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Foreword

We are pleased to present Volume 8 of the *Working Papers of the Linguistics Circle of the University of Victoria (WPLC)*. The articles appearing in this issue represent current research on language and linguistics at the University of Victoria.

It is the editorial policy of WPLC to include an even representation of work by graduate students and established scholars. We also have a commitment to an interdisciplinary approach to language issues. As an extension of that commitment, this year's journal is printed on 100% recycled paper. This change to unbleached paper is an expression of the growing awareness and response to crucial environmental issues by the academic community.

WPLC is published annually in the Fall with the support of the Department of Linguistics. We are particularly indebted to the University of Victoria's Alumni Association who have granted our *Working Papers* financial support this year. The strength of the University's research capacity is enhanced by the participation of all members of the University community, past and present. We are pleased to acknowledge this collegial support by proudly displaying the Alumni Association logo on the inside cover of the publication.

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STEM VARIATION IN MODERN SINHALA VERB MORPHOLOGY

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1. INTRODUCTION

Like many other modern Indo-European languages, modern Sinhala shows the loss of its inflections that were inherited from the ancestral languages. For example, the VP in modern Sinhala does not agree with its subject NP for person and number as it did in old Sinhala. However, each verb in modern Sinhala shows a large number of stem variations which are the residue of earlier inflectional processes. The most significant instance of stem variation is found in a verb's division into four categories which are named- Active (A), Processive (P), Active Causative (AC) and Processive Causative (PC)[1] in this paper. This paper argues within the framework of Lieber (1981), that the stem variation in modern Sinhala verbal system is a lexical process.

2. PRELIMINARIES

The verb root /bala/ "to see" in modern Sinhala has the following Present, Past and Future inflectional paradigms for each of the four categories.

2.1

	Present	Past	Future
A	balənə	bæluwə	balaawi
P	bælenə	bælunə	bæleewi
AC	baləwənə	bælewuwə	baləwaawi
PC	bæləwenə	bæləwunə	bæləweewi

There are also the following nominal derivations which are again related to the same verb root /bala/.

2.2

Active	Processive	Act. Causative	Proc. Causative
bæliim	bælum	bæləwiim	bæləwum

2.3

Nominals thus derived take part in compounds as follows:

(1)	bæl-um	+	gal	>	bælumgal	/bala/
	seeing		rock		watch tower	
(2)	kiyəw-iim	+	saala	>	kiyəwiimsaala	/kiyawa/
	reading		hall		reading hall	
(3)	wæw-ili	+	karmaantə	>	wæwilikarmaantə	/wawa/

plantation	industry	plantation industry

3. THEORETICAL BACKGROUND

According to Lieber's (1981) framework, the lexicon consists of three subcomponents:

1. Permanent Lexicon which contains lexical entries, morpholexical rules and redundancy relations
2. Lexical Structure subcomponent consisting of binary branching unlabelled trees and general node labelling conventions.
3. String Dependent rule component with productive morphological rules sensitive to the segmental nature of the string on which they operate. (Lieber, 1981:33)

The next important mechanism within this framework is the application of the general node labelling conventions. This takes place in the Lexical Structure subcomponent according to the following Feature Percolation Conventions:

1. Convention I: All features of a stem morpheme including category features percolate to the first non-branching node dominating that morpheme.
2. Convention II: All features of an affix morpheme including category features percolate to the first branching node dominating that morpheme.
3. Convention III: If a branching node fails to obtain features by Convention II, features from the next lowest lablled node are automatically percolated up to the unlabelled branching node. (Lieber, 1981:49-50)

4. ANALYSIS

In analyzing the stem variations in the modern Sinhala verbal system, this paper assumes that a verb form has three parts **Root + Affix$_1$ + Affix$_2$.** For example, the present tense form of the Active verb consists of the three parts- bala + a + na in its underlying form. (Note that /a/ and /æ/ in open syllables except the initial are reduced to ə in the surface forms). It is argued that Affix$_1$ conditions the four way division of a verb root. In other words, a verb root undergoes a Stem Building process which results in four stem shapes for each verb in modern Sinhala. For example, the verb root /bala/ has the following four stem shapes in the surface form.

4.1

A= balə
P= bæle
AC= baləwə
PC= bæləwe

The difference among these four stem shapes can be captured by two binary value features [+/-Agent] and [+/-Volitive] in the following combinations: **[+agent],[+volit]; [+agent],[-volit]; [-agent],[+volit]; and [-agent],[-volit].** The feature [+/-agent] indicates whether the action originated from the doer or not and the feature [+/-volit] indicates whether the action thus performed does or does not involve the doer's volition. It is assumed that these feature specifications are listed along with the Stem Building Affixes as a part of their diacritic features and in the stem building process, depending on what affix is attached, the stem shape would be named as in 4.2.

4.2

Active	[+Agent],[+Volit]
Processive	[+Agent],[-Volit]
Act.Causative	[-Agent],[+Volit]
Proc.Causative	[-Agent],[-Volit]

Affix$_1$ is thus involved in the Stem Building Process and Affix$_2$ in either an Aspect Building or a Noun Formation Process. Aspect Building Affixes are those that form the three tenses of a verb and Noun Forming Affixes are obviously those that take part in the noun formation process from the verbal stems. Stem Building Affixes are marked V^1, Aspect Building Affixes V^2 and the Noun Forming Affixes N. V^1 affixes always precede the V^2 or N affixes. It is, therefore, necessary to introduce subcategorization restrictions so that V^1 affixes will always be added to the verb Root and V^2 or N affixes will follow V^1 affixes. In addition, V^2 affixes will have one of the three diacritic features- [+Present], [+Past] or [+Future]. N affixes will, however, have no such diacritic features. In 4.3 is a summary of the analysis discussed so far.

4.3

(a) **Stem Building Affixes**

Affix	Diacritic Features	Category	Subcategorization
-a	[+Agent],[+Volit]	V	$]_{V}---]_{V}^{1}$
-e	[+Agent],[-Volit]	V	
-wa	[-Agent],[+Volit]	V	
-we	[-Agent],[-Volit]	V	

(b) **Aspect Building Affixes**

Affix	Diacritic Features	Category	Subcategorization
-na	[+Pres]	V	$]_{V}^{1}---]_{V}^{2}$
-uwa	[+Past]	V	
una	[+Past]	V	
-wi	[+Futr]	V	

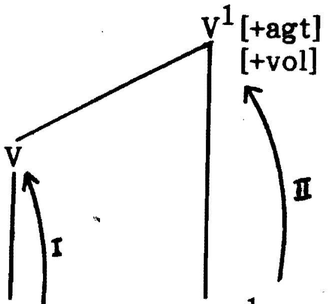
(c) **Noun Forming Affixes**

Affix	Diacritic Features	Category	Subcategorization
-iim		N	$]_{V}^{1}---]_{N}$
-um		N	
-ili		N	

5. DISCUSSION

Verb roots and the affixes will be listed in the permanent lexicon as terminal elements together with their diacritic and category features and subcategorization restrictions. Based on this information available, the process of affixation will take place in the second subcomponent of the lexicon. In this process, the terminal elements are inserted into binary branching trees and the feature percolation conventions mentioned in 3.2 percolate the features into the higher nodes. The illustration 5.1 shows how the stem building process takes place for the verb root /bala/.

5.1



(a) bala]$_V$ a]$_{V^1}$ [+agt] [+vol]

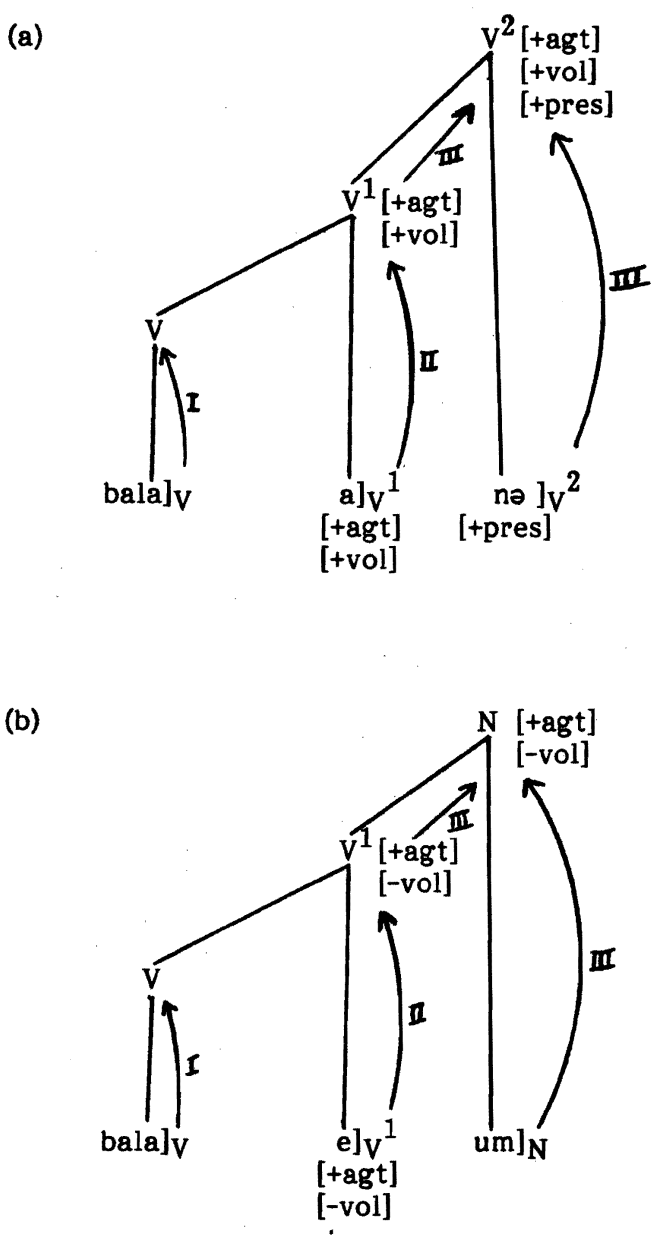
(b) bala]$_V$ e]$_{V^1}$ [+agt] [-vol]

(c) bala]$_V$ wa]$_{V^1}$ [-agt] [+vol]

(d) bala]$_V$ wa]$_{V^1}$ [-agt] [-vol]

The arrows I and II refer to the feature percolation principles I and II respectively. Arrow I shows that the category feature is percolated up to the first non-branching node by convention I. Arrow II indicates that the category feature and the diacritic features are percolated up to the first branching node that dominates the morpheme. In accordance with the subcategorization restrictions, aspect building or noun forming affixes are inserted into a binary branching tree of V^1 node. With the operation of the feature percolation conventions category features including diacritic features are percolated up the higher node as illustrated in 5.2.

5.2



In 5.2 first the convention I percolates the relevant information to the first non-branching node as shown by arrow I and arrow II indicates the percolation of the features up to the first branching node of each morpheme that dominates the morpheme by the operation of convention II. In the event that a branching node fails to receive features by convention II, features from the next lowest labelled node are automatically percolated up to the unlabelled branching node. This is illustrated in 5.2 by arrow III showing that the features [+/-agt] and [+/-vol] are percolated up the higher node.

In order to arrive at the correct surface forms, the derived forms have to undergo further changes with regard to the vocalic segments. Deletion of vocalic segments and some modifications in quality and quantity of the existing vowels are necessary. Some of such changes are phonological and some, have to be treated as morphological. This paper argues that the vowel fronting should be a morphological rule.

In the verb paradigm mentioned in 2.1, there are two types of vowel changes. In the future tense forms, it is the quantity of the final vowel that has changed. Stem final vowel is lengthened before the future suffix -wi. In the absence of phonological evidence for vowel lengthening in the future tense verb forms, it is assumed that this is morphologically conditioned and the feature [+long] is added to the morpheme -wi to indicate this. Changes in the vowel quality are found for all Past tense forms and for the P and PC verb forms in the Present tense. Except for the P and PC present tense forms, there are no clues to point out that this vowel fronting was triggered by a phonological factor. With regard to the vowel fronting in the present tense P and PC verb forms, it could be argued that the vowel fronting was triggered by the front vowel e in the stem building suffixes -e and -we. This same argument can be brought for vowel fronting in nominal forms whose suffixes are either -iim or -ili as both suffixes have high front vowels that could have triggered the vowel fronting in the stem vowels. However there is no such phonological evidence to argue for vowel fronting before the nominal suffix -um. It thus turns out to be the case that vowel fronting can be accounted for phonologically only in certain environments. This leads one to believe that the vowel fronting in the past tense forms, and also before -um suffix in the nominals is due to a morphological rule in modern Sinhala. Consequently, one has to consider whether there are two vowel fronting rules in modern Sinhala - one which is phonological and the other morphological. This paper argues that all cases of vowel fronting in the verbal system in modern Sinhala is morphological even though there are instances such as those mentioned above where there are still some phonologically accountable environments which are believed to be true in diachronic phonology. In order to capture the morphological rule of vowel fronting, the feature [+umlaut] is introduced in the relevant morphemes. The two features [+long] and [+umlaut] will then cause the relevant vowel changes to take place in the third string dependent morphological rule subcomponent. The two morphological rules that will account for this are in 5.3 and 5.4

5.3 Umlauting Rule

[+syl] --> [-bk] /---[+um]

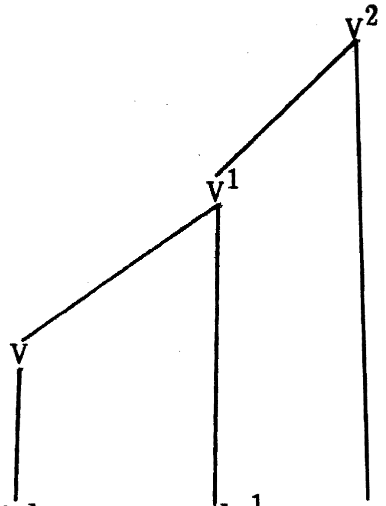
5.4 Vowel Lengthening Rule

[+syl] --> [+long]/---[+long]

The following are two examples illustrating the operation of the two rules above in the String Dependent rule subcomponent of the grammar.

5.5

(a)



(a)	bala]$_V$	a]$_V^1$	uwə]$_V^2$	==>	bala]	æ]	uwə]
		[+agt]	[+past]				
		[+vol]	[+um]				
(b)	bala]$_V$	a]$_V^1$	wi]$_V^2$	==>	bala]	aa]	wi]
		[+agt]	[+ftr]				
		[+vol]	[+long]				

As it is illustrated in 5.5, the features [+um] and [+long] trigger the morphological rules. According to Lieber (1981), morphological rules are string dependent and therefore string adjacency is required for the rule to apply. In 5.5 (a), the adjacent vocalic segment is fronted and in (b) it is lengthened. The rest of the vowels in (a) are assumed to have been fronted by an assimilation rule.

6. CONCLUSION

This paper has proposed that the stem variation in the modern Sinhala verbal system is a lexical process. Within the lexicon this argument was supported by nominals that are derived from the stems and further by having such nominals undergoing compounding. In analysis, it was pointed out that there are two sets of affixes that are added to a verb root. The first set which was named as Stem Building Affixes, is the cause of the stem variations. The second set of affixes which always follows the first is the input to either Nominals or Aspective Verbs. Both of these affixation processes were treated as derivational. The three subcomponents explained in Lieber's framework provided the essential mechanism to handle the proposed analysis. Roots and affixes are stored as terminal elements in the permanent lexicon with their relevant information such as category features. The second subcomponent handles all the derivations while filtering the proper information to the final output by means of the feature percolation conventions. The third subcomponent provides the scope for the morphological rule applications. Finally, in arriving at the correct surface forms, the derived lexical items have to undergo some phonological changes such as vowel reduction, vowel deletion etc.. For this purpose, either some modifications to the existing third subcomponent should be made or a separate level should be added for the phonological rule applications.

