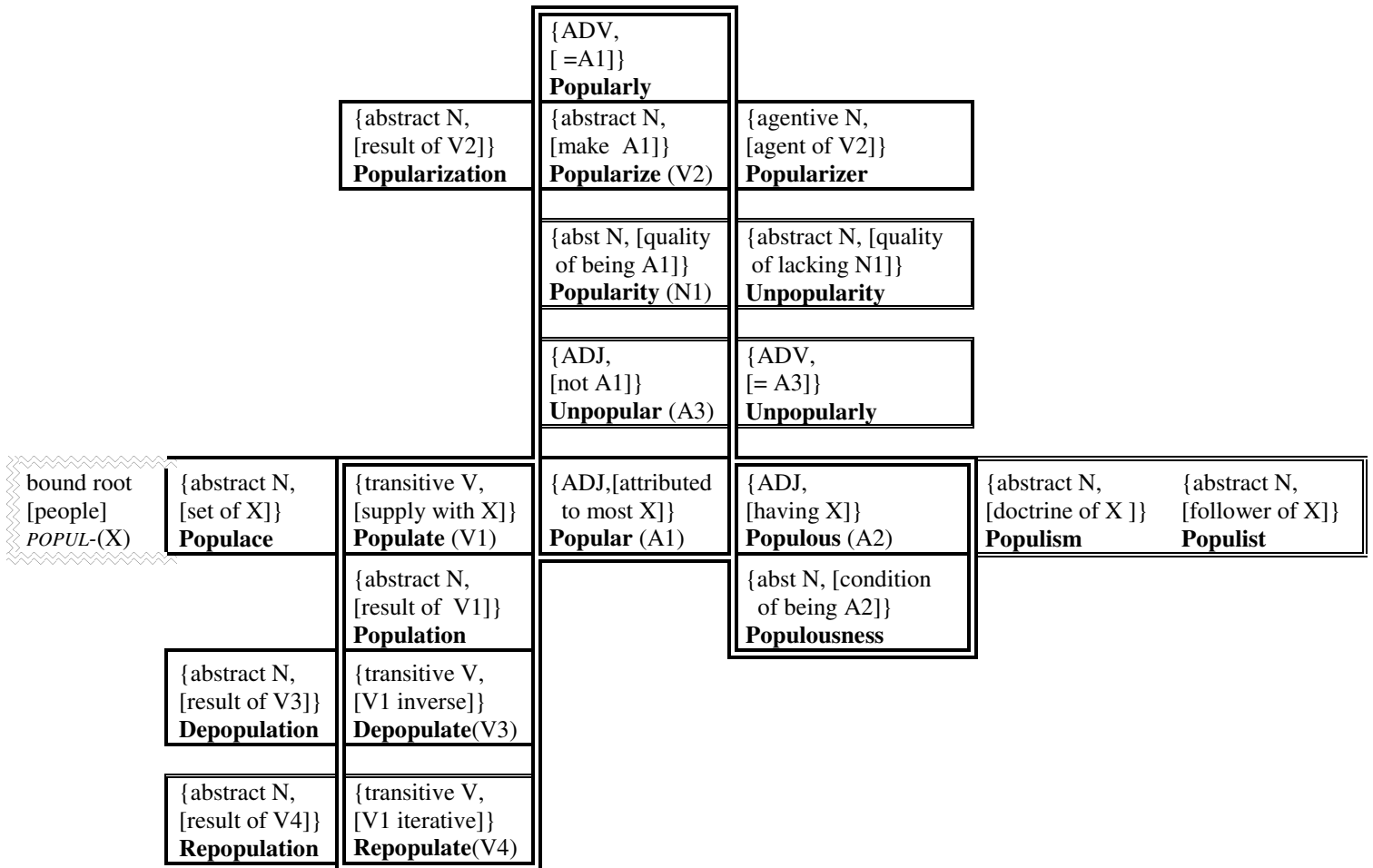


Figure (8) Example of proposed model for derivational paradigm

There is no inherent directionality represented other than what results from conditions on the base. For instance, the forms *depopulation* and *repopulation* can only occur as derivations of *depopulate* and *repopulate*, respectively, because *de-* and *re-* can only be affixed to a verbal base. Therefore, these forms cannot be derivations of the form *population*. In this sense there is an implicit directionality in that *depopulate* and *repopulate* antecede *depopulation* and *repopulation*. While not claiming this organization represents a psychological construct for speakers, the patterns abstractable among related forms are held to be linguistically significant and so part of a speaker's competence. This point bears directly on the status of *popul-* as a bound root morpheme. As discussed in §1.4, lexical meaning in WP is only associated with whole words. So *popul-* cannot lexically mean 'people', and in fact cannot be meaningfully used on its own (e.g. *\*There are too*

*many popul here.*). This does not deny speakers can and do associate *popul-* with a set of complex words all expressing individual lexical meanings related to the notion 'people'. Thus, bound roots are identifiable by virtue of systematically joining with equally identifiable affixes following regular patterns of the language.

Direct relationships between members of a single subparadigm may be categorized as *uni-dimensional*, while indirect relationships between members of different subparadigms may be categorized as *multi-dimensional*. Using these definitions the following generalization is posited:

*Paradigmatic Derivates*: Any lexeme *X* in macroparadigm  $MP_1$  is necessarily in a multi-dimensional relationship with any other lexeme *Y* in  $MP_1$  if *X* and *Y* are not members of the same subparadigm *SP* and  $X \neq Y$ .

The *Paradigmatic Derivates Generalization* (PDG) logically follows from the fact that two indirectly related lexemes by definition do not share the same stem<sup>18</sup> because they are *not* members of the same subparadigm. Thus, in figure (8), the pairs *populate~popularize*, *popular~popularization* and *populate~popularization* are just a few examples of paradigmatic derivates *per* the PDG. A precise characterization of relationships like that between Paradigmatic Derivates is unattainable in a theory lacking such requisite machinery found in the paradigm as a theoretical construct.

### 3. A GENERALIZED NOTION OF PARADIGM

#### 3.1 Overview.

Under a unified treatment of inflection and derivation, not only are the same formal operations exploited by morphological processes in both categories, arguably the same theoretical constructs are equally serviceable to both as well. The role of paradigm in morphological operations is thus independent of whether the processes involved are inflectional or derivational. Along these same lines, the convergence of several key ideas presented in this and prior sections rests on the central premise of treating inflection and derivation in a unified fashion (*cf* §1.2). On that basis, a definitive set of common features<sup>19</sup> are identified to achieve a generalized notion of paradigm

<sup>18</sup> *Stem* is not to be confused with *root* (in this case *popul-*) which all non-suppletive derivates in a paradigm share.

<sup>19</sup> some of which have been categorized by Bauer (1997)

equally well represented by a static structure for inflection (*cf* figure (2) and §1.4), or by a dynamic model for derivation (*cf* figure (8) and §2.2).

### 3.2 *Some essential characteristics of paradigms.*

Fundamentally a paradigm is a pattern. Historically the paradigm has been represented as a series of morphologically related forms sharing a base. More recently it has come to be defined rather narrowly as seen in the following definition by Carstairs (1987):

A paradigm for a part of speech N in a language L is a pattern P of inflexional realizations for all combinations of non-lexically-determined morphosyntactic properties associated with N such that some member of N exemplifies P (i.e. displays all and only the realizations in P).

This definition appears to exclude the possibility of derivational paradigm; all the same, formulating a generalized notion of paradigm begins with identifying the essential characteristics of inflectional paradigm. For expository purposes, consider Latin *monēre* ‘to warn’:

*Table (5) Partial paradigm for Latin 2<sup>nd</sup> conjugation verbs*

<u>Present tense of <i>monēre</i> ‘to warn’</u>	
1 <sup>st</sup> s. moneō	1 <sup>st</sup> p. monēmus
2 <sup>nd</sup> s. monēs	2 <sup>nd</sup> p. monētis
3 <sup>rd</sup> s. monet	3 <sup>rd</sup> p. monent

By comparing the forms in table (5), a pattern readily emerges that each consists of a common portion or stem, *mone-*, combined with one of six desinences, *-ō*, *-s*, *-t*, *-mus*, *-tis*, and *-nt*. This division into base and affix, while the most linguistically informative generalization, does not preclude a role for other potentially meaningful patterns. For instance, all but the 1<sup>st</sup> person singular have a consonant-initial affix; the affixes for all the singular forms is a single letter unlike the plural forms; both the 3<sup>rd</sup> person affixes end in */t/*, *etc.* In the restricted context of only these six forms, these additional patterns are not crucial. However, in the broader context of the entire verbal system, the likelihood of these other patterns also being informative generalizations is much greater. These forms are also semantically related by more than the meaning of the base as each represents a particular person and number concordance in the present tense, active voice and indicative mood. The morphosyntactic features realized in each form are generalizable beyond this particular verb to other members of the second conjugation such as *dēbeō*, *videō* or *valeō*. Crucially, a paradigm-

centric perspective gives prominence to the inter-relationships among forms rather than singling out any one form.

### 3.3 *The search for a single base.*

In opposition to a paradigm-centric perspective, frameworks like IA or IP give greater importance to identifying a single form from which the entire paradigm can be generated or predicted. The IA/IP notion of a morpheme as the smallest unit representing a one-to-one pairing of form and meaning (*cf* §1.4) leads to an agglutinative ideal of word formation as a process of lexical compounding. No regard is given to a form's participation in a paradigm. Each form is independently generated from its subcomponents as needed. Any generalities observable, such as the forms in table (5) sharing the same theme vowel /e/, are simply accidental and neither predicted nor explained. Principles of simplicity and economy also dictate that redundancy, if permitted in the lexicon, comes at an increased cost. Ergo, the preoccupation with establishing a 'lead' or 'base' form' to generate the entire paradigm.

This raises the question as to whether such a form exists in the Latin verbal system. Considering again table (5), an initial conclusion could be the stem *mone-* qualifies as a 'base' form<sup>20</sup>. Although this stem generates all forms in the present active indicative of the 2nd conjugation, there are a total of 4 conjugations, 6 tenses, 2 voices and 3 moods as well as participles, infinitives, and gerunds. Just looking at the 1<sup>st</sup> sg in table (6), presents an obstacle.

Table (6) Partial paradigm for Latin 1<sup>st</sup> conjugation verbs

<u>Present tense of <i>amāre</i> 'to love'</u>	
1 <sup>st</sup> s. amō	1 <sup>st</sup> p. amāmus
2 <sup>nd</sup> s. amās	2 <sup>nd</sup> p. amātis
3 <sup>rd</sup> s. amat	3 <sup>rd</sup> p. amant

Unlike the rest of the paradigm, in the 1<sup>st</sup> singular the theme vowel /a/ does not appear. This cannot be predicted by a stem like *mone-* or *ama-* which includes the theme vowel. A variety of forms are constructed from the stem without the theme vowel including the singular present imperative of the 3<sup>rd</sup> conjugation (*duc*), as well as forms of the present indicative passive of the 3<sup>rd</sup> conjugation (*dūcor . . . dūcuntur*). It could be argued that even if both versions of the stem are needed, redundancy in the lexicon is avoided as a bare stem like *dūc-* is uniformly derived by

<sup>20</sup> In Latin a bare stem (*i.e.* a form minus its desinence) never appears as a distinct word form. However, in a morpheme-based theory, a bare stem or root is a valid morpheme whether bound or unbound.

dropping the theme vowel /e/ from the listed stem *dūce-*. The shortcomings of this approach are apparent in examining perfect and future participles. Across all four regular conjugations, various compound tenses are formed using the perfect passive or future active participle. As depicted in table (7), when compared to the underlying stem (shown here as the infinitive less the *-re* suffix), the perfect participle exhibits a considerable amount of allomorphy.

Table (7) Formation of Latin perfect and future participles.

<i>Present Active Infinitive</i>	<i>Perfect Passive Participle</i> <sup>21</sup>	<i>Future Active Participle</i>	<i>Gloss</i>
laudā-re	laudāt-	laudāt-ūr-	‘praise’
monē-re	monit-	monit-ūr-	‘warn’
duce-re	duct-	duct-ūr-	‘lead’
audī-re	audīt-	audīt-ūr-	‘hear’
cape-re	capt-	capt-ūr-	‘take’
vehe-re	vect-	vect-ūr-	‘carry’
haerē-re	haes-	haes-ūr-	‘stick’
preme-re	press-	press-ūr-	‘press’
fer-re	lat-	lat-ūr-	‘bear’
loqu-ī	locut-	locut-ūr-	‘speak’
experī-rī	expert-	expert-ūr-	‘try’

Apart from uniformly ending in /t/ or /s/, the particular form of the perfect participle is not predictable from the stem with or without the theme vowel. Of course these could simply be individually listed in the lexicon as irregular forms; but doing so entirely misses an important generalization that regular formation of the future participle involves suffixing *-ūr* to the perfect participle. Regular formation of other members in the paradigm such as the supine (not shown) is also based on the perfect participle, leading Aronoff (1992) to call it the ‘third’ stem.

Thus, given these distributions in the Latin verbal paradigm system, generating all forms from a single base form does not appear to be a viable analytic option<sup>22</sup>. Separately listed forms in the lexicon, either because they are irregular or because they constitute an additional base, increase the complexity and related cost to the grammar. On this basis, an IA or IP approach would predict that only a grammar in which all forms in a paradigm can be generated from a single base is least costly and *ceteris paribus* to be more highly ranked.

### 3.4 Applying Bochner’s pattern-matching evaluation metric.

<sup>21</sup> Participles in Latin function like adjectives in further requiring person / number agreement.

<sup>22</sup> Albright (2002) argues for a Single-Surface Base Hypothesis (SSBH) yet concedes there are situations in which a single base does not suffice (*cf.* Stump, 2001; Blevins, to appear; among others).

In contrast to the IA/IP perspective on paradigm, I assume (*per* Bochner, 1993) a word-based approach in which lexical meaning is not associated with individual morphemes. Instead, lexical entries are posited to comprise either whole words or abstract patterns in various degrees of specificity. Potential redundancy of whole-word entries in the lexicon is reduced to the extent that some portion of any entry is co-extensive (*i.e.* matches) a recognized pattern or sub-pattern in the language (*cf* §2.1). Thus, the following is a recognizable pattern in Latin associated with table (5).

$$\left\{ \begin{array}{l} /X\bar{o}/ \quad /Xs/ \quad /Xt/ \quad /Xmus/ \quad /Xtis/ \quad /Xnt/ \\ \bar{V} \quad \bar{V} \quad \bar{V} \quad \bar{V} \quad \bar{V} \quad \bar{V} \\ Z \text{ 1sg} \quad Z \text{ 2sg} \quad Z \text{ 3sg} \quad Z \text{ 1pl} \quad Z \text{ 2pl} \quad Z \text{ 3pl} \end{array} \right\} \left\{ \begin{array}{l} /Xre/ \quad /mon\bar{e}re/^{23} \\ \bar{V} \quad \bar{V} \\ \text{TO Z} \quad \text{WARN} \end{array} \right\}$$

Figure (9) Bochnerian rule pattern for part of the paradigm for Latin *monēre*

Applying Bochner's pattern-matching evaluation metric (substantively described in §2.1), the complexity of *moneō* 'I warn' is calculated from determining the number of independent choices required to distinguish the form: namely, matching it to a pattern like that in figure (9), and identifying the difference. Since the form *moneō* is exactly co-extensive with a portion (*i.e.* sub-pattern) of figure (9), the affix *-ō* does *not* constitute new information (*i.e.* it is already provided by the pattern itself). Thus, the complexity value associated with any of the corresponding forms in table (5) is no greater than cost associated with the representative lexical entry *monēre* 'to warn', namely 2 (*i.e.* 1 for matching the form *monēre* to the pattern, */Xre/*, plus 1 for identifying the difference, *Z = WARN*). In this instance the result is equivalent to the complexity value computed using a morpheme-based symbol counting metric which assigns a value of 1 to each new piece of information. The cost of associating *WARN* with *mone-* plus the cost of associating *1sg* with *-ō* also yields a complexity value of 2.