NOTES

[1] This terminology for the modern Sinhala verbs was adopted with some modifications from Gunasinghe (1976).

REFERENCES

Anderson, Stephen R. (1982). Where's Morphology? Linguistic Inquiry, 13, 571-611.

________. (1987). Inflectional Morphology. Stanford University: Linguistic Institute (1987).

Aronoff, Mark. (1976). Word Formation in Generative Grammar. Linguistic Inquiry Monograph 1. Cambridge, MA: MIT Press.

Clements, G.N. and S.J. Keyser. (1983). CV Phonology: A generative Theory of the Syllable. Cambridge, MA: MIT Press.

De Silva, M.W.S. (1973). Wigrahathmaka Wagwidyawa. Colombo: Educational Publications Department.

Dissanayake, J.B. (1969). Bhashawaka Rata Samudaya. Colombo: Lake House Investments & Co. Ltd.

Geiger, Wilhelm. (1983). A Grammar of the Sinhala Language. Colombo: The Royal Asiatic Society.

Gnanaloka, K. (Ed.). (1971). Sidat Sangara Purana Sannaya. Weligama: Hemachandra V. Gunasekara.

Gunasekara, Mendis A. (1962). A Grammar of the Sinhalese Language. Colombo: Sri Lanka Sahitya Mandalaya (Academy of Letters).

Gunasinghe, Hemamali. (1978). Do and Happen: The Ergative in Colloquial Sinhala. M.A. Thesis. Victoria, B.C.: Department of Linguistics, University of Victoria, Canada.

________. (1983). Gemination as a Syllable Structure Process in Modern Sinhala. Working Papers of the Linguistics Circle, 3, 87-103. Victoria, B.C.: Department of Linguistics, University of Victoria.

________ and Joseph F. Kess. (1985). Preliminaries to the Re-analysis of the Sinhala Passive, in Suriya Ratnakul et al (Eds.), Southeast Asian Linguistic Studies presented to Andre-G. Haudricourt. Bangkok: Mahidal University.

Jackendoff, R. (1975). Morphological and Semantic Regularities in the Lexicon. Language, 51, 639-71.

Kaisse, Ellen M. and Patricia A. Shaw. (1985). On the theory of Lexical Phonology, Phonology Yearbook.

Kean, Mary-Louise. (1974). The Strict Cycle in Phonology. Linguistic Inquiry, 5, 179-203.

Kiparsky, Paul. (1982a). From Cyclic Phonology to Lexical Phonology: In The Structure of Phonological Representations, Vol. 1. (pp. 131-75). Dordrecht: Foris.

________. (1982b). Lexical Morphology and Phonology: In Linguistics in Morning Calm, (pp. 3-91). Seoul: Hanshin.

________. (1982c). Explanation in Phonology. Dordrecht: Foris.

Kumaratunga, M. and A. Gunawardana, (Eds). (1962). Sidat Sangara Wiwaranaya. Colombo: K.A. Ariyadasa & Co.

Lieber, R. (1981). On The Organization of The Lexicon. Bloomington: Indiana University Linguistic Club.

________. (1983). Argument Linking and Compounds in English. Linguistic Inquiry, 14, 251-85.

________ (1987). An Intregated Theory of Autosegmental Processes. Albany: State University of New York Press.

Mohanan, K.P. (1982). The Theory of Lexical Phonology. Dordrecht: Reidel.

Pullum, Geoffrey K. and Arnold M. Zwicky. (1986). Phonological Resolution of Syntactic Feature Conflict. Language , 62, 751-73.

Rosenthall, S. (1988). Syllabification and Representation in Sinhalese Phonology. McGill Working Papers in Linguistics, 5, 130-17.

Siegel, Dorothy. (1974). Topics in English Morphology. New York: Garland.

SUBCATEGORIZATION LISTS IN IMMEDIATE DOMINANCE RULES*

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1. INTRODUCTION.

This paper explores the use of subcategorization lists or 'stacks' in a version of Generalized Phrase Structure Grammar (GPSG) which is otherwise conceptually very close to Gazdar, Klein, Pullum and Sag (1985, hereafter, GKPS). While the use of list structures in extensions of GPSG is not new (cf. Pollard, 1984; Pollard and Sag, 1987), the present paper develops list-like feature structures in the context of Gazdar et al. (1988), where categories are set-theoretic objects—partial functions—which are constrained in various ways by statements in a formal constraint language L_C.

Before turning to the specifics of the proposal for incorporating list structures into GPSG, I sketch out analyses of two syntactic phenomena which receive more perspicuous treatments in a grammar with subcategorization lists: subject-(auxiliary) verb inversion and lexically determined case assignment. This discussion not only gives some justification for the use of list structures—a point which the reader may explore more fully in Pollard and Sag, 1987—but it provides a context for an informal exposition of the GPSG extension set out in more detail in subsequent sections.

1.1. Subject-Verb Inversion.

The English subject-verb inversion structures proposed by GKPS are not consistent with their formulation of agreement involving control and the Control Agreement Principle (see Hukari and Levine, 1987). They propose the following inversion metarule.

(1) **Subject Auxiliary Inversion Metarule.**
$V^2[\text{-SUBJ}] \rightarrow W \Rightarrow V^2[\text{+INV, +SUBJ}] \rightarrow W,\ \text{NP}$

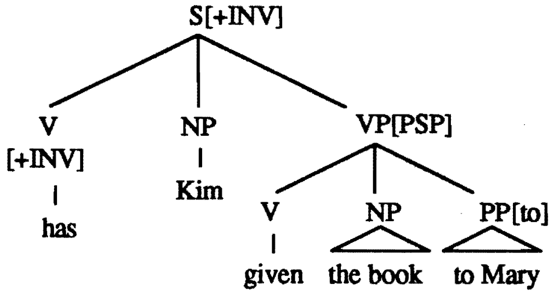
This 'liberates' the constituents of VP into S by expanding the set of licensing immediate dominance (ID) rules[1] to include S-expansion counterparts, such as (3), to certain VP rules, such as (2)

(2) VP → H[n], VP[PSP]

(3) S[+INV] → H[n], NP, VP[PSP]

yielding sentences like (4).[2] However nothing in the control mechanisms postulated in GKPS establishes a link between the subject and the auxiliary verb. Their Control Agreement Principle does not apply between the subject (*Kim*) and lexical V (*has*), nor does it link the subject with its VP sister. Thus nothing in the feature instantiation system rules (5).

(4)



(5)*Have Kim given the book to Mary?

Hukari and Levine (1987) note this problem and propose an extension of GPSG to include liberation rules (cf. Zwicky, 1985, 1986), where the liberation operation takes two immediate dominance rules, one which expands a daughter of the other, and merges them into one rule by replacing the daughter with its daughters:

(6) a. $S_0 \rightarrow NP_1, VP_2$

b. $VP_2 \rightarrow V_3, VP[PSP]_4$

c. $S_0[+INV] \rightarrow NP_1, V[+INV]_3, VP[PSP]_4$ (= liberation of (a) and (b))

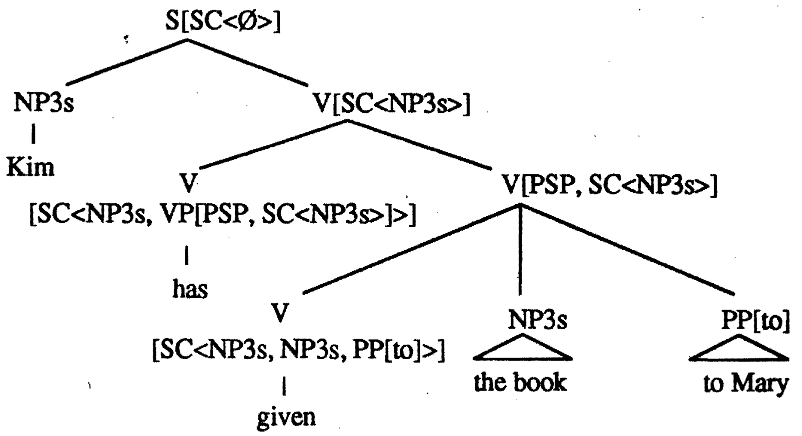
While this offers an account of subject-verb agreement in inverted sentences, it does so at the cost of introducing considerable complexity in the grammar. In fact, the resulting theory can be thought of as being multistratal. Since liberation is, in effect, structure-destroying, Hukari and Levine propose that it operates on fully instantiated immediate dominance rules. The feature instantiation principles apply to these sets of instantiated pre-liberation ID rules, such as (6) (a) and (b), where the control agreement principle links NP_1 and VP_2 in (a), and the Head Feature Convention passes the agreement feature specification down from VP_2 to V_3. Given a set of ID rules representing the structural/grammatical relations of an entire sentence, liberation maps this to a new set of rules in which liberation ID rules such as (c) replace original rules such as (a) and (b).

I consider here a very different approach to inversion, following in the spirit of Pollard (1985), and Pollard and Sag (1987), in which list-like feature structures are employed. These can be defined in a way which is compatible with the set-theoretic formulation of categories as (partial) functions in Gazdar, Klein, Pullum, and Sag (1985) and, more specifically, as in Gazdar et al. (1988), as discussed below. For the moment, subcategorization lists will be informally noted as a sequence of categories, where the rightmost is the most oblique and the leftmost, e.g., the subject, is the least oblique (cf. Dowty, 1982a and b; Pollard and Sag, 1987), so the subcategorization specification for *give* is roughly SC<NP, NP, PP[to]>, where the leftmost NP corresponds to the subject.[3] The basic ID rule for S-expansions is the following.

(7) V[SC<Ø>] → XP, H

This licenses local trees in which the mother (i.e., S) is 'saturated', that is, its subcategorization list contains no categories, and the head daughter's list contains one category corresponding to the non-head daughter (XP), as in the topmost local tree of (8).

(8)



The correspondences between the head's list and the mother's, on one hand, and the head's list and the non-head daughters, on the other, are not determined directly by the immediate dominance rule, but by two feature instantiation principles whose first approximations are as follows.

(9) **List Condition.**
The mother's subcategorization list is a portion of the head daughter's: if $C_H[SC<C_1, ..., C_n>]$ then $C_0[SC<C_1, ..., C_i>]$, where $0 \leq i \leq n$.

(10) **Subcategorization Condition.**
Given a licensing ID rule $C_0[SC<...>] \rightarrow C_H, C_1, ..., C_n$, each C_i daughter in the tree, $1 \leq i \leq n$, corresponds to one category C'_i in the portion of the head's subcategorization list which is not passed up to the mother's list, and vice versa.

Subject-verb agreement follows as a consequence of the subcategorization condition and the list condition as they apply to the topmost local tree in (8). Since the mother's subcategorization list is empty,[4] the subcategorization condition says that all categories in the heads must 'cancel' by matching non-head daughters in the tree. But the licensing ID rule mentions only one such daughter, XP, thus the head's list must be of length one, and the category in it must correspond to a third person singular NP in order to match the non-head daughter in the tree.[5]

The immediate dominance rule licensing the next lower local tree in (8) is the following general schema, or more specifically, the version of it in (12).

(11) V[SC<XP>] → H[+LEX], XP*
(12) V[SC<XP>] → H[+LEX], XP

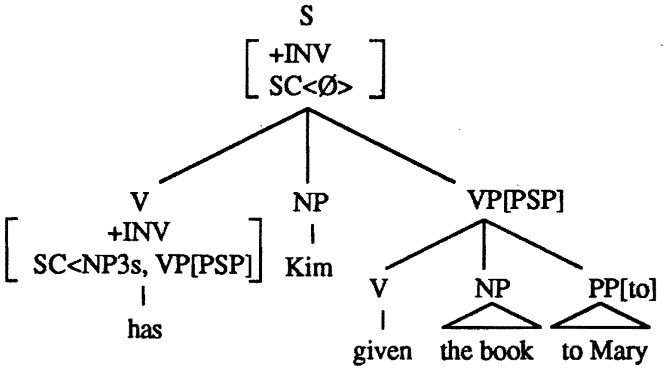
Again, the list condition and the subcategorization condition apply. In this case, the mother's list must contain one category, as determined by the ID rule. By the list condition, this must correspond to the left-most category in the head's list. By the subcategorization condition, the remaining categories in the head's list must cancel with the non-head daughters in the tree. Since the head's list is of length two—roughly, <NP3s, VP>—just the last element in the list corresponds to a non-head daughter. The next lower local tree is headed by *given*, whose subcategorization list is roughly <NP, NP, PP[to]>, and the relevant case of (11) is the following.

(13)V[SC<XP>] → H[+LEX], XP, XP

The inversion ID rule stipulates that the subcategorization list of the mother must be empty. The principles above ensure that all categories in the head verb's subcategorization list which are not also in the mother's are matched by constituents in the tree, so the entire list must cancel.

(14) V[SC<Ø>, +INV] → H[+LEX], XP*

(15)



And subject-verb agreement still follows from the subcategorization condition, since the subject NP (*Kim*) must match the left-most category in the head's list.

1.2 Lexically Governed Case Assignment.

A second problem area for GPSG is the assignment of case to subjects and objects. GKPS force nominative case in subjects of tensed clauses via the agreement system. This is accomplished by means of a feature co-occurrence restriction saying that tensed VP must agree with a nominative subject. But if this approach is extended to lexically determined subject case assignment in languages like Icelandic (cf. Andrews, 1982; Zaenen, Maling and Thráinsson, 1985), we arrive at a strange asymmetry. Lexically conditioned subject case assignment will presumably involve inherent specification for the agreement feature AGR, so Icelandic *hvolfdi* 'capsized' is specified [AGR: NP[CASE: DAT]], as in

(16) Bátnum(D) hvolfdi. 'The boat capsized'. [Andrews, example 50d]

But lexically conditioned object case assignment would presumably be imposed in immediate dominance rules such as the following for dative case assignment to objects of such verbs as Icelandic *bjöguðu* 'rescued'.

(17) VP → H[n], NP[CASE: DAT]

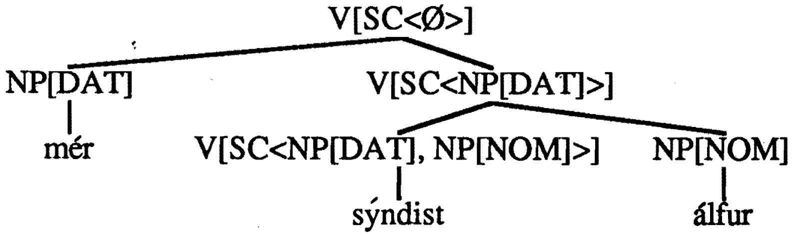
But a single account of lexically governed case assignment is readily available in a grammar which employs subcategorization lists (cf. Pollard and Sag,1987). We can say, for example, that a verb which assigns dative case to its subject and nominative case to its object has a list of the form

(18) SUBCAT<NP[CASE: DAT], NP[CASE: NOM]>

If we assume that immediate dominance rules along the lines of (7) and (11) extend to basic sentences in Icelandic, the subcategorization and list conditions noted above guarantee that the appropriately case-marked noun phrases will be selected, as in

(19) Mér(D) sýndist álfur(N). 'I thought I saw an elf.' [Andrews, example 50h]
me thought-saw elf

(20)



Furthermore, though a treatment of Icelandic passives is well beyond the scope of the present paper, an approach which employs subcategorization lists seems promising. For example, active verbs which select dative objects in Icelandic have corresponding passives selecting dative subjects (see Zaenen, Maling and Thráinsson, 1985).