Unlike with the simple form *moneō*, the IA/IP and WP approaches lead to considerably different results when applied to the data in table (7). If in the IA/IP framework the base form for the perfect participle is the stem (infinitive less *-re*) + *-t*, then only two of the listed forms (*laudāt-* and *audīt-*) could be considered regular formations. Using the symbol counting metric, these forms have an associated complexity value of 3 (stem, *-t*, and person-number affix). The other nine forms would all have to be treated as irregular forms incurring a complexity value of at least 3+ because they each have three morphemes (an irregular stem, *-t* or *-s* and a person-number affix) plus the

<sup>23</sup> By convention the present infinitive is used to represent regular forms in a paradigm but, in terms of paradigmatic relationships, the choice is arbitrary as any regular form could equally well serve the same purpose.

additional cost of positing some mechanism like a diacritic on the stem to associate the irregular stem to the regular forms. In a WP framework, on the other hand, the two regular formations would only incur a complexity value of 2 (matching to the pattern and identifying the difference). Partial pattern matching is possible with eight of the remaining forms (*i.e.* with all but *lat-*). As an example of partial pattern matching consider figure (10) depicting Latin *dūcere* ‘to lead’.

$$\left. \begin{array}{l} /Xtus/ \quad /Xtus/ \quad /Xtus/ \quad /Xtī/ \quad /Xtī/ \quad /Xtī/ \\ V \quad , \quad V \quad , \quad V \quad , \quad V \quad , \quad V \quad , \quad V \\ Z \text{ 1sg} \quad Z \text{ 2sg} \quad Z \text{ 3sg} \quad Z \text{ 1pl} \quad Z \text{ 2pl} \quad Z \text{ 3pl} \end{array} \right\} \left\{ \begin{array}{l} /duc-tum/ \quad /dūcere/ \\ V \quad , \quad V \\ \text{TO BE} \quad Z \quad \text{LEAD} \end{array} \right\}$$

Figure (10) Bochnerian rule pattern for part of the paradigm for Latin *dūcere*

As shown the six forms related to *ductum* while missing the theme vowel /e/, still partially match *dūcere*. Thus, these forms each incur a complexity value of 2+ where the portion exceeding 2 is a gradient value reflecting the degree to which the irregular participle varies from the regular forms represented by the present infinitive. The forms *lat-* and *ferre*, however, share nothing in common precluding any partial pattern matching and resulting in a complexity value of 3. This ‘worst case’ scenario under the lexical approach involves only one of the nine irregular forms in table (7) and yet is still less costly than the complexity value assigned to all nine irregular forms using the morpheme-based symbol counting metric.

In treating the formation of each word in isolation, an IA/IP approach neither recognizes nor can make use of the regularities or partial regularities defined by the inter-relationships among the forms in a paradigm. This has further theoretical implications. As observed in table (7), all perfect participle forms, both regular and irregular, have either a *-t* or an *-s* occurring between the base and person-number suffix. Morpheme-based theories equate this to being a ‘marker’ of the perfect passive on the assumption that not doing so is tantamount to claiming the *-t* or *-s* has no identifiable independent meaning at all (*i.e.* what Hockett (1947) calls an ‘empty’ morph). However, this position becomes untenable when these theories attempt to explain the future active participle, the forms of which clearly use the perfect passive as a base for additional affixation. How can a marker of the perfect participle be reconciled as part of a future active form? Are there two markers, if so to what purpose? Clearly this undermines the morpheme-based ideal of an isomorphism between form and meaning.

None of these concerns diminish a word-based lexicalist approach, in fact degrees of overlap or ‘form sharing’ is not only predicted but indispensable in a theory conferring equal status in the lexicon to whole words and the inter-relationships among them. The observed ‘parasitic’ (as Matthews (1972) describes it) formation of the future participle on the perfect participle is just one of many examples of what I suggest in natural language is a constraining process of self-exploitation. Re-using a formation or portion of it strengthens the relationship among forms and simultaneously reduces the burden imposed on speakers to both acquire and recall those forms. Another example is the future tense in French which exploits the present tense forms of the verb *avoir* ‘to have’ by affixing them to an infinitive like *finir* ‘to finish’.

Table (8) Present tense forms of French *avoir* and future tense forms of French *finir*

a. <u>Present forms of <i>avoir</i></u>		b. <u>Future forms of <i>finir</i></u>	
J’ai	Nous avons	Je finirai	Nous finirons
Tu as	Vous avez	Tu finiras	Vous finirez
Il a	Ils ont	Il finira	Ils finiront

In table (8) the future affixes exactly duplicate the corresponding forms of *avoir* in all cases except for the 1pl or 2pl and even with these forms the parallelism is not lost. As exemplified by the perfect and future participle formation in Latin, a lexicalist theory holds no preconception (or perhaps misconception) that the *-ir* morpheme of the future forms of *finir* has a specified meaning of its own, or that the various person-number affixes of these future forms have any intrinsic information content associated with the semantics of the verb *avoir*. Rather, the role and value of the paradigmatic relationships among the forms themselves in both table (7) and table (8) are explicitly recognized and put to advantageous use as measured by the pattern-matching metric available in a lexicalist framework.

### 3.5 Summarizing A GENERALIZED NOTION OF PARADIGM.

The insight behind Bochner’s pattern-matching metric is that formal associations among related word forms play a crucial role in synchronic word-formation processes. Within this ‘network of relationships’ (*i.e.* paradigm) the content of rule patterns may be highly specific while their structure remains abstract enough to be applicable to either inflectional or derivational word-formation. Thus, a notion of rule patterns provides a conceptual basis to a generalized notion of paradigm. Moreover, rule patterns may be mapped directly into the conventional (static) structure of

inflectional paradigms or the proposed (dynamic) model of derivational paradigm. To illustrate, a rule pattern for data from table (7) is first shown in figure (11) and then the relational inter-dependencies of these forms are shown using the proposed model in figure (12).

$$\left\{ \begin{array}{ccc} /Xu/ & /Xum/ & /Xurus/ \\ \text{V} & \text{V} & \text{V} \\ \text{LATTER Z} & \text{FORMER Z} & \text{ABOUT TO Z} \end{array} \right\} \left\{ \begin{array}{cc} /vect-us/ & /vehere/ \\ \text{V} & \text{V} \\ \text{TO BE Z-ED} & \text{CARRY} \end{array} \right\}$$

Figure (11) Bochnerian rule pattern for part of the paradigm for Latin *vehere*

	{supine, [former X]} <b>vectum</b>	{supine, [latter X]} <b>vectu</b>
	{future participle, [about to X]} <b>vecturus</b>	
{present inf, [to warn]} <b>vehere (X)</b>	{passive participle, [to be X-ed]} <b>vectus</b>	

Figure (12) Representing selected forms of Latin *vehere* using dynamic paradigm

The two supine forms in figures (11) and (12) were added to emphasize the need for a construct like paradigm in order to capture both *local* and *non-local* dependencies in word-formation<sup>24</sup>. The five forms in figure (12) participate in three subparadigms. The forms *vectus*, *vecturus* and *vectum* all share a common stem *vect-* and so constitute one subparadigm. Any one of these three forms could constitute another subparadigm with *vehere*, however using the passive participle reflects the arrangement of the data in table (7). Finally, the two related forms of the supine itself constitute a third subparadigm. *Per* the Paradigmatic Derivates Generalization, reference to a construct like paradigm is required to adequately account for the precise relationship between forms like *vehere* and *vectu*.

The inter-relationships among the verbal forms depicted in figure (12) exhibit the hallmarks associated with paradigm. All the categories indisputably bear a relationship to one another both formally and semantically. None of the categories can be singled out as a common base from which the others may be directly predicted. It is only through consideration of the relationships among the forms themselves that a clear pattern linking them emerges and is re-enforced by varying degrees to which a form in one category resembles that in another. Finally, the pattern established by the inter-relatedness of the forms is not confined to these examples, but generalizable to all members of the

<sup>24</sup> This is not to imply that a conventional representation of inflectional paradigm is incapable of capturing both local and non-local dependencies, nor that the proposed dynamic model is more appropriate for these inflectional forms. The only intent here is to demonstrate the plausibility of obtaining a generalized notion of paradigm.

Latin verbal system having participle and supine forms. In the next section it is shown that these definitive characteristics are equally fundamental to an adequate account of forms bearing a derivational relationship, and thus evidence that paradigm plays as crucial a role in derivational word-formation as it does in inflectional word-formation.

#### 4. SYNCHRONIC EVIDENCE FOR DERIVATIONAL PARADIGM<sup>25</sup>

##### 4.1 *Overview.*

Maiden (1992) claims paradigmatic associations amount to a “marginal junkpile” of diachronic side-effects. Far from being marginal, derivational paradigm has a central role in synchronic word-formation as evidenced by the three-pronged analysis of cross-linguistic data examined in this section. The generalized set of definitive features attributable to paradigm (*cf* §3) is shown to be applicable to derivational processes examined in English, French, Tigre and Lithuanian. A WP account of these processes is found to be less costly to the grammar (in terms of increased complexity) as evaluated under Bochner’s pattern-matching metric (*cf* §2.3). Also crucial paradigmatic generalizations are demonstrated to be adequately captured with the proposed model for derivational paradigm (*cf* §2.4). Together these investigations indicate paradigm as a theoretical construct has a key role in a unified account of word-formation.

##### 4.2 *The case of Latinate roots in English.*

A particularly notable occurrence of paradigm in derivation is found in the systematic inter-relationships among various denominal, deadjectival and deverbal forms in English sharing a common Latinate root. (*cf.* Bochner, 1993)<sup>26</sup>. A prominent pattern illustrated by the examples in table (9) is the use of derived forms as bases for further derivation. The inter-relationships holding are structurally identical to those of the Latin participles shown in table (7). Just as the Latin perfect participle is not uniformly predictable from the present infinitive, denominal adjectives or deadjectival verbs in table (9) do not all derive from corresponding nouns or

*Table (9)a* English derivates sharing a common Latin root.