(21) Þeir björguðu stúlkunni(D). they rescued the-girl [Andrews, example 56a]
(22) Stúlkunni(D) var bjargað. the-girl was rescued [Andrews, example 58a]

Assume for the sake of argument that passive is a lexical rule which eliminates the least oblique (left-most) argument:

(23) $[\text{ V, SC}<C_1, C_2, \ldots, C_n>] \rightarrow [\text{V, +PASS, SC}<C_2, \ldots, C_n>]$

It follows automatically that—barring any language-specific constraints to the contrary—whenever an active verb governs a special object case, this property should be transferred to passive subjects, as in (22).

2. THE STRUCTURE OF LISTS.

Lists can be constructed in set-theoretic terms roughly along the lines discussed for indexed grammars in Gazdar et al. (1988). While simple sequence notation was used in the previous discussion, this form of notation, as in (24)

(24) $\text{SUBCAT}<C_1, C_2, C_3>$

stands for the feature structure

(25) $$\left[\text{SUBCAT: } \left\{\begin{array}{l}\text{ARG: } C_3 \\ \text{SUBCAT: } \left\{\begin{array}{l}\text{ARG: } C_2 \\ \text{SUBCAT: } \left\{\begin{array}{l}\text{ARG: } C_1 \\ \text{SUBCAT: NIL}\end{array}\right\}\end{array}\right\}\end{array}\right\}\right],$$

where we can think of C_3 as being the most oblique complement and C_1 the least. The value of SUBCAT is a set, a (highly specialized) category whose content is restricted to a list-like structure by a feature co-occurrence restriction (see footnote 14) which has the effect of guaranteeing that the category value of SUBCAT contains either specifications for ARG(gument), a category-valued feature, and SUBCAT and nothing else, or just the element NIL (which can be taken as an abbreviation of {+NIL}).

If lists are treated as category-valued features rather than some entirely different feature structure, this makes that the constraint language of Gazdar et al. (1988) available and, furthermore, the definitions of extension (subsumption) and unification found in GKPS hold without modification for categories containing subcategorization lists. Suppose, for example, we use the following definition of extension, where type-0 features take atomic values (e.g., +, -, 1, 2, 3) and type-1 features take category values.

(26) **Extension.** $A \sqsubseteq B$ (B extends A) iff
  a. if $\tau(f) = 0$, then if $A(f)$ is defined, then $A(f) = B(f)$,
  b. if $\tau(f) = 1$, then if $A(f)$ is defined, then $A(f) \sqsubseteq B(f)$.

It is easy to see that $C[SC<C_1, ..., C_n>]$ extends $C[SC<C'_1, ..., C'_n>]$ just in case C_i extends C'_i for each i, $1 \leq i \leq n$. Further, given that the list feature structure always terminates in the singleton set {<+, NIL>}, it turns out that neither of two categories containing list-valued features can extend the other unless the lists are of exactly the same length. For example, suppose two categories differ only in their subcategorization lists, which are as follows:

(27) $SC<C_1, C_2>$:

$$\left[\text{SC: }\left\{\begin{array}{l}\text{ARG: } C_2\\ \text{SC: }\left\{\begin{array}{l}\text{ARG: } C_1\\ \text{SC: }\{\text{NIL: } +\}\end{array}\right\}\end{array}\right\}\right]$$

(28) $SC<C_1, C_2, C_2>$:

$$\left[\text{SC: }\left\{\begin{array}{l}\text{ARG: } C_3\\ \text{SC: }\left\{\begin{array}{l}\text{ARG: } C_2\\ \text{SC: }\left\{\begin{array}{l}\text{ARG: } C_1\\ \text{SC: }\{\text{NIL: } +\}\end{array}\right\}\end{array}\right\}\end{array}\right\}\right]$$

Neither will extend the other, since the value of SUBCAT in latter does not extend the value in the former (nor, of course, vice versa). That is, the category {ARG: C_3, SC: ...} clearly does not extend the category {ARG: C_2, SC: ...}, unless possibly $C_3 = C_2$. Suppose for the sake of argument that $C_3 = C_2 = C_1$. Even so, the value of SC in (28) does not extend that in (27) and this is because the value of the next-to-lowest token of SUBCAT in (28)—{ARG: C_1, SC: {NIL: +}}—would have to extend the lowest token of SUBCAT in (27)—SC: {NIL: +}—and it does not. This property of lists makes it possible to write immediate dominance rules in which the length of the subcategorization list can be specified. So, for example, the 'VP' rule (11) in 1.1 above

(11) $V[SC<XP>] \rightarrow H[+LEX], XP^*$

says that a verbal category with a subcategorization list of length one dominates a lexical verbal category and any number of phrases XP, where the category labelling the mother node in the local tree must be an extension of the left-hand side category in the rule (hence the restriction on the length of its subcategorization list).

3. IMMEDIATE DOMINANCE RULES.

Consider the following two types of immediate dominance rule.

(29) $C_0 \to H, C_1, ..., C_n$
(30) $C_0[SC<C_1, ..., C_n>] \to H, C^*$

These follow the ID/LP format of GKPS, where ID rules license hierarchical order but not linear order. Rules of the first type are like those in GKPS: the categories on the right-hand side constitute a multiset; there is a one-to-one correspondence between these and the daughters, such that each daughter extends exactly one; and the mother in the tree extends C_0. Rules of the second type—actually a rule schema—involve cancellation or 'off-loading' of the head's subcategorization list.[6] Both species of rule can be subsumed under the definitions in GKPS, provided feature instantiation principles regulate the relationship between the lists in the head and the mother, on one hand, and the relationship between the head's list and the non-head sisters in the tree, on the other. So the only additions we need in order to augment GPSG with a list-valued subcategorization feature are the List Condition and the Subcategorization Condition (see section 1.1.), which are given below in their full form.

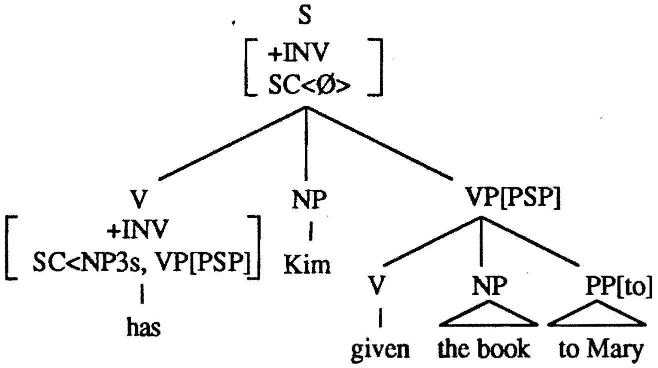
But certain notational conventions require explication before we turn to the constraints.[7] The relationship between an ID rule *r* and a tree is described in GKPS as a projection function ϕ, where categories as node-labels in a tree extend corresponding categories in the rule. Following their notation, I write $\phi(C_i)$ to denote the projection in the tree of C_i in the ID rule (so $C_i \sqsubseteq \phi(C_i)$). Expressions in square brackets are statements in the category constraint language L_c of Gazdar et al. (1988). Given a constraint $[\psi]$, $[\psi](C)$ is to be interpreted as meaning '$[\psi]$ is true of category C'. And a constraint $[\Diamond\psi]$ 'ψ is possible' is true of a category just in case ψ is true at some level of inclusion (but see below a necessary revision of the semantics of the modal operators).

(31) **List Condition**. In a rule $r = C_0 \to C_H, C_1, ..., C_n$ and a tree $\phi(r)$, if SUBCAT is specified in C_0,[8] then the subcategorization list in the mother $\phi(C_0)$ is contained in the value of SUBCAT in the head $\phi(C_H)$ at some level of inclusion:[9]

$$[SC](C_0) \supset [SC: \Diamond[\phi(C_0)(SC)]](\phi(C_H))$$

An example of this is the inversion rule from 1.1 above.

(14) V[SC<Ø>, +INV] → H[+LEX], XP*
(15)



Since C_0 in the licensing rule contains SUBCAT, the List condition says that the head's list in the tree must contain the mother's list at some level of inclusion. The two lists are as follows:

(32) $[\text{SC: \{NIL: +\}}]$

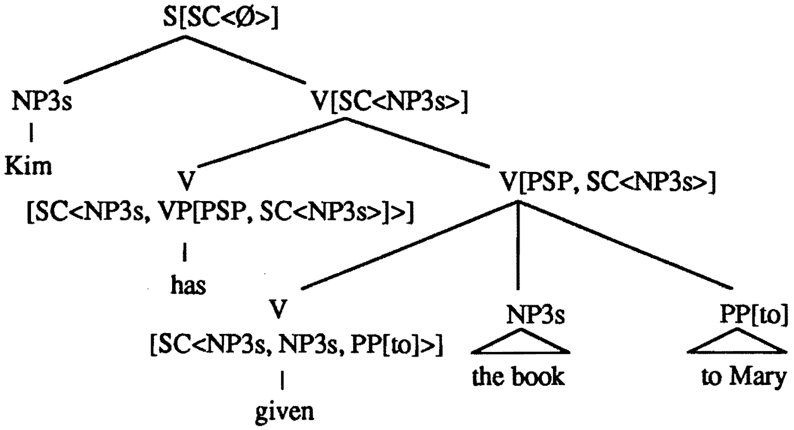
(33) $$\begin{bmatrix} \text{SC:} \left\{ \begin{matrix} \text{ARG: VP[PSP]} \\ \text{SC:} \left\{ \begin{matrix} \text{ARG: NP3s} \\ \text{SC: \{NIL: +\}} \end{matrix} \right] \end{matrix} \right] \end{bmatrix}$$

And the value of SUBCAT in (32) is contained at some level of inclusion—the deepest—in the value of SUBCAT in (33).

A second example is the VP-expansion rule which applies in the uninverted counterpart to the sentence above.

(11) V[SC<XP>] → H[+LEX], XP*

(8)



In the local tree headed by *has*, the subcategorization lists for the mother and the head are as follows.

(34) $$\begin{bmatrix} \text{SC:} \left\{ \begin{matrix} \text{ARG: NP3s} \\ \text{SC: \{NIL: +\}} \end{matrix} \right] \end{bmatrix}$$

(35) $$\begin{bmatrix} \text{SC:} \left\{ \begin{matrix} \text{ARG: V[PSP, SC<NP3s>]} \\ \text{SC:} \left\{ \begin{matrix} \text{ARG: NP3s} \\ \text{SC: \{NIL: +\}} \end{matrix} \right] \end{matrix} \right] \end{bmatrix}$$

And the mother's list is contained at some level of inclusion in the head's.

The Subcategorization Condition stipulates the relationship between the head's subcategorization list and the non-head sisters in the tree.

(36) **Subcategorization Condition**. In a rule $r = C_0 \rightarrow C_H, C_1, \ldots, C_n$ and a tree $\phi(r)$, if $[SC](C_0)$, then for all i, $1 \leq i \leq n$,
a. $\phi(C_i) = C'_i$,
b. $[SC: \Diamond[[ARG: C'_i] \ \& \ [SC: v_i]]](\phi(C_H))$, and
c. $[SC: \neg\Diamond[[ARG: C'_i] \ \& \ [SC: v_i]]](\phi(C_0))$.

That is, there is (a) a one-to-one correspondence of identity between each non-head daughter $\phi(C_i)$ and each C'_i which is (b) at some level of inclusion in the head's subcategorization list and (c) not in the mother's.[10] Consider again the uninverted sentence in (8). In the second local tree the subcategorization list of the head (*has*) is as in (35) and thus it contains—at one level of inclusion or another—two structures satisfying (b) in (36):

(37)
i. [[ARG: V[PSP, SC<NP3s>] & [SC: {ARG: NP3s, SC: {NIL: +}}]]
ii. [[ARG: NP3s] & [SC: {NIL: +}]]

But the second (ii) also appears in the subcategorization list of the mother, so only the first (i) is relevant, and the Subcategorization Constraint stipulates that the category-value V[PSP, SC<NP3s>] must correspond to a sister-constituent of the head.The inversion structure is similar, except the mother's subcategorization list is 'empty', so the values of ARG in both (i) and (ii)—V[PSP, SC<NP3s>] and [NP3s]—must correspond to sisters of the head in the tree.

4. THE MODAL OPERATORS.

There is a problem in formulating modal statements about the composition of subcategorization lists using the language of category constraint L_c in Gazdar et al. (1988). In particular, we want to be able to state constraints on the composition of subcategorization lists which pertain to what we intuitively think of as categories in the list, but not to values deeply embedded in those categories. For example, given a constraint

(38) [SC: ◊[NIL]]

it turns out that we want this to be interpreted in such a way that the evaluation stays on the recursive SUBCAT path, that a modal constraint is not satisfied (or falsified) by, say, looking deeply into a particular category on the list.[11] In other words, finding a specification for NIL deeply inside PP in SUBCAT< NP, PP, VP> should not satisfy the constraint, while terminating the list in NIL (see (25)) should. (See also the discussion of (41) below.)

The definition of the semantics of the modal necessity operator '□' in Gazdar et al. (1988) is as follows (where F^1 are the category-valued features and '$\Delta(C)$' denotes the domain of C, i.e., the features which are specified in C):

(39) A category α satisfies a constraint of the form '□φ':

$\|\Box\phi\|_{\Sigma, \alpha} = 1$ just in case

(i) $\|\phi\|_{\Sigma, \alpha} = 1$, and

(ii) for all $f \in F^1 \cap \Delta(\alpha)$, $\|\Box\phi\|_{\Sigma, \alpha(f)} = 1$

I revise the semantics of the modal operator here so that the evaluations take into account accessibility relations between features. Atomic-valued features are type 0 (belonging to the set F^0), category-valued features are type 1 (they are in F^1), and list-valued features are type 2 (in F^2).[12] Features of a given type—for types 1 or 2—are accessible to each other, meaning that they can see into each other's values. Type 2 features may be accessible to type 1 features (I leave the matter open), but type 1 features are not accessible to type 2 features. The accessibility relation *R* is the set of ordered pairs <f, f'> such that the second is accessible to the first. And the definition of the modal operator invokes *R* as follows:[13]

(40) A category α satisfies a constraint of the form '$\Box\phi$':

$\|\Box\phi\|_{\Sigma,\alpha} = 1$ just in case
(i) $\|\phi\|_{\Sigma,\alpha} = 1$, and
(ii) $\|\Box\phi\|_{\Sigma,\alpha(f)} = 1$ for all f, f' such that
a. $f \notin F0$
b. if $\alpha = \beta(f')$, then $f \in R(f')$, and
c. $f \in \Delta(\alpha)$.

Consider an example step-by-step. The FCR—which is an approximation of the restriction on list-valued features—says that if a category has a specification for SUBCAT, then its value must have, at all levels of inclusion, specifications for SUBCAT and ARG, or for NIL.[14]

(41) FCR: [SC] → [SC: $\Box$[[SC & ARG] ∨ NIL]]

Let us confine ourselves to the case where $\|SC\|_{\Sigma,\alpha} =1$, so the consequent must be true. Then we need one further semantic rule from Gazdar et al. (1988):

(42) $\|f : \phi\|_{\Sigma, \alpha} = 1$ just in case $\|\phi\|_{\Sigma, \alpha(f)} =1$

Consider the evaluation of the following feature structure with respect to (41).