Column A	Column B	Column C
	<i>Denominal</i>	<i>Deadjectival</i>

<sup>25</sup> For exemplary diachronic evidence see Booij (2002) or Fehringner (2003) on paradigm uniformity effects in derivation.

<sup>26</sup> The analysis in this section is based on the use of related examples in Bochner (1993) specifically conforming to prefix + root + *ion*, *-ive* or *-ous*.

<i>Noun</i>	<i>Adjective</i>	<i>Noun</i>
cause	causal	causality
mode	modal	modality
angle	angular	angularity
circle	circular	circularity

Table (9)b English derivates sharing a common Latin root.

Column A	Column B	Column C
<i>Adjective</i>	<i>Deadjectival Verb</i>	<i>Deverbal Noun</i>
popular	popularize	popularization
formal	formalize	formalization
*legitim(ate)	legitimize	legitimization
*(ag)grand	aggrandize	aggrandization

adjectives in the same way. For instance with *angle* and *circle* a /u/<sup>27</sup> is additionally inserted to derive *angular* and *circular*. Similarly the suffix *-ize* is added directly to adjectives *popular* or *formal* to derive *popularize* and *formalize*, but *legitimate* loses a final /ate/ in forming *legitimize* and *grand* gains an initial /ag/ in forming *aggrandize*. The non-derived nouns in (9)a and adjectives in (9)b also serve as bases for the formation of adjectives and verbs, respectively (which then serve as bases for the formation of deadjectival and deverbal nouns, respectively) just as Latin future participles or supines are regularly derived from perfect participles.

In a morpheme-based approach, forms in Column B like *legitimize* or *aggrandize* lacking a non-derived base upon which to suffix *-ize* (*\*legitim-* or *\*aggrand-*) would have to be individually listed in the lexicon as irregular forms<sup>28</sup>. Separately listing forms not having a base isomorphic to the adjective from which they derive unfoundedly limits the gross generalization that verbs ending in *-ize* form a category systematically deriving nouns ending in *-ization*. Furthermore, using a symbol-counting metric, forms in Column B would be twice as costly as corresponding non-derived forms in Column A. In contrast, by using a pattern-matching metric the cost of the forms in Column B is reduced to the extent that they partially match a corresponding non-derived noun or adjective in Column A. The systematic inter-relationships among the forms in Column B and Column C are a source of even more gains when evaluated under the pattern-matching metric. Without exception all the deadjectival nouns are formed by suffixing *-ity*, while all the deverbal nouns are formed by suffixing *-ation* to the corresponding form in Column B. Consequently, all

<sup>27</sup> pronounced [j-schwa] – the [j] indicating the schwa is reduced from /u/

<sup>28</sup> or, alternatively, a corresponding bound root (e.g. *legitim-* or *aggrand-*) would have to be individually listed

forms in Columns B and C have an equal complexity value using the pattern-matching metric.

Figure (13) abstractly represents uniform patterns of inter-relationships among forms in table (9)b.

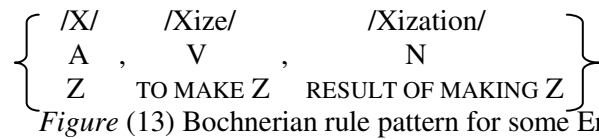


Figure (13) Bochnerian rule pattern for some English Latinate derivatives

The examples of *popular* and *formal* completely match the pattern in figure (13) while *legitim(ate)* and *(ag)grand* only partially match the pattern. Under the symbol-counting metric, the complexity value of the forms in Column C would necessarily be greater because of the additional affix required to form it. A morpheme-based analysis might alternatively posit combinations of *-al* or *-ar* with *-ity* as a single ‘complex’ affix; or *-ation* plus *-ize* as a single affix. Doing so, however, is essentially redundant (*cf* §1.3). There is no explanation other than coincidence for a ‘complex’ affix exactly matching the combination of ‘component’ affixes. There are also no occurrences in English of a word ending in *-ality*, *-arity* or *-ization*, that in removing final affix, the remaining form is *not* a valid word<sup>29</sup>. Finally, there is no reason for a ‘complex’ affix to be any more beneficial (or less costly to the grammar) than some other entirely unique affix.

Figure (14) is a portion of the derivational paradigm in figure (8) and appropriately captures regularities among the derived forms in table (9). Included are two additional items, the bound root *popul-*<sup>30</sup> and another derived form, *populate*. With these inclusions, the partial paradigm depicted consists of three subparadigms. The fact that *populate* is related to *popularization* even though they do not share the same (immediate) stem is the result of their relationship to *popular~popularize*.

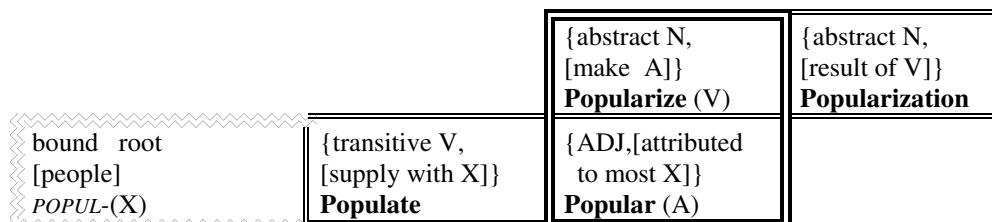


Figure (14) Partial derivational paradigm for the English bound root *popul-*

In figure (14) the pairs *popular~popularization*, *populate~popularization* and *populate~*

<sup>29</sup> While this is admittedly ‘negative’ evidence, it is persuasive nonetheless.

<sup>30</sup> As discussed in §2.4, a bound root like *popul-* has the status of a morpheme and is not equivalent to a word with a lexical entry.

*popularize* are all paradigmatic derivatives *per* the Paradigmatic Derivates Generalization (PDG). As already noted, a precise characterization of the relationship between Paradigmatic Derivates requires appeal to a theoretical construct like paradigm.

Formally and semantically the categories in table (9) all bear a relationship to one another; yet, none of the categories is a base for directly deriving the others. This lack of a common base requires recognizing and using inter-relationships among the categories themselves, and makes cross-referencing within the paradigm the only regular means to derive all forms. Finally, the inter-relationships are generalizable to any deadjectival verbs ending in *-ize* or denominal adjectives ending in *-al* or *-ar*. The essential characteristics of paradigm are crucial to an explanatorily adequate account of forms with common Latinate roots and so provide compelling evidence that paradigm has a role in the derivational word formation of English.

#### 4.3 *The case of French adverbials and the case of Tigre diminutives.*

Two striking incidences of paradigm in derivation are exemplified by several productive word-formation processes in French and Tigre. These two cases are analyzed in tandem because, in addition to providing evidence for derivational paradigm, they each illustrate a further possibility of inter-paradigmatic in contrast to intra-paradigmatic relationships. The French case involves inter-relationships among some masculine adjectives, their corresponding feminine forms and related deadjectival adverbials as shown in table (10)<sup>31</sup>.

Table (10) Derivation of French adverbials with *-ment*

a. <i>Masc. Adj.</i>	<i>Fem. Adj.</i>	<i>Adverb</i>	<i>Gloss</i>
faux	fausse	faussement	'falsely'
lent	lente	lentement	'slowly'
heureux	heureuse	heureusement	'happily'
certain	certaine	certainement	'certainly'
b. <i>Masc. Adj.</i>	<i>Fem. Adj.</i>	<i>Adverb</i>	<i>Gloss</i>
beau	belle	bellement	'beautifully'
franc	franche	franchement	'frankly'
sec	sèche	sèchement	'dryly'
vieux	vieille	vieillement	'archaically'

The French adverbs appear to derive from the feminine form of the corresponding adjective. An alternative explanation might be that the exponence realizing the property 'adverbial' is actually

<sup>31</sup> The analysis in this section is based on the use of related examples in Booij (1997).

*-ement* rather than the *-ment* with the *e* of *-ement* triggering the same stem allomorphy as found in the feminine adjectives. However this explanation is disproved by the examples in group (b) of table (10) in which the identical pattern still uniformly holds even though the differences between these feminine adjectives and the corresponding masculine forms go beyond simple stem allomorphy.

An IA/IP approach might specify a lexical entry for the morpheme *-ment* to subcategorize specifically for feminine adjectives. However, doing so would not explain the relevance of being feminine to an adverbial form. In addition, using a symbol counting metric, masculine adjectives and corresponding feminine forms are equally costly as neither is predictable from the other. By using a pattern-matching metric, in contrast, the cost to the grammar of these forms is reduced to the extent that they partially match a related each other.<sup>32</sup> The invariant relationship between feminine adjectives and related adverbs yields an equal complexity value when evaluated under the pattern-matching metric. Under the symbol counting metric, the complexity values of the adverbials would necessarily be greater because of the additional affixes required to form them.