(43)
$$\begin{bmatrix} \text{SC}^0\text{:} & \begin{bmatrix} \text{ARG}^1\text{: VP} & \\ \text{SC}^1\text{:} & \begin{bmatrix} \text{ARG}^2\text{: PP} & \\ \text{SC}^2\text{:} & \begin{bmatrix} \text{ARG}^3\text{: NP} \\ \text{SC}^3\text{: [NIL: +]} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

(44) $\|SC: \Box[[SC \,\&\, ARG] \vee NIL]\|_{\Sigma, \alpha} =1$ iff

a. $\|\Box[[SC \,\&\, ARG] \vee NIL]\|_{\Sigma, \alpha(SC^0)} = 1$[by (42)], iff

b. $\|[[SC \,\&\, ARG] \vee NIL]\|_{\Sigma, \alpha(SC^0)} = 1$ [which it does], and

c. $\|\Box[[SC \,\&\, ARG] \vee NIL]\|_{\Sigma,\alpha (SC^0)(f)} = 1$ for all f, $f \in R(SC)$ and $f \in \Delta(\alpha(SC^0))$ [f = SC^1 only], iff

e. $\|[SC \,\&\, ARG] \vee NIL\|_{\Sigma, \alpha(SC^0)(SC^1)} = 1$ [which it does], and

f. $\|\Box [[SC \,\&\, ARG] \vee NIL]\|_{\Sigma, \alpha(SC^0)(SC^1)} = 1$ for all f such that $f \in R(SC)$ and f $\Delta(\alpha(SC^0)(SC^1))$ [f = SC^2 only], iff

g. $\|[SC \,\&\, ARG] \vee NIL\|_{\Sigma, \alpha(SC^0)(SC^1)(SC^2)} = 1$ [which it does], and

h. $\|\Box [[SC \,\&\, ARG] \vee NIL]\|_{\Sigma, \alpha(SC^0)(SC^1)(SC^2)(SC^3)} = 1$ for all f such that $f \in R(SC)$ and f $\Delta(\alpha(SC^0)(SC^1)(SC^2))$ [f = SC^3 only], iff

i. $\|[SC \,\&\, ARG] \vee NIL\|_{\Sigma, \alpha(SC^0)(SC^1)(SC^2)(SC^3)} = 1$[which it does], and

j. $\neg\exists f[f \in R(SC) \,\&\, f \in \Delta\alpha(SC^0)(SC^1)(SC^2)(SC^3)$.

Clearly the constraint will not be satisfied unless at *every* relevant level of inclusion the feature SUBCAT and ARG, or the feature NIL occurs, which is true in (43).

Suppose from SC^0 we were allowed to go into ARG^1 and evaluate

(45) $\|\Box[[SC \& ARG] \vee NIL]\|_{\Sigma,\alpha(SC^0)(ARG^1)}$

While the value of AGR^0, which is VP, will actually contain a specification for SUBCAT, it will not contain one for ARG. That is, the VP value of ARG^0 might be realized as something along the following lines:

(46) $$\begin{bmatrix} \text{-N} \\ \text{+V} \\ \text{VFORM: INF} \\ \text{SC: } \begin{bmatrix} \text{ARG: NP} \\ \text{SC: NIL} \end{bmatrix} \end{bmatrix}$$

Thus if the value of ARG^0 were accessible to SUBCAT, the structure would fail the constraint. But, given the constraint on accessibility, the evaluation does not involve ARG since <SC, ARG> $\notin R$. Therefore the evaluation proceeds down through successively more deeply embedded values of SUBCAT, never evaluating the value of ARG, and the constraint is satisfied.

The modal possibility operator '$\Diamond$' is analogous. While we can think of it simply as the dual of the necessity operator—$\Diamond\phi =_{def} \neg\Box\neg\phi$—its semantics can be defined independently as follows:

(47) A category α satisfies a constraint of the form '$\Diamond\phi$':

$\|\Diamond\phi\|_{\Sigma,\alpha} = 1$ just in case

(i) $\|\phi\|_{\Sigma,\alpha} = 1$, or

(ii) $\|\Diamond\phi\|_{\Sigma,\alpha(f)} = 1$ for some f, f' such that

a. $f \notin F^0$

b. if $\alpha = \beta(f')$, then $f \in R(f')$, and

c. $f \in \Delta(\alpha)$.

5. VARIABLES.

As a final, minor point, consider the use of variables for partial representations of lists in the list notation.

(48) V[SC<XP>] → H[SC<XP,VP[INF], *W*>]; X*

If such partial representation is desirable, then *W* must be provided with an interpretation. Clearly we want it to correspond to the upper portion ('...') of the feature structure:

(49) $$\left[\text{SUBCAT: } \left\{ \ldots \left\{ \text{SUBCAT: } \left\{ \begin{array}{l} \text{ARG: V[INF]} \\ \text{SUBCAT: } \left\{ \begin{array}{l} \text{ARG: XP} \\ \text{SUBCAT: NIL} \end{array} \right\} \end{array} \right\} \right\} \ldots \right\} \right]$$

A perfectly straightforward interpretation exists for the *W*-variable notation, namely, as the modal operator of possibility '$\Diamond$' in statements in the category constraint language L_C, as in the following examples.

(50) a. SC<C, *W*> = [SC: $\Diamond$[ARG: C & [SC: NIL]]
b. SC<*W*, C> = [SC: [ARG: C]][15]
c. SC<*W*, C, *W*> = [SC: $\Diamond$[ARG: C]]
d. SC<*W*, C_1, *W*, C_2> = [SC: [ARG: C_2 & $\Diamond$[ARG: C_1]]
e. SC<C_1, *W*, C_2> = [SC: [[ARG: C_2] & $\Diamond$[[ARG: C_1] & [SC: NIL]]]]

Leaving aside the matter of whether such partial representation of lists is needed in immediate dominance rules, consider the following approximation of a constraint on reflexives, inspired by work in progress by Carl Pollard and Ivan Sag.

(51) **Reflexive Rule.**
SUBCAT<*W*, XP, *W*, XP[RE: α],*W*> $\supset$ SUBCAT<*W*, XP[α], *W*, XP[RE: α], *W*>

That is, if the subcategorization list contains an anaphor (a category specified for RE) in non-final (non-subject) position, then it agrees with a less oblique category in the list (i.e., a more deeply embedded category). This can be stated in L_c as follows, where subscripted numbers are provided on some brackets for the reader.

(52) **Reflexive Rule.** For any category C,

$$[_1[_2\mathrm{SC}\!: [_3\Diamond[_4\mathrm{ARG}\!: [\mathrm{RE}\!: \alpha] \;\&\; [\mathrm{SC}\!: \Diamond[\mathrm{ARG}]]_4]_3]_2] \supset$$
$$[_5\mathrm{SC}\!: \Diamond[_6[\mathrm{ARG}\!: \alpha] \;\&\; [\mathrm{SC}\!: \Diamond[\mathrm{ARG}\!: [\mathrm{RE}\!: \alpha]]]_6]_5]_1]$$

A number of considerations arise in the treatment of reflexivization, and, while these are beyond the scope of this paper, I will at least mention them. One issue is whether a constraint along these lines should pertain just to reflexive NPs (i.e., anaphors) or also to constituents containing, at some depth, a reflexive pronoun. This, in turn, raises the matter of whether or not RE is a foot feature. Also related to these matters, is the status of anaphors when there is no higher element on the subcategorization list, as in the following, under the assumption that *for himself to have done better* and *a picture of herself* are constituents corresponding to the 'saturated' categories V[SC<Ø>] and N[SC<Ø>].

(53) Kim would have preferred for himself to have done better.
(54) Lee saw a picture of herself in the newspaper.

The constraint proposed above exempts cases where the anaphor is highest in the subcategorization list. If, however, RE is a foot feature, then the saturated categories will be specified for RE, and the constraint will apply in the matrix clause. Finally, I have not made explicit the feature content of α in the rule, which may or may not involve a syntactic binding feature (i.e., an index).

NOTES

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[1] Immediate dominance rules, like phrase structure rules, state structural relations (sister-of, daughter-of) but, unlike phrase structure rules, they say nothing about the linear (sequential) order of daughters. Insofar as daughters are linearly ordered, their order is determined by linear precedence rules. See GKPS; Gazdar and Pullum, 1981; and Pullum, 1982.

[2] As INV is a head feature, it will appear on the lexical head, and a feature co-occurrence restriction prevents -AUX verbs from containing a +INV specification, thus the metarule yields useful ID rules only in constructions in which the head verb is an auxiliary verb. This use of INV carries over to the other analyses discussed below.

[3] This departs from the notational convention in Pollard and Sag (1987), where the least oblique complement is rightmost (e.g., *give* is SC<PP[to], NP, NP >).

[4] SC<Ø> does not denote an empty list; rather, the list contains no categories for cancellation. As discussed below, <Ø> denotes a value containing a feature specification [+NIL], not the empty set. The fact that list structures terminate in [+NIL] guarantees that whenever a list is mentioned in an ID rule, the matching category in the tree will have a list of exactly the same length.

[5] I assume a somewhat more complex account of agreement, though this has no bearing on the matters at hand. That is, I assume there is an agreement feature AGR, whose value must match the subject (leftmost category) in the subcategorization list. Matching here may be confined to a small set of agreement features, such as person, number, and possibly an index.

[6] See Evans (1987) for an interesting alternative formulation of the relationship between ID rules and trees, where rules contain statements in L_c and the category labels in trees are models of these.

[7] SUBCAT is a HEAD feature and the List Condition should over-ride the Head Feature Convention, but when SUBCAT is not mentioned in an ID rule, the HFC applies.

[8] We might wish to also stipulate that SUBCAT is not mentioned in the head in the ID rule: SUBCAT $\not\in \Delta(C_H)$. I leave this matter open. See the discussion of (43) in section 5.

[9] Strictly speaking, a constraint of the form '$\Diamond[\phi(C_0)(SC)]$' is not a statement in L_c, where '$\phi(C_0)(SC)$' denotes the category-value of SUBCAT in $\phi(C_0)$. But this can be written as a statement in L_c augmented with variables: $[[SC](C_0)\ \&\ [SC{:}\ \alpha](\phi(C_0))] \supset [SC{:}\ \Diamond\alpha](\phi(C_H))$.

[10] Alternatively, this correspondence involves extension rather than identity: $C'_i \sqsubseteq \phi(C_i)$. Note the crucial use of v_i here. Two tokens of the same category may occur at different levels of inclusion in the list, and these are distinguished here by the fact that at different levels, the value of v_i in $\{<ARG{:}\ C_i>, <SC, v_i>\}$ will be different, given the geometry, so to speak, of the feature structure.

[11] This is given strictly for exemplification; (38) is not offered here as a constraint.

[12] Strictly speaking, list-valued features are also category-valued here, since lists are a highly specialized sort of category (one which never labels nodes in trees). But I assume that type-2 features are not type-1 and conversely.

[13] Recall that the possibility operator '$\Diamond$' is the dual, and can be defined derivatively as '$\neg\Box\neg$'.

[14] This of course will not suffice to characterize the content of the value of SUBCAT, since no other features should occur at any level. Perhaps we could say that for all features f and g, $f \neq SC, ARG$, $g \neq NIL$
FCR: $[[SC] \rightarrow [SC\text{: } \Box[[SC \,\&\, ARG\& \neg f] \vee [NIL \,\&\, \neg g]]]$.

[15] Since nothing is specified in (b) beyond the stipulation that the top of the list contains C, a modal operator is not needed here. For the same reason, (c) contains only one modal operator.

REFERENCES

Andrews, Avery D. (1982). The representation of case in modern Icelandic. In Joan Bresnan (ed.), *The mental representation of grammatical relations* (pp. 427-503). Cambridge, MA: MIT Press.

Dowty, David R. (1982a). Grammatical relations and Montague Grammar. In Pauline Jacobson and Geoffrey Pullum (eds.), *The nature of syntactic representation* (pp. 79-130). Dordrecht: Reidel.

Dowty, David R. (1982b). More on the categorial analysis of grammatical relations. In Annie Zaenen (ed.), *Subjects and other subjects* (pp. 115-153). Bloomington: Indiana University Linguistics Club.

Evans, Roger. (1987). Towards a formal specification for defaults in GPSG. *Cognitive Science Research Paper* no. CSRP 084, University of Sussex.

Gazdar, Gerald, Ewan Klein, Geoffrey K. Pullum, and Ivan Sag. (1985). *Generalized Phrase Structure Grammar*. Cambridge, MA: Harvard University Press.

Gazdar, Gerald and Geoffrey K. Pullum. (1981). Subcategorization, constituent order, and the notion "head". In M. Moortgat, H. v.d. Hulst, and T. Hoekstra (eds.), *The Scope of Lexical Rules* (pp. 107-123). Dordrecht: Foris.

Gazdar, Gerald, Geoffrey K. Pullum, Ewan Klein, Robert Carpenter, Thomas E. Hukari, and Robert D. Levine. (1988). Category structures. *Computational Linguistics 14*, 1-19.

Hukari, Thomas E. and Robert D. Levine. (1987). *Generalized Phrase Structure Grammar* : A review monograph. To appear in *Linguistic Analysis*.

Hukari, Thomas E. and Robert D. Levine. (1988). Liberation and inversion in GPSG. In Hagit Borer (ed.), *Proceedings of the West Coast Conference on Formal Linguistics 7* (pp. 159-170). Stanford: Stanford Linguistics Association.

Pollard, Carl J. (1984). Generalized Phrase Structure Grammars, Head Grammars, and natural language. Ph.D. Dissertation, Stanford University.

Pollard, Carl J. (1985). Phrase structure grammar without metarules. In Jeffrey Goldberg, Susannah MacKaye, and Michael Wescoat (eds.), *Proceedings of the West Coast Conference on Formal Linguistics 4* (pp. 246-261). Stanford: Stanford Linguistics Association.

Pollard, Carl J. and Ivan Sag. (1987). *Information-based syntax and semantics, volume 1: Fundamentals*. CSLI Lecture Note Series no. 13. Chicago: University of Chicago Press.

Pullum, Geoffrey K. (1982). Free word order and phrase structure rules. In James Pustejovsky and Peter Sells (eds.), *Proceedings of the North Eastern Linguistic Society 12* (pp. 209-220). Amherst, MA: Graduate Linguistic Student Association, University of Massachusetts.

Zaenen, Annie, Joan Maling, and Höskuldur Thráinsson. (1985). Case and grammatical functions: The Icelandic passive. *Natural Language and Linguistic Theory 3*, 441-483.

Zwicky, Arnold M. (1985). Free word order in GPSG. Paper presented at the Linguistic Society of America summer meetings, Georgetown University.

Zwicky, Arnold M. (1986). Concatenation and liberation. In Anne Farley, Peter Farley and Karl-Erik McCullough (eds.), *Papers from the Regional Meeting of the Chicago Linguistic Society 22* (pp. 65-74). Chicago: Chicago Linguistic Society, University of Chicago.

ASSIGNMENT OF SYLLABLE STRESS IN A DEMISYLLABLE-BASED TEXT-TO-SPEECH SYNTHESIS SYSTEM

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The purpose of this paper is to describe an algorithm that has been developed to determine the stress pattern of polysyllabic words in English. Stress is one determinant of word pronunciation in English, and the algorithm is an important component of a demisyllable-based text-to-speech synthesis system. The algorithm described here is a computationally efficient and accurate system for assigning primary stress to English words.

1. INTRODUCTION

The conversion of written English text into intelligible speech by means of a computer involves a number of different steps. The first of these is the conversion of text to some abstract linguistic form that represents the pronunciation of each word in the text. Within this stage there are two components that rely on each other in obtaining a high degree of accuracy for later stages in the synthesis procedure. The first of these is the conversion of English letters into phonemes. The second is the determination of the stress pattern for polysyllabic words. This paper describes an algorithm that has been developed to predict English stress. The algorithm is currently being used in a demisyllable-based text-to-speech synthesis system (Eady *et. al.*, 1988).

2. SRESS IN ENGLISH

The correct assignment of stress to words in English is an important aspect of any text-to-speech synthesis system. Stress in English can be defined as the relative prominence of the syllables in a word, and it has an important influence on pronunciation. For example, it is a difference in stress that causes the difference in pronunciation between the noun "*OBject*" (with primary stress located on the first syllable) and the verb "*obJECT*" (with primary stress located on the second syllable). This difference in stress is manifested by variations in the pitch, duration and amplitude of each syllable in a word. There are varying degrees of stress in English words and the main concern of this paper is to determine the placement of the primary or main stress in words (i.e., the most prominent syllable).

3. AN ALGORITHM FOR STRESS ASSIGNMENT

While English is notorious for its complicated stress patterns, there are certain features of the language that can be exploited to help predict stress placement in a word. These features can be used in an algorithm for predicting the location of primary stress. In particular, it has been noted that the morphological and phonological structure of an

English word can be used to predict the location of the primary-stressed syllable. For example, it is known that certain English suffixes influence stress. Thus, the suffix -eer (as in the word *enginEER*) attracts primary stress to itself. On the other hand, words containing the suffix -ical (as in *CHEMical*) cause the primary stressed syllable to immediately precede the suffix.

Previous work on this problem has shown that a simple rule for the assignment of stress to English words can operate as accurately as other more complex algorithms (Bernstein and Nessly, 1981). However, there are some problems with this approach, because it does not account for the variations in stress patterns that are predictable from the morphological composition of words in English. In particular, it has been noted that the most effective way of predicting the primary stress of a word is accomplished by incorporating a basic stress rule with some level of morphological decomposition (Klatt, 1987).

Following the analysis by Fudge (1985), on the effect of affixes (i.e., prefixes and suffixes) on stress patterns in English, an algorithm has been developed that will locate the primary stressed syllable. The algorithm has two components: one makes use of a basic stress rule, the other involves the analysis of words into their constituent morphemes. These components will be discussed in detail in the following sections. This in turn will be followed by a description of how the two components interact in the design of the algorithm.

3.1 Basic Stress Rule

Much work has been done to formally capture the systematic variations in the location of main stress for English words (Chomsky and Halle, 1968; Liberman and Prince, 1977; Selkirk, 1984). This previous work has pointed to the concept of "syllable weight" as being important for stress determination in a word. Syllable weight refers to the phonological structure of each syllable. A "heavy" syllable is one that ends in a consonant cluster (i.e., more than one consonant). A "light" syllable is one that ends with a single consonant. This concept is important for stress placement, because it is usually a heavy syllable that carries primary stress. Light syllables are usually unstressed.

Another important observation about basic stress patterns in English is that primary stress rarely occurs on the last syllable of a word. It usually occurs on the penultimate (second to last) or on the antepenultimate (third to last) syllable. The choice of which of these syllables receives primary stress depends on the concept of syllable weight. In particular, stress placement depends on the weight of the penultimate syllable. The following examples illustrate this point.

1. verANDa	2. PAMela
AlASKa	CINema
SamANTHa	aPOCalypse

Note that in 1., the main stress falls on the penultimate syllable, while in 2., the main stress falls on the antepenultimate syllable. This difference in stress assignment is due to a difference in syllable weight for the penultimate syllable of each word. The penultimate syllables in the words of list 1. (i.e., and, ask, anth) are heavy and are thus stressed. For the words in 2., on the other hand, the penultimate syllables, (i.e., el, em, al) are light and are not stressed.

The basic stress rule developed in this algorithm makes use of these generalizations in determining the location of the main stress in each word. The rule is stated as follows:

1. locate the penultimate syllable of the word.
2. if it is heavy, then stress it.
3. otherwise stress the antepenultimate syllable.

This stress rule is capable of assigning stress accurately in conditions where no stress-affecting affixes are located. It is easily stated and easily encoded into an algorithm.

3.2 Effect of Affixes on Stress Placement

Fudge (1985) has produced a comprehensive analysis of the effect of affixes on the stress patterns of words in English. How an affix determines the location of primary stress is known as its *accentual property*. In his analysis of English stress patterns, Fudge has proposed a number of categories capturing these accentual properties. There are four different categories, including both suffixes and prefixes. The categories are described below, and examples of each type are shown in Table 1.

3.2.1 Autostressed Suffixes

As in the example given above, the suffix -eer attracts stress to itself. Suffixes of this type are referred to as *autostressed* suffixes. Autostressed suffixes may be one or more syllables in length. Other examples of autostressed suffixes are listed in Table 1.

3.2.2 Pre-stressed Suffixes

The largest class of stress-affecting suffixes are those that cause stress to be located on a syllable preceding the suffix. These *pre-stressed* suffixes can be subdivided into groups, based on which preceding syllable receives the stress. There are three types of *pre-stressed* suffixes: *pre-stressed 1*, *pre-stressed 2*, and *pre-stressed 1/2*. Examples of each are given in Table 1.

Pre-stressed 1 suffixes are those that stress the syllable immediately preceding the suffix. An example of this is the suffix -ic, which predicts the stress in the words *matheMATic*, *sporADic* and *humanISTic*.

Pre-stressed 2 suffixes cause stress to be placed two syllables prior to the suffix. An example of this is the suffix -tude, which correctly assigns stress to words such as *ATtitude* and *SOLitude*.

The third type of *pre-stressed* suffix is the *pre-stressed 1/2* suffix which locates the stress on either the syllable immediately preceding the suffix or two syllables prior to the suffix. The decision as to which of the two syllables before the suffix will receive stress is based on the notion of syllable weight (as described above). In particular, if the syllable immediately preceding the pre-stressed 1/2 suffix is heavy, then it will carry primary stress. If it is light, then stress will be assigned two syllables preceding the suffix. An example of this type of suffix is -al as in the words *uniVERSal* and *orIGinal*. In the first example, the syllable preceding the suffix (i.e., VERS) is heavy and receives stress. In the second example, the syllable in question (i.e., in) is light, and so stress is assigned to the preceding syllable (i.e., RIG). Other examples of pre-stressed 1/2 suffixes are shown in Table 1.

Table 1

Accentual Properties of English Affixes.

Affix Type	**Affix**	**Example**
Suffixes		
Autostressed	-ette	cigarETTE
	-ation	imaginATion
	-self	himSELF
Pre-stressed 1	-ic	sporADic
	-ssion	perMISSion
	-metry	geOMetry
Pre-stressed 2	-ene	acETylene
	-gon	PARagon
	-tude	SOLitude
Pre-stressed 1/2	-al	uniVERSal
		oRIGinal
	-is	syNOPsis
		GENesis
Stress-Neutral	-less	BOTtomless
	-ish	YELlowish
	-dom	MARtyrdom
Prefixes		
Stress-Repellent	ex-	exERT
	ac-	acCOUNT
	af-	afFECT

3.2.3 Stress-neutral Suffixes

The last group of suffixes are referred to as *stress-neutral*. While *stress-neutral* suffixes do not directly influence the placement of primary stress, they do play a role in the stress location. *Stress-neutral* suffixes do not have an accentual property associated with them. This can be seen in how they can attach to words without affecting the stress pattern. For example, when the suffix -ment is attached to the word *GOVern* to create the form *GOVernment*, there is no change in the stress pattern. However, if the suffix -ment is not located prior to the determination of stress, when the basic stress rule is applied it will incorrectly assign main stress on the penultimate syllable as follows: *govERNment*. This is because the penultimate syllable (ERN) is considered heavy and will be assigned stress according to the basic stress rule. Therefore it is important to strip off all *stress-neutral* suffixes prior to the application of the basic stress rule. In this way, *stress-neutral* suffixes are important in the development of a more accurate system of stress assignment.

3.2.4 Prefixes

Prefixes are important in the determination of stress in that there are some with the accentual property of repelling stress. These, appropriately, are referred to as stress-repellent prefixes. An example of this is the prefix ex- in the words *exPEL*, *exCITE* and *exERT*. In these words, we would normally expect to have stress on the first syllable (in accord with the basic stress rule). However, the presence of the stress-repellent prefix causes stress to be placed on the second syllable in each case. Note that these prefixes have a bearing on stress placement, only if there are no stress-affecting suffixes attached to the word in question.

3.3 Design of the Algorithm

The algorithm developed for assignment of primary stress is based on the basic stress rule and the stress-affecting affixes that were just described. As mentioned previously, the stress-assignment algorithm is just one component in the conversion of text to speech. Thus, its development has been influenced by other components. In particular, it is closely linked to the letter-to-sound rules which determine the phonetic pronunciation of each syllable. In fact, the stress-assignment algorithm works simultaneously with the letter-to-sound rules to determine the pronunciation of a word. The input to these two components is English orthographic text. The output is a phonetic transcription of each word along with assignment of primary stress on a particular syllable.

The stress-assignment component works as follows. When a word is encountered, the program attempts to detect the presence of suffixes. If there is a suffix, one of two things occurs. If the suffix is *stress-neutral*, then it is necessary to check for further suffixes. This continues until either a stress-affecting suffix is located, or until no more suffixes are found. The algorithm then does one of two things to determine the stress. If the suffix is not *stress-neutral*, then stress is located based on the *accentual properties* of the suffix. In the event that no stress-affecting suffixes are located, then the program looks for stress-affecting prefixes. If no suffixes or prefixes are found, or if only *stress-neutral* suffixes are found, then the location of the primary stressed syllable is determined by the basic stress rule (described above).

3.4 Sample Derivations

To clarify how the algorithm works some sample derivations will be given that illustrate some of the various components of the algorithm. The first example is the word ALASKA. When the algorithm checks for the presence of suffixes or prefixes it finds none. Therefore, stress must be assigned by the basic stress rule. This operates by examining the penultimate syllable to see if it ends in a consonant cluster. Because the syllable is ASK, and it ends in a consonant cluster, it correctly receives the main stress.

The second example is the word HIMSELF. When the algorithm checks for the presence of suffixes or prefixes it finds that the word ends in the suffix -SELF. This is noted to be an autostressed suffix. Therefore the main stress is located according to this accentual property. The main stress is correctly located on the final syllable of the word.

4. LEVEL OF ACCURACY

The algorithm described here has been evaluated using a method that has been used to assess other such algorithms. A corpus of 475 polysyllabic words was compiled from the Brown Corpus of most frequent words of English (Kucera and Francis, 1967). The list contains the most frequent polysyllabic words of English. The algorithm was tested on this list in order to determine its accuracy and to compare it to the accuracy of other systems. After each word was tested, it was evaluated as to whether the stress was located on the correct syllable. When a doubtful stress pattern was encountered, the Canadian Gage Dictionary was used as a reference.

For this corpus of 475 most frequent words it was found that the program currently operates at a level of 85% accuracy. This is as accurate or more accurate than other systems discussed in the literature. Using the same corpus of words, Hunnicutt (1976) reported an accuracy of about 68%. Bernstein and Nessly (1981) by using a simple basic stress rule alone reported an accuracy of 75%. Church (1985), by taking advantage of the accentual properties of suffixes plus a basic stress rule has achieved an accuracy level of 82%.

A further test of accuracy for the algorithm described here was run on a text that will be used as part of an information delivery system under development at the Centre for Speech Technology Research. The text consisted of 1318 words, 145 of which were unique occurrences of polysyllabic words. The algorithm maintained its accuracy level of 85%.

This high level of accuracy was achieved without the use of an "exceptions dictionary". Klatt (1987) has noted that when an algorithm that predicts stress at a level of 85% accuracy is combined with an exceptions dictionary of 2000 words, this results in an overall accuracy of 97%. This suggests that the use of such an exceptions dictionary with the stress-assignment algorithm described here will produce a level of accuracy that will be quite adequate for text-to-speech synthesis.

5. SUMMARY

In summary, the algorithm presented here represents a computationally efficient and accurate system for the task of assigning primary stress to English words. Combined with a set of letter-to-sound rules, it allows one to type any English word and have as output a phonemic representation of the word with the location of the primary stressed syllable.

The algorithm has been designed so that if there are any further changes that need to be made to increase the accuracy, this can be accomplished with great facility.

6. ACKNOWLEDGEMENTS

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REFERENCES

Bernstein, J. and Nessly, L. (1981). "Performance comparison of component algorithms for the phonemicization of orthography." *Proceedings of the 19th Meeting of the Association of Computational Linguistics*: 19-22.

Chomsky, N. and Halle, M. (1968). The Sound Pattern of English. Harper and Row. New York.

Church, K.W. (1985). "Stress Assignment in Letter-to-Sound Rules for Speech Synthesis." *Proceedings of the 23rd Meeting of the Association for Computational Linguistics*: 246-253.

Eady, S.J., T.M.S. Hemphill, J.R. Woolsey, and J.A.W. Clayards. (1989). "Development of a demisyllable-based speech synthesis system." *Proceedings of the IEEE Pacific Rim Conference on Communications, Computers and Signal Processing*, this volume.

Fudge, Eric. (1985). English Word Stress. George Allen and Unwin Publishers.

Hunnicutt, Sharon. (1976). "Phonological Rules for a Text-to-Speech System." *American Journal of Computational Linguistics*. Microfiche 57. 1-72.

Klatt, Dennis (1987). "Review of text-to-speech conversion for English." *Journal of the Acoustic Society of America*, 82(3). 737-793.

Kucera, H. and Francis, W.N. (1967). Computational Analysis of Presentday American English. Brown U.P. Providence, R.I.

Liberman, M. and A. Prince. (1977). "On stress and linguistic rhythm". *Linguistic Inquiry* 8: 249-336.

Selkirk, E.O. (1984). Phonology and Syntax: the Relation between Sound and Structure. MIT Press, Cambridge, Massachusetts.

ADJECTIVES IN ENGLISH COMPOUNDS*

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In this paper, I advance two claims about English adjectives, explore the predictions made by these claims, and discuss the ramifications of the analysis for current debates about how phrasal syntax interacts with the word-level phenomenon of compounding. The aspect of phrasal syntax most relevant to this material involves adjectival modifiers inside noun phrases; in the NP *red balloons*, *red* modifies the head noun *balloons*, where 'modifies' refers to an operation on the head which limits or restricts its meaning. The aspect of compound structure to be investigated here also involves adjectives; the compound formation rules of English contain (the equivalent of) a PSR N → A N, which generates compounds like *redhead* (Selkirk 1982: 16). It is not standard to say that *red* modifies the head of this highly lexicalized exocentric compound; no productive operation is being performed on the head *head*. A major difference between compounds and phrases is that an adjective may appear in a compound and not modify anything (*redhead*), while adjectives in phrases always perform a modificational function (*red balloons*); if this position could always be maintained, an interesting formal distinction between compounds and phrases would have been determined. But these two cases illustrate only the ends of a phrasal-to-compound spectrum. Compounds display varying degrees of lexicalization, and under some circumstances an adjective may modify the head inside a compound. For example, Zwicky (1986) argues that *lunar explorátion* is a compound, and it is not unreasonable to claim that *lunar* modifies *exploration*. But if adjectives can be modifiers inside compounds, is there a consistent difference between compounds and phrases in this regard? And is the difference in stress pattern between *rédhead* and *lunar explorátion*, which displays the stress pattern of a phrase, related to the greater degree of compositionality in the latter? In answering 'yes' to each of these questions, this paper identifies a heretofore unnoticed difference between compounds and phrases in English: the behavior of adjectives differs systematically in the two environments.

English compound formation involves aspects of syntax, phonology and morphology, and researchers in all of these areas have employed data from compounds to support their claims. My own work is particularly concerned with how the various structural analyses of compounds compare with the structural descriptions required by accepted theories of compound phonology, specifically compound stress. I draw here on two researchers who have two very different approaches to the problem of integrating

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theories of compound prominence and structure: Selkirk (1984) and Zwicky (1986).

These two theories share the notion that there is an unmarked or default compound stress pattern in English, which is characterized by stress on the first constituent in a two member compound like *hóuseboat*. Zwicky calls this forestress. Under certain conditions, compounds may receive afterstress, that is, stress on their second constituent, as in *state híring, motorcycle máintenance.*[1] The rules which assign afterstress precede and apply disjunctively with the default rule which assigns forestress, by the Elsewhere Condition (Kiparsky 1973, 1982).