The Tigre case, on the other hand, involves the formation of some denominal diminutives, augmentatives and perjoratives not previously described in the literature as evidence for derivational paradigm<sup>33</sup>. The inter-relationships among some Tigre singular/plural nouns and corresponding singular/plural diminutives are illustrated in table (11).

Table (11) Derivation of diminutives for some Tigre nouns<sup>34</sup>.

<i>Gloss</i>	<i>Singular</i>	<i>Plural</i>	<i>Diminutive Singular</i>	<i>Diminutive Plural</i>
'stone'	'əbən	'əbän	'əbbän-ät	'əbbän-at
'coffepot'	gəban	gäbän-otat	gäbän-ät	gäbän-etat
'paper'	wəraq	wäräq-otat	wäräq-ät	wäräq-etat
'pot'	säkänab	säkännəb	säkäneb-ät	säkäneb-at

As a Semitic language aspects of Tigre's phonology and morphology are traditionally analyzed as templatic. In each example in table (11) the various forms share the same sequence of stem consonants or radicals which form a 'template'. Vowel changes differentiate related forms and sometimes, as with the plural of 'əbən 'stone' or säkänab 'pot', exclusively so. Plurals formed by

<sup>32</sup>members of a French masculine-feminine adjective pair or Tigre singular-plural noun pair having nothing in common would necessarily be equally costly.

<sup>33</sup> to my knowledge at least.

<sup>34</sup> All Tigre data is from Palmer (1962).

stem-internal vowel changes are called ‘broken-plurals’ in contrast to plurals formed through suffixation only without other changes. Some broken-plurals also bear a suffix (*e.g.* *gābān-otat* ‘coffepots’ or *wārāq-otat* ‘papers’), a prefix, or both. Tigre has an assortment of denominal derivatives including diminutives, augmentatives and perjoratives generally derived from the corresponding singular noun; but in some cases derived from a corresponding broken-plural. Several phonological features are described as characteristic of diminutives in Palmer (1962). These include the /o/ of the plural suffix *-otat* changing to /e/ in the diminutive plural suffix *-etat*<sup>35</sup>, and the gemination of /b/ when preceded by /ə/ as in the forms derived from ‘*əbān* ‘stone’. Palmer also describes the gemination of a consonant preceding /ə/ or /i/ (*e.g.* the /n/ in *sākännəb* ‘pots’) as a phonetically long consonant that is morphologically a single radical.

The inter-relationships among forms in table (11) are structurally identical to the relationships involving Latin participles, or English forms derived from Latinate roots. Just as the Latin perfect participle is not uniformly predictable from the present infinitive in table (7), neither are these Tigre plural nouns predictable from the singular forms. The unpredictable form also serves as the base for further derivation, similar to the Latin future participle and supine which are regularly derived from corresponding (unpredictable) perfect participles.

An IA/IP approach might specify a lexical entry for a Tigre diminutive morpheme to subcategorize specifically for plural nouns. However, doing so would not explain the relevance of being plural to a diminutive form<sup>36</sup>. In addition, using a symbol counting metric, single nouns and corresponding broken-plurals, are equally costly. By using a pattern-matching metric, in contrast, the cost to the grammar of these forms is reduced to the extent that the plurals partially match a related singular noun.<sup>37</sup> The invariant relationship between Tigre plural nouns and related derivatives, results in an equal complexity value when evaluated under the pattern-matching metric. Under the symbol counting metric, the complexity values of diminutives would necessarily be greater because of the additional affixes required.

---

<sup>35</sup> Differentiating these diminutive plurals from the corresponding regular plurals may have conditioned this change, a possibility Palmer does not discuss.

<sup>36</sup> without compelling evidence that the feminine form is least marked in French or plurals least marked in Tigre

<sup>37</sup> members of a French masculine-feminine adjective pair or Tigre singular-plural noun pair having nothing in common would necessarily be equally costly.

As shown in figures (15) and (16), the proposed model for derivational paradigm adequately captures the regularities among derivates of French feminine adjectives like *vieille* as well as Tigre plural nouns like *wäräqotat*. Included in figure (15) are two additional terms, *vieilliot* and *vieillotte* which are also derived from *vieille*. With the addition of these terms, the paradigms for the French and Tigre examples consist of three different subparadigms each.

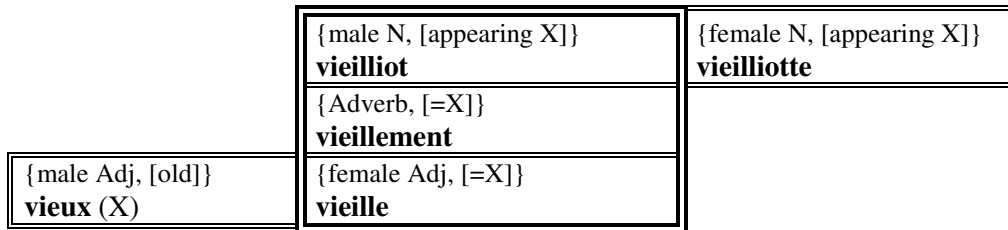


Figure (15) Partial derivational paradigm for French adjective *vieille*.

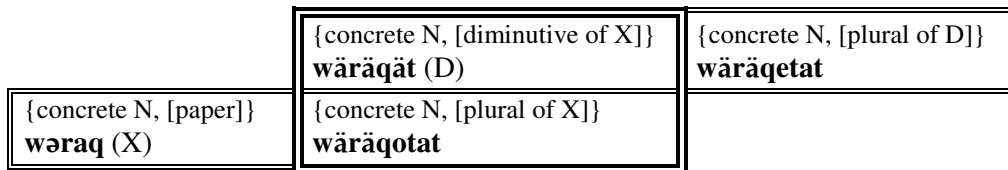


Figure (16) Partial derivational paradigm for Tigre noun *wäräqotat*.

Within the macroparadigm for *vieille*, the pairs *vieux~vieillement*, *vieux~vieilliot* and *vieille~vieillotte* are paradigmatic derivates *per* the Paradigmatic Derivate Generalization (PDG). Similarly within the macro-paradigm for *wäräqotat*, the pairs *wəraq~wäräqät*, *wäräqotat~wäräqetat* and *wəraq~wäräqetat* are also paradigmatic derivates. As previously noted, a precise characterization of paradigmatic derivates is only attainable in a theory having something like paradigm as a theoretical construct.

The relationships among the forms depicted in figures (15) and (16) also bear directly on inflection and derivation forming a continuum (*cf* §1.2). The French forms *vieux* and *vieille* are arguably part of a nominal inflectional paradigm as the mandatory assignment of gender implies that it is an inflectional property in French. Since number is generally considered an inflectional property as well, the Tigre forms *wəraq* and *wäräqotat* are also arguably part of an inflectional paradigm. In contrast, Tigre diminutives are justifiably derivational because they involve a change in lexical meaning and are not sensitive to the syntax (*i.e.* a diminutive maybe used syntactically

anywhere any other noun may be used)<sup>38</sup>. Effectively then the partial paradigms in figure (15) and (16) represent the intersection of inflectional and derivational paradigm. The Paradigmatic Derivate Generalization holding across this intersection illustrates how a given form like *vieille* or *wäräqotat* may simultaneously participate in both inflectional and derivational paradigm leading to *inter-paradigmatic* dependencies in the grammar in addition to *intra-paradigmatic* ones.

As shown, while the forms in tables (10) and (11) are formally and semantically related to each other, no one form serves as a common base to directly derive the others. Hence, recognizing and using inter-relationships among members in the paradigm is the only regular means of deriving all the forms. The generalizability of regularities among the forms to other deadjectival adverbs in French, or denominal derivatives in Tigre, is especially characteristic of paradigm. Thus, the role of paradigm in the derivational word-formation of French and Tigre is convincingly demonstrated in these processes displaying all the definitive traits attributable to paradigm.