Selkirk embeds her analysis of non-default stress within a general theory of focus prominence, with stress assignment rules sensitive to the argument structure of the items comprising the compound. Heads and arguments, as opposed to adjuncts, may optionally receive pitch accents which translate into greater prominence in the metrical grid of the compound.[2] Selkirk's framework derives a premium on the stress patterns in (1), below, where *trúck driver* receives forestress since *truck* fills a semantic argument of the head, just as it fills a semantic argument of *drive* in the phrase *drive trucks*. *Truck* receives a pitch accent because it is an argument.

(1) Selkirk (1984) (a) árgument head — trúck driver
(b) adjunct héad — lily whíte
(c) árgument héad — motorcycle máintenance

Lily-whíte has afterstress because *lily* is an adjunct of *white* and only the head receives a pitch accent. In *motorcycle máintenance*, both the head and the argument receive pitch accents, and this is interpreted as afterstress.

Zwicky's analysis is based not on argument structure, but on more general semantic properties and the categorial makeup of the compounds. The goal of Zwicky's paper is to refute the popular notion that afterstress is only assigned by the Nuclear Stress Rule; that is, that afterstress in a two member item is a reliable diagnostic for the phrasal status of that form. Zwicky claims with Lees (1960) that the ambiguity of an item like *legal dócument* cannot be accounted for if all compounds have forestress. He argues that *legal dócument* is a phrase when it carries the interpretation 'document which conforms to the law'. When it carries the interpretation 'document employed in the legal profession', however, *legal dócument* is a compound, stressed in accordance with the generalization in (2).

(2) Zwicky (1986) [A N] compounds are usually afterstressed.
legal dócument
lunar explorátion

Zwicky argues that *lunar explorátion* is unambiguously a compound and receives afterstress under the same generalization.

Selkirk's analysis enjoys a greater range of coverage than Zwicky's does, and at first it seems that no change is required to enable Selkirk's analysis to capture the facts in (2); afterstress can be derived on adjunct-head and argument-head forms in which the heads and arguments receive pitch accents, as in (1b) and (1c). *Legal dócument*, under both its interpretations, would be adjunct-head, like *lily-whíte*, while *lunar explorátion*, which is arguably of the form argument-head, could receive afterstress in the same manner as *motorcycle máintenance*. But such a solution cannot predict the consistent difference in prominence illustrated in (3), where all of the compounds are argument-head, but the ones which begin with adjectives consistently receive afterstress, in accordance with the generalization in (2). It seems that a change in Selkirk's system is required to account for Zwicky's generalization.

(3)	lunar explorátion	cáve exploration
	stellar observátion	stár observation
	corporate mánagement	stóre management
	nuclear prótest	árms protest

The change I am advocating is developed in Bates (1987), an analysis of compound stress which encompasses the insights of Selkirk's metrical grid-based analysis, but assigns a more limited role to focus-prominence mechanisms in favor of structure-sensitive rules which can also account for Zwicky's generalizations. I will introduce these rules shortly. First, notice that in addition to incorporating Zwicky's generalization in (2), and accounting for the facts in (3), the analysis will have to account for adjective-noun compounds like *bláckbird* and *gréenhouse*, which receive forestress and do not obey the generalization. In fact, only a subset of English adjectives appear in the first position of adjective-noun compounds like those in (2) and (3). Zwicky notes this, citing Levi (1978) and arguing that only non-predicating adjectives appear in compounds like *lunar explorátion* and *corporate mánagement*. I have found it useful to adopt such a position in my analysis of English compounds; it forms one of the two claims I will advance about the English lexicon. Each adjective is marked in its lexical entry with a value for the feature [±pred(icating)]. The standard test applies for determining which value a particular adjective is marked for. If the adjective can alternate between prenominal and postcopular position in a simple main clause, then it is [+pred]:

(4a) The red ball (bounced).
The ball is red.
red, A, [+pred]

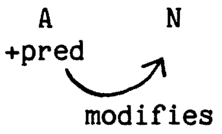
If the adjective may only appear in prenominal position in a phrase, it is [-pred]:

(4b) The presidential election (dominates the media).
*The election is presidential.
presidential, A, [-pred]

Of course, some adjectives have a predicating and a non-predicating use; this is Zwicky's account of the ambiguity of *legal document*; note that the sentence *The document is legal* has only one reading, that the document conforms to the law.

The second claim I wish to make is schematized in (5). Noun phrases may have the form A N, where A is [+pred] and modifies the head.

(5a) Phrases:



[red ball]$_{N'}$

The generality and regularity of this structure indicates its syntactic nature. In contrast, the non-regularity and item-specific semantics of [-pred] adjectives require combinations of the form in (5b) to be listed in the lexicon; that is, these are compounds:

(5b) Compounds: A N [presidential election]$_N$
-pred
modifies

The claim, then, is the normal domain of [+pred] adjectives is syntactic, while the normal domain of [-pred] adjectives is lexical.

So far, I have not made any novel claims. The distinction between predicating and non-predicating adjectives is motivated in the works of Levi (1978), Zwicky (1986), and Coulter (1983), and the first two argue [-pred] adjectives appear in compounds. My analysis does, however, provide a new perspective on the behavior of [+pred] adjectives inside compounds.

All adjectives must be available for the compound formation rules of the language. But the canonical position for [+pred] adjectives to modify another constituent is within a phrase. The idea proposed in Bates (1988) is that [+pred] adjectives may appear in compounds as long as they behave differently inside the compounds than they do in phrases. That is, productively derived phrasal environments are reserved for [+pred] adjectives with their predictable, compositional, modificational, predicating properties, while lexical environments are by definition in conflict with entirely predictable and compositional structures, being fundamentally part of a list. A [+pred] adjective may, however, appear inside a compound if it does not actually modify anything within the compound, because non-modificational structures must be listed, due to their idiosyncratic nature. A [+pred] adjective may also appear in a compound if it adopts some [-pred] behavior. Details follow.

The compound stress mechanisms are sensitive to the feature [±pred]. The templates in (6) are special beat-addition rules introduced in Bates (1987).[3] They specify bracket configurations in which an extra beat is added to the compound. The extra beat is the x in each template:

(6) Bates (1987) Adjective Template 1 (AT1): $x]_{\substack{A\\+pred}}$

Adjective Template 2 (AT2): $]_A \quad [x$

Default Template: $x]_W \quad {}_W[$

The extra beat translates into greatest prominence on the constituent closest to the target position of the beat, which is where "x" is positioned in the template. The templates are given here in order of (disjunctive) application.

A template aligns with a compound right to left, at the first position in which its bracket configuration is completely satisfied. The beat added by the template aligns with the closest grid column at the highest metrical level. Thus, AT1 prosodically highlights [+pred] adjectives appearing in compounds, as in the derivation in (7a), where the circled gridmark represents the one added by the template, and the template is shown directly below the rightmost position in which its bracket configuration is satisfied.

(7a)

```
    ⓧ
    x         x
    x         x
    x         x
 [black]A  [board]N          base
      +pred

      x]A                    AT1
      +pred
```

(7b)

```
              ⓧ
    x         x
    x         x
    x         x
 [grass]   [green]A          base
                +pred

               x]A           AT1
                +pred
```

The noncircled gridmarks represent the lexical grids for the constituents of the compound which form the input to the compound formation and compound stress rules. The derivation in (7b) shows that [+pred] adjectives in head position are also given prosodic highlighting by AT1. AT1-stressed compounds, in general, are the most lexicalized of the adjective-containing compounds; this prosodic highlighting can be looked at as a signal that an adjective is exhibiting some behavior beyond what it is normally lexically specified to do.

But some adjectives are behaving quite in keeping with their lexical entries by appearing inside compounds. Adjectives which are lexically specified as [-pred] require no special stress marking, since item-particular semantics is the norm for them and they require listing anyway. Structures which contain [-pred] modification fall in the middle of the phrasal-to-compound spectrum. Although less compositional than the normal predicating modification of phrases, a structure defined by [-pred] modification is more compositional than one with a [+pred] adjective appearing in the compound, since modification of whatever type is a more tractable operation than the idiosyncratic connections formed in non-modificational structures like *redhead* and *blackboard*. This lack of a requirement for highlighting results in Adjective Template 2, a general stress template for adjective-containing compounds which applies disjunctively with AT1.

Adjective Template 2 expresses Zwicky's generalization that A N compounds normally receive afterstress, as in the derivation in (8):

(8)

```
                ⓧ
   x            x
   x            x
   x x          x x
 [solar]A    [power]N        base
     -pred

       ]A    [x              AT2
```

AT2 assigns its compounds the same prominence relations found in phrases; this is consistent with their relatively more compositional nature and the fact that syntactic prehead modifiers are normally not prosodically prominent. The model at this point makes no formal connection between AT2 and the Nuclear Stress Rule, but these considerations suggest that AT2 is a natural rule.

The default template in (6) assigns forestress to compounds consisting of two W categories, where W is the morphological category Word (Selkirk 1982). This is illustrated in (9a):

(9a)

```
          ⓧ
          x          x
          x          x
          x          x
        N[house]N  N[boat]N .            base

             x]W  W[                     Default Template
```

The default template has counterparts in both Zwicky's and Selkirk's analyses and is well motivated as a rule of English grammar. Striking confirmation of the analysis is provided when the head on an N A compound is [-pred]; the following derivation is predicted to hold:

(9b)

```
          ⓧ
          x       x
          x       x
          x       x
        N[dog]N  A[eared]A               base
                      -pred

           x]W  W[                       Default Template
```

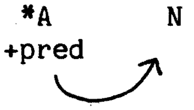
Neither AT1 nor AT2 could assign stress to the compound in (9b) since their structural descriptions are not met; default forestress obtains.

According to the claims in (4) and (5), adjectives in English compounds can differ in at least two ways: they can be + or - predicating, and they can either modify a constituent within the compound or not modify anything within the compound. These two parameters, coupled with the two possibilities for the placement of an adjective in a two member compound, spawn several possibilities for compound structure. Another variable lies in the fact that adjectives may either appear with nouns or other adjectives inside compounds. The different possibilities predicted by the interaction of all of these factors are enumerated in Table 1.

Each of the compound types listed in Table 1 is predicted to bear a certain stress by the rules in (6). I will now turn to a discussion of the possibilities in Table 1 and to the consequences of this analysis.

The first combination described in Table 1 is not a compound at all. The form is A N, where the adjective is [+pred] and modifies the head:

(10) Type 1



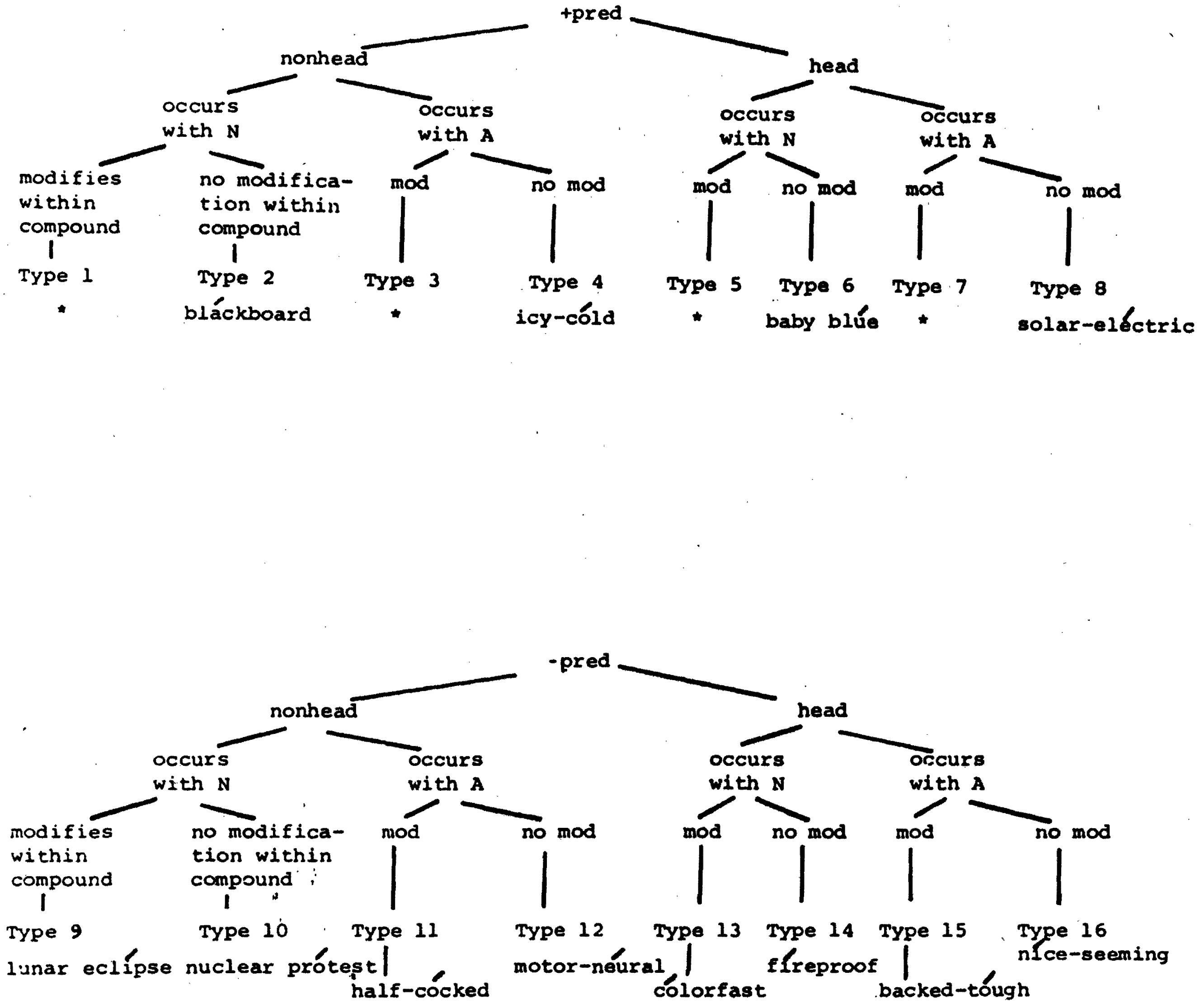


TABLE 1

A TAXONOMY OF ADJECTIVE-CONTAINING COMPOUNDS

This is of course the canonical form for a noun phrase:

(11) [the red ball]$_{NP}$

A lexical compound of this form could not exist under the analysis presented here, which claims that productive [+pred] modification is a syntactic phenomenon. In order to become a compound, the phrase would have to become lexicalized.[4] I claim that the formal concomitant of this lexicalization is the loss of the [+pred] feature on the adjective. This would yield an item of the form A N, where A is [-pred] and modifies the head. This is type 9 in Table 1 and will be discussed shortly.

The only way the adjective could retain its [+pred] feature would be to not modify the head, and simply be semantically juxtaposed to the N, rather than predicating of it. This is type 2 in Table 1.

Examples of type 2 compounds appear in (12):[5]

(12) Type 2
bláck board
bláck bird
hót tub
hígh school
swéet talk
hígh jump

This is a very productive type of compound. A [+pred] adjective is combined with a head noun, but does not modify that head noun. I suggest that these are interpreted in a manner analogous to N N compounds. The following quotation from Selkirk (1982) expresses a standard, if informal, position on the interpretation of endocentric N N compounds; I suggest it be extended to cover type 2 compounds as well.

> In general, in endocentric compounds, of which *string apron* and *apron string* are examples, the class of elements denoted by the compound is a subset of the class of elements that would be denoted by the head on its own. The non-head constituent of the compound in some way further defines the head ... (Selkirk 1982: 22).

Modification, I suggest, differs from this kind of interpretation in that not only is a subset relation defined, but the head is actually claimed to possess the property which defines the subset. Under this analysis, *hot* in *hot tub* may define a subset of tubs without actually modifying *tub*; this allows the real-world situation in which a *hót tub* can be cold, or a *bláckboard* can be green. True modification, as in the phrase *a hot stóve*, must involve the head possessing the attribute *hot*.

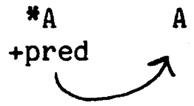
The data in (12) illustrate the first situation which requires prosodic highlighting by AT1; *black*, *hot*, and the other adjectives of (12) are lexically specified to be predicating modifiers, but inside these compounds they are not modifying anything. This type of deviation from the lexical specification of the adjective has a formal concomitant in this theory - the non-modificational relationship in (12) allows the [+pred] adjective to retain its [+pred] feature. AT1 then predicts forestress on the compound, as shown in the derivation in (13). Ignoring word-level grids for clarity of exposition, the top gridmark represents the associated gridmark of the template:

(13)
$\overset{x}{[\text{hot}]_{A}}$ $\quad {}_{N}[\text{tub}]$
$\quad\quad$ +pred

$x]_{A}$ $\quad\quad$ AT1
+pred

As the diagram in (14) shows, type 3 compounds are supposed to have a [+pred] adjective in non-head position and another adjective in head position, where the non-head modifies the head. These do not occur, as indicated by the asterisk below and in Table 1.

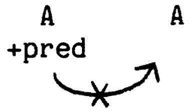
(14) Type 3



The existence of this type of compound is ruled out independently, because adverbs are always non-predicating, by hypothesis. Although I have no detailed motivation for the claim that adverbs are always [-pred], the working definition of a predicating adjective is one which may appear in postcopular position, and this claim about adverbs is at least consistent with this definition. Thus, whenever an adjective modifies another adjective and is thus an adverb, the first will always be [-pred].

As schematized in (15), type 4 compounds have the form A A, where the non-head does not modify the head.

(15) Type 4



Type 4 compounds are illustrated in (16).

(16)
icy-cóld
white-hót
hot pínk
electric blúe

The same principles of interpretation may apply to these compounds as apply to type 2 compounds.

The afterstress on the compounds in (16) is the result of AT1, since the heads in (16) are all [+pred]. The first [+pred] adjective the template can align with, going right to left across the compound, is the head adjective. This is illustrated in (17):

(17)
$[\text{icy}]_{A}$ $\quad \overset{x}{[\text{cold}]_{A}}$
+pred $\quad$ +pred

$x]_{A}$ $\quad\quad$ AT1
+pred

Note that afterstressed compounds are often embedded in Rhythm Rule contexts like *white-hot stóve*; this should not deter us from assigning afterstress on the first compound cycle, since in phrase-final, non-Rhythm Rule contexts, afterstress is the norm for these compounds: *The stove is white-hót.*

When modification is not present, a dvandva or coordinate interpretation is possible for some compounds:

(18) dvandvas: [blue-green]$_A$ shirt

The reading intended is one in which the shirt has the quality of being blue and the quality of being green, whether this be describing a solid color halfway between blue and green or a plaid or striped shirt. Type 4 dvandvas are restricted, however, to adjectives which share many semantic features. Notice the illformedness of a compound like **tall-drúnk*, as in the following:

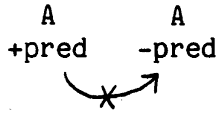
(19) *[tall-drunk]$_A$ man

This item may not describe a man who has the quality of being tall as well as the quality of being drunk. In Bates (1988), I argue that coordinate readings in lexical structures always require the conjuncts to share many semantic features. In order to express the reading intended in (19), a phrasal structure must be employed. At the phrasal level, items can be combined which share very few semantic features:

(20) $_{N'}$[tall $_{N'}$[drunk man]]

The diagram in (21) illustrates that there is another possibility for type 4 compound structures.

(21) Type 4



Type 4 compounds may appear with [-pred] adjectives in head position. The compounds in (22) illustrate this structure.[6]

(22)
róugh cast
níce seeming
néw modeled
stránge sounding
roúgh shod

Although the subset relation does not illuminate the interpretation of these compounds, the [+pred] non-heads are claimed to do something other than modify the heads. In support of this, in the phrase *nice-seeming person*, it is the person, and not the seeming, that has something about niceness being predicated of it.[7]

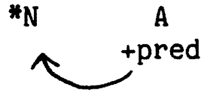
The forestress on these compounds comes from AT1, which skips over the [-pred] head and assigns a beat to the [+pred] initial constituent:

(23)
x
[nice]$_A$ [seeming]$_A$
+pred -pred

x]$_A$ AT1
+pred

With type 5 compounds, we turn to [+pred] adjectives in head position.

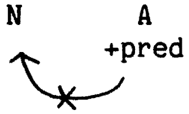
(24) Type 5



Consider the A N structure above. There is nothing to prevent an adjective in head position from modifying the non-head inside a compound; we will have examples of this. However, normal modification of N by [+pred] adjectives is the domain of N' syntax,[8] and type 5 compounds are therefore predicted to be non-occurring in the same manner that type 1 compounds are predicted to not occur. In order to appear with N inside a compound, the A head must either modify the head and lexically lose its [+pred] feature, making a type 13 compound like *cólorfast*, or it may retain its [+pred] feature by not modifying anything inside the compound, which would render the compound type 6.

Type 6 compounds have the form in (25):

(25) Type 6

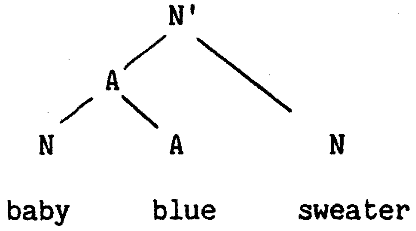


AT1 assigns prominence to these forms by giving the adjective a beat:

(26)
baby blúe
knee déep
grass gréen
dog tíred

The difference between these compounds and *high school*, which illustrates Type 2, is the fact that when the adjective is in head position, as in *baby blúe*, the entire compound is an adjective which can modify something outside the compound. In this way, the integrity of the adjective is preserved in a way that is lost when the adjective is in non-head position. The example in (27) shows the compound *baby blúe* modifying a head noun inside an N', which is the normal way for [+pred] adjectives to modify nouns.

(27)

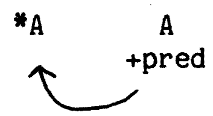


The prediction of this system is that the sweater, and not the baby, is blue, since the [+pred] adjective *blue* is prevented from modifying any constituent inside the compound if it is to retain its [+pred] feature. This is of course the correct interpretation of *baby blue sweater*. In the same way, I claim that in *knee deep water*, the [+pred] adjective is

not modifying *knee*, but *knee* and *deep* combine in a non-modificational relationship to form the compound [+pred] adjective *knee deep*, which in turn modifies *water* in the normal way for [+pred] adjectives to modify nouns within N' phrases.

Type 7 structures are schematized in (28).

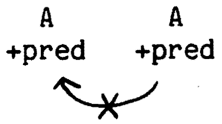
(28) Type 7



A [+pred] head modifying an adjectival non-head is ruled out independently in the same way as type 3 compounds. An adjective modifying another adjective will always be [-pred], due to the adverbial nature of modification of an adjective by another adjective.

Type 8 compounds have the form in (29):

(29) Type 8



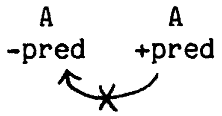
A [+pred] head appears with, but does not modify a [+pred] adjective. These can be illustrated with the same forms as type 4 compounds. Other examples appear in (30) below:

(30)
dead tíred
blind drúnk
wet-cóld

Neither [+pred] adjective modifies the other. AT1 assigns a beat to the rightmost adjective, and afterstress is correctly derived.

In type 8 compounds, a [+pred] head may also appear with a [-pred] non-head which it does not modify:

(31) Type 8



These are illustrated in (32).

(32)
solar-eléctric
lunar-hormónal
fighting-mád

Once again, the dvandva reading is possible when no modification takes place. This is shown clearly in *solar-electric power*. AT1 is responsible for the afterstress of these forms, as it 'flags' the [+pred] adjective appearing in the compound.

This exhausts the possibilities for the occurrence of [+pred] adjectives inside compounds. The rest of the discussion focusses on types 9 through 16, and the behavior of [-pred] adjectives in compounds.

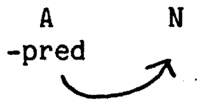
Two possible origins exist for a [-pred] adjective inside a compound; either the adjective is [-pred] by virtue of its lexical entry, as in *lunar*, *nuclear*, and *presidential*, or the adjective is normally [+pred] and has lost that [+pred] feature by virtue of its lexical connection with the other element of the compound. A continuum expressing the amount of lexicalization is perhaps the best way to view the position being taken here.

least lexicalized, purely syntactic: [+pred] A modifying N
   $_{NP}$[an intelligent man]
somewhat lexicalized: A modifying N inside the compound
   $_{N}$[lunar eclípse] $_{N}$[dry íce]
most lexicalized: [±pred] A appearing with, but not modifying N
   $_{N}$[hót dog]

This continuum applies only to compounds of the form A N. When the adjective is in head position, an independent factor comes into play: the percolation of the meaning of the head adjective to the entire compound differs depending on whether the adjective modifes the non-head or not. This will be discussed further in conjunction with type 13 compounds below.

As (33) shows, type 9 describes a [-pred] adjective modifying a head noun.

(33) Type 9



This is the canonical position for [-pred] adjectives to effect modification. Some examples appear below:

(34)
presidential propósal
lunar eclípse
urban spráwl
solar pówer
historical linguístics
generative grámmar

These compounds should be as plentiful as [-pred] adjectives themselves, since it is within compounds that the highly idiosyncratic semantic relationships required by [-pred] adjectives is normally found. Compare, in this regard, the use of *lunar* in *lunar eclipse* and in *lunar madness.*

I have no formal analysis of the semantics of nonpredicational modification to accompany my claim that the adjectives in (34) modify their heads. The very fact that these items are often analyzed as phrases is enough to indicate that the adjective is operating in a manner similar to that of normal predicating adjectives and justifies the claim that some modification is taking place in (34). I do, however, have a few informal observations about the difference between predicating and nonpredicating modification. The subset relation common to predicating modification holds in (34); *lunar eclipses* can be viewed as a subset of the set of eclipses, just like *red balls* form a subset of the set of all balls. Within the set of eclipses, the subset distinguishes items which possess the property of "being lunar" from those which do not. But the intersection relation common to predicational modification is missing in (34); *red balls* is the intersection of the set of balls with the set of red things, but there is no set of "lunar things" which could intersect with the set of eclipses to form the set of lunar eclipses. The model presented here can derive this, because in this model, *lunar* only appears in compounds. Because it only appears in lexical structures, it always forms some special connection with its head. A set of lunar things, defined as a set of things all bearing the same relation to the word *lunar*, is impossible to assemble, because the different heads that appear with *lunar* bear idiosyncratic relations to the adjective. Assembling a set of red things, in comparison, is a straightforward matter, since each item bears exactly the same relation to the adjective *red*; that is, they each possess the property of being red. This contrast is so clear because *lunar* and *red* are easily categorized as to their value for the feature [±predicating]. *Lunar* is [-pred] by virtue of its lexical entry, and *red* is a typical [+pred] adjective; the situation is less clear with adjectives like *legal*, which is marked in its lexical entry as having a predicating and a nonpredicating use, and by the processes which allow [+pred] adjectives to appear inside compounds. The claim is that if modification occurs inside compounds, then that modification will be [-pred] modification, where modification is defined informally as a subset relation requiring the head to possess the property designated by the adjective and [-pred] modification is defined as modification plus some idiosyncratic lexical connection.

The compounds in (34) are Levi's (1978) complex nominals, and she presents several arguments that they are dominated by a lexical, rather than phrasal category; I will not review those arguments here. Compounds like *lunar exploration*, *presidential proposal*, and *stellar observation* (cf. (3) above) also illustrate type 9. The fact that these have additional thematic relationships being assigned inside them is independent of the determination of the + or - pred status of the adjectival constituents and whether modification is taking place inside the compound. However, any statement of thematic roles is beyond the scope of this presentation; Bates (1988) contains some discussion of this issue.

The compounds in (34) receive stress via AT2, since there is no [+pred] adjective for AT1 to assign a beat to. The derivation in (35) is illustrative.

```
(35)                               x
                [lunar]A      N[eclipse]
                     -pred

                       ]A      [x                  AT2
```

The data in (34) all contain adjectives which are marked as non-predicating in their lexical entries. The data in (36) illustrate that type 9 compounds can also be created when an originally [+pred] modifies the head and the modificational relationship becomes highly lexicalized, making these items candidates for compoundhood, and distinguishing their modificational relationship from the normal predicating relationship which is found in phrasal collocations. The proposed analysis of these forms is that the [+pred] adjective assumes a [-pred] usage in order to modify a constituent inside the compound. This [-pred] usage can be attained by adding some extra piece of idiosyncratic meaning to the modificational relationship. This is of course what is normally referred to as lexicalization. Examine the following forms, keeping in mind the claim that there is modification as well as some degree of lexicalization in these forms:

(36)
dry íce
blue cóllar
high kíng
(my) old lády
(the) Blue Ángels
wild ánimal (in [wild animal] park)

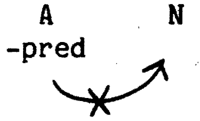
The question at this point is, what evidence do we have that there actually is modification in these structures, and not, for example, a purely lexicalized, non-modificational relationship between the adjective and the noun, as in type 2 compounds? Recall that the distinction between modification and the usual subset relation created by compounding is that in the modificational structure, the head must possess the property defining the subset, while in plain endocentric compounds (e.g., *apron string*), the head need not possess the property which defines the subset (e.g., *blackboard*). The claim is, then, that the heads in (36) possess, to a certain extent, the property normally associated with the adjective on its left, and that these compounds differ from type 2 compounds in exactly this way. An illustrative contrast can be seen in *drýrot*, a type 2 compound, versus *dry íce*, or type 9. In *drýrot*, or *drýdock*, the heads *rot* and *dock* are not really dry in any obvious way; the subset relation between *rot* and *dry rot* is defined in a very idiosyncratic way. But in *dry íce*, I suggest, *dry* is to *ice* as *lunar* is to *eclipse* in *lunar eclipse*; non predicational modification obtains. Possession of the property *dry* can define a subset of kinds of ice, but *dry ice* does not belong to a subset of dry things. The latter would be true if this were predicational modification. *Dry* modifies *ice*, but loses its lexical [+pred] feature by assuming the meaning which prevents all ice that happens to be dry from being solidified carbon dioxide. *Old lády* is another example of a [+pred] adjective taking on extra meaning inside the compound; *old* really does modify *lady* in *old lady*; *lady* possesses the property *old* which defines the subset relevant to the interpretation of the compound, but the *old* inside *old lady* does not refer solely to age, but to status within a relationship.

In contrast, in the type 2 compounds *drýdock* and *drýrot*, the heads do not possess the property *dry* even in a nonpredicational sense. This is not to say that the choice of the first member of a normal endocentric Type 2 compound is totally idiosyncratic (cf. Levi (1978) on why this is not the case); the observation is simply that the meanings of type 9 compounds are more compositional that those of type 2 compounds, in that in type 9 compounds a salient modificational relationship exists between the adjective and the head. Type 2 compounds, in contrast, are no more compositional in semantics than normal endocentric N N compounds like *ápron string*. Of course, even within a particular type, lexicalization should be viewed on a continuum. On the one hand, the compound *wild ánimal* is quite compositional even though the normally [+pred] *wild* is non-predicating here: *The animal is wild* does not paraphrase *the wild animal*. A St. Bernard dog could be a *wild animal* in the predicating sense (*the dog is wild*) and still never be a candidate for a *wild animal park*. On the other hand, *red herring* would be included in the type 9 compounds, and it has extremely idiosyncratic semantics. I would include *red herring* in (36) because all of the compounds in (36) receive afterstress by AT2 (cf. the derivation in (35)) and *red herring* has afterstress. At this point the argument is in danger of being circular - I argue that the compound stress mechanisms are sensitive to the distinctions enumerated in Table 1, but I characterize *red herring* as Type 9 since it has afterstress. Actually, the danger of circularity is not great; the central claim of this paper is that we do not find normal modification by [+pred] adjectives inside lexical structures. *Red herring* is surely not a counterexample to this claim. The model does force me to say that modification exists inside *red hérring*, even though that modificational structure is overshadowed by the great degree of lexicalization in this form. Perhaps *red herring* is not a compound at all, but a real syntactic idiom. I would not like to call all of the items in (36) idioms, however, since they are compositional to a certain extent.