#### 4.4 *The Case of Lithuanian reflexivization.*

In Lithuanian two regular word-formation processes, reflexivization and prefixation, interact in a particularly intriguing occurrence of paradigm in derivation, not previously described in the literature.<sup>39</sup> The examples in table (12) illustrate the inter-relationships among four categories. In Lithuanian grammars verbs are classified as either *simple*, without a prefix, or *compound*, with a prefix. Forming compound verbs via prefixation is very prevalent. While most prefixes add a locative or directional element (*e.g.* *at-* ‘to’, *į-* ‘in’, *nu-* ‘away’, *per-* ‘across’ or *už-* ‘up’), some like *pa-* denote completion, duration or intensity of an action, and others like *pra-* form inchoatives. In addition, because the negative particle *ne-* is always used as a prefix, all verbs become compound verbs in their negative forms. The process of verbal reflexivization involves the affixation of the reflexive particle *si* or its allomorph *s*, which only appears word-finally. The reflexive marker systematically appears as a suffix with simple verbs. However, with compound verbs, it is an infix between the prefix and verb. In many cases the effect on the semantics is the expected sense of the action being directed back upon the subject. Some verbs via reflexivization have their meaning altered in other ways (*e.g.* *tikėti* ‘to believe’ when reflexivized becomes *tikėtis* ‘to expect’). Whether

---

<sup>38</sup> Deriving diminutives from plural forms also refutes the claim that inflection does not feed derivation.

<sup>39</sup> to my knowledge at least.

or not reflexivization alters the semantics, the process is also productively involved in the formation of reflexive active participles, half-participles and gerunds, many of which undergo further inflection for gender and case (*e.g.* infinitive *ne-si-tikėti* ‘not to expect’ ~ masc. nom. *ne-si-tikėsias* ‘which will not expect’ ~ fem. nom. *ne-si-tikėsianti* ‘which will not expect’). If incorporation of the *-si-* marker were inflectional, the resulting form would not be expected to undergo further

Table (12) Derivation of Lithuanian prefixed and reflexive verbs<sup>40</sup>.

<i>Verb (unprefixed)</i>	<i>Reflexive (unprefixed)</i>	<i>Prefixed Verb</i>	<i>Reflexive of Prefixed Verb</i>
kėlti ‘to raise’	kėltis ‘to get (oneself) up’	atkėlti ‘to move’	atsikėlti ‘to move oneself’
statyti ‘to build’	statytis ‘to build for oneself’	pastatyti ‘to set’	pasistatyti ‘to set for oneself’
gelbėti ‘to rescue’	gelbėtis ‘to save oneself’	pagelbėti ‘to help’	pasigelbėti ‘to help oneself’
reñgti ‘to prepare’	reñgtis ‘to prepare for oneself’	apreñgti ‘to dress’	apsireñgti ‘to get (oneself) dressed’

inflection. Thus, there are compelling arguments for classifying Lithuanian reflexives as derivational. The single marker *si* is used for any person-number antecedent combination as a suffix or an infix.

To account for the distribution of the Lithuanian reflexive marker, a morpheme-based framework would first need to distinguish between simple and compound verbs. This essentially amounts to having access to the derivational history of a complex form. Presuming the *-si-* variant of the reflexive marker specifically subcategorizes for a prefixed verb, infixing the marker could not possibly apply *prior* to the prefixation process creating the ‘target’ compound verb. A subsequent process infixing *-si-* would then be ‘looking into’ the internal structure created by the prior prefixation process – a violation of the Adjacency Condition (Siegel, 1977; Allen, 1978)<sup>41</sup>. One alternative is to have a diacritic ‘earmark’ the output of the prefixation process. However, even if such a mechanism were justified, correctly infixing the reflexive marker between the prefix and verb requires determining where the prefix ends and the verb begins (*i.e.* effectively ‘undoing’ the prefixation process producing the compound verb). A final alternative is to have every prefixed verb

<sup>40</sup> All Lithuanian data is from Ambrazas (1997).

<sup>41</sup> Access to internal structure is also precluded by bracket erasure in Lexical Phonology (Kiparsky, 1982).

separately listed in the lexicon. This not only fails to account for an obvious generalization, but is unavoidably redundant. Since the negative particle is a prefix, every negative form of every verb would have to be individually listed as well!

A word-based lexicalist framework has no need to resort to dubious diacritics or anti-prefix operations to account for the intricate distribution of the reflexive morpheme *si*. Its distribution is entirely and aptly captured by the uniform pattern of inter-relationships among the forms abstractly represented as in figure (17) (where P stands for prefix).

$$\left. \begin{array}{cccc} /Xti/ & /Xtis/ & /PXti/ & /PsiXti/ \\ V & V & V & V \\ \text{TO Z} & \text{TO Z ONESELF} & \text{TO PZ} & \text{TO PZ ONESELF} \end{array} \right\}$$

Figure (17)a Bochnerian rule pattern for deriving Lithuanian reflexive verbs

$$\left. \begin{array}{cccc} /neXti/ & /nesiXti/ & /nePXti/ & /nePsiXti/ \\ V & V & V & V \\ \text{TO NOT Z} & \text{TO NOT Z ONESELF} & \text{TO NOT PZ} & \text{TO NOT PZ ONESELF} \end{array} \right\}$$

Figure (17)b Bochnerian rule pattern for the negative formation of Lithuanian verbs

As these patterns are completely productive<sup>42</sup> and exceptionless, with a pattern-matching metric any verb matching one part of these patterns has the same complexity value as a verb matching any other part. With a symbol-counting metric the complexity value of a reflexive prefixed form having three morphemes is not be equal to that of a non-reflexive prefixed form having only two morphemes. For all parts of the pattern to receive the same complexity value in a morpheme-based theory, the combination of a prefix and reflexive marker (*e.g. atsi-*, *pasi-*, or *apsi-*) must be considered a single (complex) affix. As noted with English derivates sharing a Latinate root, positing ‘complex’ affixes is essentially redundant. Other than coincidence, there is no explanation for a ‘complex’ affix exactly matching the combination of component affixes; nor any reason for it to be more beneficial than some unique affix. Lastly, because the Lithuanian negative particle *ne-* is prefixed to all verbs, combinations like *nesi-* or *nepasi-* would also be single affixes – missing a generalization that *ne-* in the negative verb *negelbėti* ‘to not rescue’ is the same as *ne-* in *nepasigelbėti* ‘to not help oneself’.

<sup>42</sup> This is not to say that all verbs *must* have a reflexive variant, a prefixed variant and/or a reflexive prefixed variant although some may. All verbs and related variants do however have corresponding negative formations.

As shown in figure (18), the proposed model for derivational paradigm adequately captures regularities among the derivates of unprefixated verbs. The paradigm depicted for the lexeme *kélti* consists of three subparadigms. Within the macroparadigm for *kélti*, the pairs *kélti~atsikélti*,

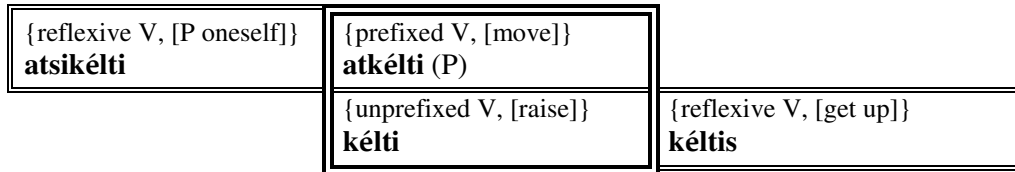


Figure (18) Partial derivational paradigm for Lithuanian verb *kélti*.

*kéltis~atkélti* and *kéltis~atsikélti* are paradigmatic derivates *per* the Paradigmatic Derivate Generalization (PDG). A precise characterization of paradigmatic derivates requires a theory having something like paradigm as a theoretical construct.

As seen in the previous cases of derivational word-formation in this section, Lithuanian verbs derived by reflexivization exhibit several hallmarks of paradigm. Each category in table (12) formally and semantically bears a relationship to the others, yet it is impossible to single out one of them as a common base to directly derive the others. Recognizing and using the inter-relationships among the categories is necessitated by the lack of a common base and makes cross-referencing within the paradigm the only regular means of deriving all the forms. Finally, the inter-relatedness of these forms can be generalized to not only all Lithuanian verbs but also to a large number of derived participle formations as well. All the characteristic elements of paradigm are needed to achieve an explanatorily adequate account of Lithuanian reflexive verbs and provides conclusive evidence that paradigm has a crucial role in the derivational word-formation of Lithuanian.

## 5. IMPLEMENTING A FORMALIZATION FOR DERIVATIONAL PARADIGM.

### 5.1 *Paradigm Function Morphology*.

In the volume *Inflectional Morphology* (2001) Stump develops in explicit detail a formal framework for analyzing word structure referred to as Paradigm Function Morphology (PFM). This framework embodies a theory of inflection reflecting a central insight that paradigm has an essential role in the word-formation system of a language. In PFM realization rules serve as clauses in the definition of an overarching construct called the Paradigm Function (PF). The versatility of the PF permits a wide variety of generalizations about inflectional forms to be adequately captured. In this section I

show that PFM is equally suitable for formalizing the dynamic model of derivational paradigm proposed in §2.2.

Lithuanian derived reflexives (*cf* §4.4) are used in this demonstration to show how the proposed model for derivational paradigm might be implemented using PFM. The facts regarding this data are arguably more of a challenge than the other languages investigated. Thus by successfully accounting for Lithuanian reflexives, it is likely that data in the other languages can be equally well addressed. Before presenting the proposed paradigm function definition, several premises need to be disclosed. Firstly, I posit non-reflexive, unprefixing verb forms in Lithuanian to be more basic (*i.e.* least marked). Secondly, both reflexivization by suffixing ‘-s’ to unprefixing verbs, and derivation by prefixing a basic verb form are posited to be less marked morphotactic processes. Thirdly, reflexivizing a prefixed verb by affixing ‘-si-’ between the prefix and basic verb form is posited to be a more marked morphotactic process in Lithuanian. With these premises established, the statement of paradigm function is as follows:

### 5.2 Statement of Paradigm Function.

1. Where  $s$  is a complete set of lexicosemantic properties for derivatives of category  $V_{PRE}$ ,

$$PF(\langle X, s \rangle) =_{\text{def}} \text{Nar}_{III} (\text{Nar}_{II} (\text{Nar}_{I} (\langle X, s \rangle)))$$

[Applied to reflexives and derivatives of Lithuanian *rengti* ‘to prepare’ ~ *aprengti* ‘to dress’]

$$2. \text{ a. } PF(\langle \text{rengti}, \{\text{refl}\} \rangle) = \text{RR}_{II:i} (\text{RR}_{I:iii} (\langle \text{rengti}, \{\text{refl}\} \rangle)) = \langle \text{rengtis}, \{\text{refl}\} \rangle$$

$$\text{ b. } PF(\langle \text{rengti}, \{\text{deriv}\} \rangle) = \text{RR}_{III:i} (\text{RR}_{II} (\text{RR}_{I:iii} (\langle \text{rengti}, \{\text{deriv}\} \rangle))) = \langle \text{aprengti}, \{\text{deriv}\} \rangle$$

$$\text{ c. } PF(\langle \text{rengti}, \{\text{refl}, \text{deriv}\} \rangle) = \text{RR}_{III:i} (\text{RR}_{I:ii} (\langle \text{rengti}, \{\text{refl}, \text{deriv}\} \rangle)) = \langle \text{apsirengti}, \{\text{refl}, \text{deriv}\} \rangle$$

$$\text{Block I: i. } \text{RR}_{[III, II], \{\text{refl}, \text{deriv}\}, V} (\langle X, s \rangle) =_{\text{def}} \langle \text{si}X, s \rangle$$

ii. Where  $s$  is a complete extension of  $\{\text{refl}, \text{deriv}: t\}$ ,

$$\text{RR}_{III, \{\}, V} (\langle X, s \rangle) =_{\text{def}} \langle Y, s \rangle, \text{ where } \text{Nar}_{III} (\langle X, t \rangle) = \langle Y, t \rangle$$

$$\text{(FCD) iii. } \text{RR}_{[III, II], \{\}, U} (\langle X, s \rangle) =_{\text{def}} \text{Nar}_{III} (\text{Nar}_{II} (\langle X, s \rangle))$$

$$\text{Block II: i. } \text{RR}_{II, \{\text{refl}\}, V} (\langle X, s \rangle) =_{\text{def}} \langle Xs, s \rangle$$

$$\text{Block III: i. } \text{RR}_{III, \{\text{deriv}\}, V} (\langle X, s \rangle) =_{\text{def}} \langle \text{ap}X, s \rangle$$

### 5.3 Explanation.

Part 1: defines the general paradigm function (PF) for the realization of derivatives of  $V_{pre}$  (*i.e.* verbs capable of being prefixed). Lexicosemantic properties are any well-formed set of properties associated with a cell in the derivational paradigm for a lexeme. The definition of the PF itself equates realization of a word form to the successive application of realization rules to a stem-property set pairing. Successive application is ordered from most to least narrow (*i.e.* Nar).

Part 2: defines three specific instantiations of the general PF.

2a) realizes the reflexive of an unprefixed verb

2b) realizes a prefixed verb (without reflexivization)

2c) realizes a reflexivized prefixed verb

Each of these specific PF's specifies the required ordering (from most to least narrow) of the available rule blocks according to what is needed to realize the particular form. The three rule blocks group the relevant realization rules into fixed combinations. In this example two of the rule blocks contain only one realizational rule each.

Rule Block I has three rules (which are successively invoked):

- i) realizes *si* as prefixed to the stem if the properties are 'reflexive' and 'prefixed' (*i.e.* 'deriv')
- ii) a 'rule of referral' that invokes rule block III if the properties are 'reflexive' and 'prefixed'
- iii) functional composition default which simply realizes the same form as is the argument of its function and redirects the output to the other rule blocks

Rule Block II suffixes the exponence *-s* to the stem if the associated property is 'reflexive' (only)

Rule Block III prefixes a particular morpheme if the associated property is 'prefixed' (only).

#### 5.4 Execution.

I) If the stem is associated with the single property 'reflexive':

In Rule Block I only the third rule applies (functional composition default).

In Rule Block II the only rule applies and the form realized is the stem with *-s* suffixed.

In Rule Block III no rule applies.

II) If the stem is associated with the single property 'prefixed':

In Rule Block I only the third rule applies (functional composition default).

In Rule Block II no rule applies.

In Rule Block III the only rule applies and the form realized is the stem with prefix.

III) If the stem is associated with both the properties ‘reflexive’ and ‘prefixed’:

In Rule Block I the first rule applies and (initial) form realized is the stem with *si* prefixed.

In Rule Block I the second rule of referral applies invoking rule block III.

In Rule Block III the only rule applies and the (final) form realized is the stem (already prefixed with *si*) with the prefix added.

### 5.5 Comments.

In this approach the less marked realizations are handled by Rule Blocks II and III. However, the execution of Blocks II and III is ‘prevented’ by a novel application of the usual portmanteau rule contained in rule i) of Block I only if the properties realized are both ‘reflexive’ and ‘derivative’. In this case the affix ‘-si-’ is prefixed first, then via a regular rule of referral in rule ii) of Block I, the derivative prefix is adjoined to the ‘*si-V*’ combination. Rule iii) of Block I, the Functional Composition Default, is invoked only when the properties being realized are either ‘reflexive’ alone or ‘derivative’ alone. The property ‘reflexive’ or ‘derivative’ then invokes execution of Rule Block II or Rule Block III, respectively. The net effect is one of disjunctive ordering in which realization of a more highly specified form pre-empts that of a more general form *per* the Elsewhere Condition.

### 5.2 Non-paradigmatic alternatives.

The formal implementation of my proposed model given in the previous section §5.1 is contingent upon my central claim that a generalized notion of paradigm is applicable to derivational as well as inflectional word formation. A paradigm-centric view maintains that aspects of word formation are crucially dependent on relationships holding between words; that is, the derivation of some complex words (*i.e.* polymorphemic forms) is not predictable from their constituent elements in isolation. As seen across the languages examined, this can arise when two related forms do not share a common base (*e.g.* *vehere~vectu*); when two forms are related and there is no (surface) base for one or both (*e.g.* *ligitimate~ligitimize, \*ligitim*); or when the base for one form is itself derived from some other related form (*e.g.* *beau~bellement* from *belle*). The point of these examples is not the mechanics (*i.e.* morphotactics) of ‘assembling’ the words, rather it’s the recognition that the constituent parts are not arbitrary but in fact regular and predictable when given the context of their relationships to other words with which they are derived as well as unrelated words sharing the same pattern of relationships. Paradigm provides, or in a sense *is*, the needed context. Omitting paradigm leaves the

formation of such words as idiosyncratic and dismisses obvious generalizations. A framework for implementing a paradigm-centric model must provide a mechanism for relating forms such as rules which can ‘refer’ the form of one word to that of another. Paradigm Function Morphology has such a mechanism, while non-paradigmatic alternatives like Finite State Morphology do not.

In the volume *Finite State Morphology* (2003) Beesley and Karttunen provide an implementational guide to finite-state theory for the creation of computer-based morphological analyzers, generators and tokenizers. The explicit assumption is that both word-formation rules and morpho-phonological alternation rules can be modeled as finite-state machines. All lexical tokens (*i.e.* words) are represented as regular expressions compiled into transducers that map underlying representations directly to a surface forms. Beesley and Karttunen claim that unless a WFR requires recursion, any process of word formation in natural language is translatable into a regular expression. The ability to represent natural language morphotactics as regular expressions is not disputed. The deficiency is that inter-relationships among words is captured only to the extent that various forms of a word are constructed from a common base. Should a particular form of a lexeme derive from a different base it is treated as an unrelated word. The form can be produced but its association with other words with which it is related must be separately stipulated. This perhaps achieves generative adequacy but little explanatory adequacy.

In a separate article, Karttunen (2004) claims that referral rules can be implemented as regular expressions (and questions why anyone would want to do it). However, the example given only shows how a particular affix can be ‘stored’ as a regular expression and then used (*i.e.* referred to) by any number of other regular expressions in forming words. This completely misses the point. The regular expressions ‘referring’ to the stored affix are still forming words in isolation of one another. There is no sense in which the relationships among words, particularly if they don’t have a common base, are represented. Realizing syncretic forms is a common use for a rule of referral, but there are a number of other uses (as I showed in §5.2) for these rules that cannot be imitated by ‘storing’ an affix. An explanatorily adequate theory of word formation cannot dismiss patterns of relationships among derived words as simply coincidence.

## 6. CONCLUSION.

The extent to which inter-relationships among derived words constitute a derivational paradigm was investigated. A more comprehensive and precise characterization of derivational paradigm was

achieved through a unified treatment of inflection and derivation. In an effort to make a generalized notion of paradigm somewhat less abstract, a dynamic model was proposed for representing the role of derivational paradigm in synchronic word formation. The proposed model adequately captures local versus non-local derivational associations as identified via what I refer to as the Paradigmatic Derivate Generalization (PDG). Also, using a novel adaptation of PFM (Stump, 2001), the suitability of the model for implementation using WFR was demonstrated through an analysis of a fragment of Lithuanian data. Both the model and a generalized notion of paradigm developed from the rule-patterns of Bochner (1993), were applied a variety of derivational processes in English, French, Tigre and Lithuanian to identify and analyze the paradigmatic relationships upon which word formation in these languages is dependent.

In each case word formation was found to be crucially dependent on the relationships holding between words and cross-referencing within the paradigm was the only regular means of deriving all the related forms. Repeatedly across the languages examined, this occurs when two related forms do not share a common base; or when two forms are related and there is no (surface) base for one or both; or when the base for one form is itself derived from some other related form. This evidence provides a compelling argument for appealing to paradigm in providing an adequate account of derivational word formation in these languages. In conclusion, while inflectional and derivational paradigms are not parallel in function and may differ in their range of applicability, they do share many of the same characteristics. The results of this investigation indicate that generalizing paradigm as a theoretical construct to derivational word formation is supported by cross-linguistic evidence.

These results are another step towards establishing a clearer understanding of the role morphology plays as a grammatical module. Some further reaching implications include gaining a foothold into working out a general coherence within the domain of morphology. A comprehensive notion of paradigm encompassing both inflectional and derivational word formation provides a basis for establishing unified principles and/or modes of operation to account for similarities in mechanisms of affixation, reduplication, *etc.* Furthermore, recognizing paradigm as being applicable to both inflectional and derivational morphology is a firm claim against the Split Morphology Hypothesis (Perlmutter 1988) and by the same token an equally firm claim in favor of the Strong Lexicalist Hypothesis. Finally, there are some potentially interesting psycholinguistic

correlations between paradigm functionality and cognitive abilities related to language acquisition and use.

## BIBLIOGRAPHY

- Albright, A. (2002) "The identification of bases in morphological paradigms." PhD Dissertation, UCLA.
- Allen, (1978) "Morphological investigations." PhD Dissertation, University of Connecticut.
- Ambrazas, V., ed. (1997) *Lithuanian Grammar*. Baltos Lankos: Lithuania.
- Anderson, S.R. (1992) *A-morphous Morphology*. Cambridge University Press, Cambridge.
- Aronoff, M. (1992) "Stems In Latin Verbal Morphology." In M. Aronoff, ed. *Morphology Now*. SUNY Press, New York.
- (1994) *Morphology by Itself*. MIT Press, Cambridge.
- Bauer, L. (1997) "Derivational paradigms." In *Yearbook of Morphology 1996*: 243-256.
- (2001) "What you can do with derivational morphology." In *Selected Papers from the 9<sup>th</sup> Morphological Meeting, Vienna, 24-28 February 2000*. pp. 37-48.
- Beard, R. (1986) *On the Separation of Derivation from Morphology*. Indiana Univ. Linguistics Club, Bloomington.
- Beesley, K.R. and Lauri Karttunen. (2003) *Finite State Morphology*. CSLI Publications, Stanford.
- Blevins, J.P. (1995) "Syncretism and paradigmatic opposition." In *Linguistics and Philosophy* 18:113-52.
- (2001) "Paradigmatic derivation." In *Transactions of the Philological Society* 99/2: 211-222.
- Bochner, H. (1993) *Simplicity in Generative Morphology*. Mouton de Gruyter, New York.
- Booij, G.E. (1993) "Against Split Morphology." In *Yearbook of Morphology 1993*: 27-50.
- (1996) "Inherent versus contextual inflection and the Split Morphology Hypothesis," In *Yearbook of Morphology 1995*:1-16.
- (1997) "Autonomous morphology and paradigmatic relations." *Yearbook of Morphology 1996*: 35-54
- (1997b) "Allomorphy and the autonomy of morphology," *Folia Linguistica*, 31:25-56.
- (2002) *The Morphology of Dutch*. Oxford University Press, Oxford.
- Bybee, J. (1985) *Morphology*. John Benjamins, Amsterdam.
- Carstairs, A. (1983) "Paradigm Economy." In *Journal of Linguistics* 19:
- (1987) *Allomorphy in Inflexion*. Croom Helm, London.
- Carstairs-McCarthy, A. (1991) "Inflection classes: Two questions with one answer." In F. Plank, ed. *Paradigms: The Economy of Inflection*. Berlin: de Gruyter. pp. 213-253.
- Fehringer, C. (2003) "Morphological 'gangs': constraints on paradigmatic relations in analogical change." In *Yearbook of Morphology 2003*: 249-272.
- Hockett, C. (1947) "Problems of Morphemic Analysis." In *Language* 23: 321-43.
- (1954) "Two models of Grammatical Description" In *Word*, 10:210-231.
- Hoeksema, J. (1992) "Categorial Morphology and the valency of Nouns." In M. Aronoff, ed. *Morphology Now*. SUNY Press, New York.
- Jackendoff, R. (1975) "Morphological and semantic regularities in the lexicon." In *Language*, 51: 639-671.

- Karttunen, L. (2004) "Computing with realizational morphology." *Lecture Notes in Computer Science*.
- Kiparsky, P. (1982) "Lexical morphology and phonology." In I.-S. Yang (ed.) *Linguistics in the Morning Calm*. Hanshin: Seoul, 3-91.
- Maiden, R. (1992) "Irregularity as a determinant of morphological change." *Journal of Linguistics*, 28:285-312
- Matthews, P.H. (1972) *Inflectional Morphology: A Theoretical Study Based on Aspects of Latin Verb Conjugation*. Cambridge University Press, Cambridge.
- (1991) *Morphology*. Cambridge University Press, Cambridge.
- Palmer, F.R. (1962) *The Morphology of the Tigre Noun*. Oxford University Press, London.
- Perlmutter, D. (1988) "The Split Morphology Hypothesis." In M. Hammond and M. Noonan, eds., *Theoretical Morphology*, 79-100. Academic Press, San Diego.
- Pewtress, H.H. and T. Gerikas, eds. *Marlborough's English-Lithuanian and Lithuanian-English Dictionary*. E. Marlborough & Co. Ltd., London.
- Plank, F. (1986) "Paradigm size, morphological typology and universal economy." In *Folia Linguistica* 20: 29-48.
- (1994) "What agrees with what in what, generally speaking?" In *EUROTYP Working Papers VII/23*: 39-58.
- Pounder, A. (2000) *Processes and Paradigms in Word-Formation Morphology*. Mouton de Gruyter, Berlin
- Robins. R.H. (1959) "In defense of WP" In *Transactions of the Philological Society*. 116-44.
- Scalise, S. (1988) "Inflection and derivation." In *Linguistics* 26/4: 561-583.
- Siegel, D. (1977) "The adjacency condition and the theory of morphology." In *NELS* 8: 189-97.
- Spencer, A. (*to appear*) "Generalized Paradigm Function Morphology." manuscript, University of Essex.
- (*to appear*) "Towards a typology of mixed categories." manuscript, University of Essex.
- Stump, G.T. (1992) "The adjacency condition and the formation of diminutives in Mwera and Kikuyu." In *Proceedings of 18<sup>th</sup> Annual Meeting of the Berkeley Linguistics Society*. pp. 441-452.
- (2001) *Inflectional Morphology*. Cambridge University Press, Cambridge.
- van Marle, J. (1984) *On the Paradigmatic Dimension of Morphological Creativity*. Dordrecht: Foris.
- Wheelock, F.M. (1963) *Latin: An Introductory Course Based on Ancient Authors*. Harper & Row, New York.