The treatment of type 9 compounds is central to any discussion of the interaction between syntax and morphology; more research is required to fully explore the predictions of this system. Some further remarks on type 9 compounds are included at the end of this paper.

Type 10 compounds have a [-pred] adjective in construction with a head noun which it does not modify.

(37) Type 10



Since this is the canonical position in which [-pred] adjectives modify their heads, and the semantics of [-pred] modification is so item-particular, examples of type 10 may be difficult to distinguish from type 9 compounds. But in the compounds in (38), it seems reasonable to claim that the adjective does not modify the head noun, that the head noun does not possess the property designated by the adjective.

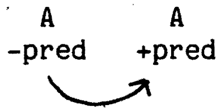
(38)

nuclear prótest
historical línguist
generative grammárian
nuclear enginéer

It is a familiar observation that in no sense is the protest itself nuclear in the normal reading of *nuclear prótest*. Similarly, *historical* appears in type 9 *historical linguistics*, where it modifies the head, and also in *historical linguist*, in which it does not modify the head. These compounds have of course been the center of much discussion, since items like *historical linguist* seem to violate principles of level ordering, and are cited in Sproat (1985) as counterexamples to a lexical phonology model like that proposed in Kiparsky (1982). The system presented here predicts that such compounds should be possible simply because the constituents are available for compounding at level 2, *historical* and *linguist* being products of level 1 processes. The claim is that *historical linguist* is interpreted in the same way as a type 2 compound. This is simply to say that *linguist* does not possess the property of being historical, while *historical* still defines the subset of historical linguists within the set defined by the head *linguists*. The same distinction should be made with regard to *electrical engineering*, a type 9 compound, versus *electrical engineer*, of type 10. Further research is needed to determine how many putative bracketing paradoxes might be explained independently with reference to the framework employed in this paper.

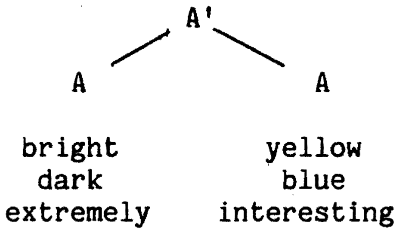
Type 11 specifies a [-pred] adjective modifying a following adjective, which may be [+pred], as indicated in (39):

(39) Type 11



This is the canonical configuration for one adjective to modify another inside A':

(40)



Adverbial modifiers are always [-pred], so an originally [+pred] adjective is under no pressure to form an idiosyncratic connection with the head in order to appear inside the compound. This explains the scarcity of true compounds with converted [+pred] adjectives of type 11. Lexical adverbs will always be [-pred], so the compounds in (41) count as type 11 compounds. These particular items seem lexicalized enough to be called compounds.

(41)
half-cócked
ever-lásting
half-báked
ever-vígilant

I will not treat lexical adverbs in detail in this paper.

The head in a type 11 compound need not be [+pred], however. The compounds in (42) have [-pred] heads and modifiers which were originally [+pred].

(42)
tight-físted
good lóoking
broken-héarted
red-hánded
fast-móving

Notice that even though the [-pred] feature is automatically present on the first adjective, because of its adverbial function, these compounds still tend to take on meanings over and above the normal modificational force found in phrases. Compare *red-hánded*, which means 'guilty' in addition to saying something about the color of the hand (in a figurative sense), with the N' [a red hand], which of course carries no extra meaning.

Type 11 compounds receive stress from AT2: AT1 may not apply, since both adjectives are [-pred].

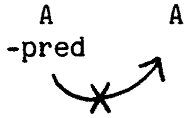
(43)

```
                                x
              [tight]A      [fisted]A
                  -pred         -pred

                   ]A       [x                    AT2
```

Type 12 compounds are schematized in (44).

(44) Type 12



When no modificational relationship exists between the [-pred] non-head and the adjective head, there is no sense in which the first is adverbial, so adjectives which have been converted from [+pred] should not necessarily be prevalent in type 12 compounds.

The data below illustrate lexical [-pred] adjectives in first position inside type 12 compounds.

(45)
solar-eléctric
urban-polítical
motor-néural
stellar-lúnar

The heads in (45) include predicating and non-predicating adjectives (*political* vs. *neural*). Note that the dvandva reading is made possible by the non-modificational structure: *solar-electric power*. Type 12 compounds need not be coordinate in structure, however; compounds like the ones below fit the criteria for type 12 without having a dvandva reading:

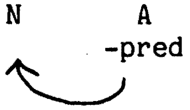
(46)
[hopping]$_A$ mád
[fighting]$_A$ mád

These also illustrate type 8.

The compounds in (45) and (46) receive afterstress from AT1 when the head is [+pred] (*urban-polítical*), and from AT2 when the head is [-pred]: *motor néural.*

Type 13 describes an N A compound in which the [-pred] adjective modifies the noun:

(47) Type 13



So far, we have not had any examples of modification to the left inside a compound. Since adjectives modify a following constituent in English syntax, perhaps there is a general restriction which prohibits a head from modifying a non-head inside a compound. This would automatically exclude types 5, 7, 13 and 15 from being predicted to be possible compounds. However, recall that types 5 and 7 can be independently accounted for in the system presented here. I suggest that type 13 compounds are found in structures like the following; if this suggestion is followed, then no general prohibition exists against modification to the left inside compounds:

(48)
cólor fast
bráin dead
nóse open (existing compound meaning 'angry' or 'aroused')
fóot sore
múscle bound
héart broken

When the originally [+pred] head modifies the non-head, the compound as a whole does not inherit the semantics of the head in the same way it does when the head modifies nothing inside the compound. This is due to the high degree of lexicalization concomitant with [+pred] adjectives appearing in a modificational lexical structure. In this regard, compare a type 6 compound like *dog tíred*, in which the head does not modify the first constituent, with type 13 *cólorfast*. When each is used in a noun phrase, the meaning of the head *tired* is retained to a greater extent than that of *fast*:

(49) Type 6 a dog-tired student
Type 13 a color-fast sweater

This can be seen in the fact that the student is tired, but the sweater is not fast. The percolation of the meaning of the head of a compound intact to the meaning of the mother compound is one sign of the lesser degree of lexicalization in type 6 compounds as opposed to type 13 compounds and other compounds in which normally predicating adjectives modify constituents within lexical structures.

This system suggests that the semantic connection between the adjective and the noun in (48) is strong and idiosyncratic enough to trigger the removal of the [+pred] feature on the adjective. This certainly seems to be true of *fast*, *open* and *bound* in their respective compounds in (48), and it also explains why type 13 compounds are not particularly productive. The following compounds sound strange because the [+pred] adjectives do not easily assume enough extra meaning to allow them to modify within the compound:

(50)
*a [window-open] house
*a [street-dirty] city
*a [dress-white] bride

Once the lexicalization triggers the loss of the original [+pred] feature on the adjective, the compounds in (48) do not meet the structural description of AT1 or AT2. The default template must apply, assigning forestress to these forms:

(51)

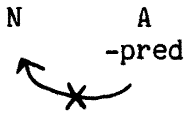
$$\begin{array}{ll} \text{x} & \\ [\text{color}]_N & {}_A[\text{fast}] \\ & \text{-pred} \\ & \\ \text{x}]_W & {}_W[\end{array}$$

Default Template

I have found no lexical [-pred] adjectives in head position of type 13 compounds. Although I have no formal account of this fact, it could be due to the fact that despite the existence of compounds like those in (48), modification to the left is a marked option inside compounds, and only normally predicating adjectives may appear in such marked structures.

Type 14 compounds have an N A structure in which the [-pred] head does not modify the noun:

(52) Type 14



Stress in these forms is predicted to fall on the noun, because AT1 requires a [+pred] feature and AT2 looks for a compound-initial adjective. The default template must apply. These compounds are quite common:

(53) séa-faring
dóg-eared
fróstbitten
diséase-prone
fíre-proof

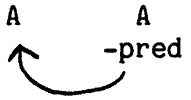
The heads in (51) are lexically [-pred]. Although there is no pressure for lexicalization in a compound with no modificational structure, lexicalization is of course allowed. This yields the following, which have heads that are normally [+pred], but become [-pred] due to the lexical connections inside the compound:

(54) blóod thirsty
sláp happy
gírl crazy
séasick

These compounds contrast with type 8 *baby blúe,* which has afterstress because the [+pred] feature has been retained on the head adjective. Moreover, the compound *baby blúe* inherits the semantics of its head *blue* in the same way that type 6 *dog tíred* inherits the meaning of *tired. Bloodthirsty* and the other compounds in (54), in contrast, do not inherit the meanings of their heads intact, placing them higher on the continuum of lexicalization than the more compositional forms of type 8. The head in *blóodthirsty* has lost its [+pred] feature due to this lexicalization, and forestress by the default template is consistent with the fact that *bloodthirsty* has highly non-compositional semantics. Even *seasick,* although it does refer to a subset of types of discomforts which might be called sicknesses, lacks the meaning 'diseased' which normally accompanies the normal predicating use of the adjective *sick.*[9]

Type 15 compounds have the following form.

(55) Type 15



These are not well attested. However, this result may be derivable. According to the suggestion at the end of the type 13 discussion, lexical [-pred] adjectives resist modifying to the left because they lack the ability to appear in this marked construction. Type 15 compounds with lexical [-pred] non-heads are ruled out because non-predicating adjectives cannot themselves take modifiers, even in phrasal collocations: **a reportedly nuclear engineer,* **some often lunar eclipses.*

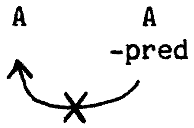
Originally [+pred] adjectives in head position inside type 15 compounds would be under no pressure to undergo extensive lexicalization, since they would be [-pred] by virtue of being adverbial. But without lexicalization, the proper configuration for adverbial modification of an adjective is within adjective phrases. The following, from a Ford Motor Company advertisement, seem to have a coined, lexicalized quality, and might be synonymous with the adjective phrases *toughly built* and *toughly backed.*

(56) [built tough] American cars
[backed tough] warranty

These are candidates for type 15 compounds, but I believe that further research will reveal a general prohibition against the configuration in (55), due to the combination of factors mentioned above.

Concluding the discussion of Table 1, type 16 compounds have the form designated below.

(57) Type 16



Type 16 compounds have already been illustrated. When the non-head is [+pred], the compound has the same structure as a type 4 compound like *níce-seeming*. When the non-head is non-predicating, type 12 compounds illustrate (57): *motor-néural*. The following dvandvas illustrate type 12 and type 16:

(58)
stellar-lúnar
presidential-gubenatórial
legal-lógical

Many of the [-pred] adjectives which have illustrated other types are constrained by an independent factor which Walinska de Hackbeil (1986) terms redundancy. These include the head adjectives in compounds like *long-legged*, *bare-headed*, and refers to the fact that such adjectives are not used alone because it is pragmatically odd to speak of a *legged man* or a *headed woman*. This independent consideration explains why this last illustration of type 16 is not very productive and can only have non-redundant non-predicating constituents like *lunar* and *presidential*, the following compounds being ill-formed as redundant adjectives in isolation:

(59)
*legged-headed
*faring-seeming
*proof-resistant
*boggling-prone

Having illustrated the possibilities predicted by the claims in (4) and (5), I turn now to a brief discussion of one of the consequences of this analysis for current debates in morphological theory. The model assumed in this work and in Bates (1988) incorporates the Principle of Syntax-Free Morphology.[10] The idea that there is a fundamental distinction between lexical and syntactic processes is under attack in the works of Walinska de Hackbeil (1986), Sproat (1985) and others. The present analysis is based on the claim that [+pred] adjectives behave differently in compounds than they do in phrases; to the extent that it is successful in accounting for the complex facts involving compounds, support is found for the Principle of Syntax-Free Morphology. True phrasal combinations should not appear embedded inside compounds if this position is to be maintained.

Type 9 compounds are at the center of any debate regarding the phrasal/lexical behavior of English adjectives, and I return now to type 9 compounds which contain lexically specified [+pred] adjectives which have developed [-pred] uses inside lexical structures like those in (36). As explained in footnote 4, this analysis does not require productive derivation of [-pred] adjectives from lexically specified predicating adjectives. However, Bates (1988) suggests that speakers do have the ability to productively assign idiosyncratic meanings to lexical [+pred] adjectives which appear, for whatever reason, inside a novel compound. That discussion involves contrived items like [[brown dog] catcher] ('catcher of brown dogs'), which Sproat (1985) claims is an example of a phrasal projection *brown dog* appearing inside a compound, supporting his position that there is no formal separation between lexical and syntactic processes. Such a separation is supported, however, by the observation that if *brown dog catcher* is interpretable in this way, it is my strong impression that *brown dog* must be given some [-pred] force, resulting in a reading which presumes something special about the brown dogs that are being caught, some quality that they share over and above the color of their fur. The particular extra quality assumed could vary from hearer to hearer, or simply remain unspecified; the essential point is that some lexical connection is assumed to exist. In the same manner, the attested compound [[old house] lover] designates a person who appreciates a particular style of architecture, not one who loves any hovel which predates a particular period; the second would be the expected reading, if the lexical [+pred] adjective *old* had not developed a [-pred] use inside the lexical structure. These are preliminary comments on the results of the analysis presented here; further research will clarify these issues.

NOTES

[1] Dialect and idiolect differences may exist between the author and the reader with regard to the existence of particular compounds and the stress associated with them. Most of the data in this paper are cited in published sources, all dealing with American English (cf. Roeper and Siegel (1978), Selkirk (1982, 1984), Zwicky (1986)).

[2] For background on the use of grids in metrical phonology, see Liberman and Prince (1977), Prince (1983), and Selkirk (1984).

[3] For a discussion of the use of templates in generative phonology, see McCarthy and Prince (1986).

[4] Although this discussion is cast in derivational terms, it is not necessary that the model include actual derivations from [+pred] to [-pred]. This could be reformulated in terms of a checking mechanism which values compounds more to the extent that they conform to the configurations enumerated in this paper.

[5] The classification of the compounds in (12) as belonging to type 2 implies the characterization of *black, hot, high* and *sweet* as [+pred] adjectives. In this paper, I will not argue for a particular assignment of [±pred] for a given adjective, because the relevant test is simple to construct (cf. (4)). The reader should bear in mind that some adjectives are lexically specified for a predicating and a nonpredicating use. See also footnote 6.

[6] The [-pred] classification for the heads in (22) deserves some comment. These are all deverbal adjectives, and homophonous forms in *-ing* can appear after progressive *be*: *is seeming, is sounding*, and the others can appear in passives: *is cast, was modelled*, but the test [+pred] status involves postcopular position only. Adjectival passives are difficult to characterize in this regard, since many have developed predicating uses: *The torn book, The book is torn*; the second has a copular as well as a passive reading. This issue is related to the lexicalization of deverbal forms in general; the more lexicalized a form becomes, the more likely it is to develop a [+pred] use. This topic, however, is beyond the scope of this paper.

[7] In the same manner, in *strange-sounding person, strange* is not modifying *sounding* and can therefore percolate its meaning intact to the mother compound. This analysis, however, does not extend to items like *stránge-sounding* when it is used in a phrase like *strange-sounding violin.* If *strange* is an adverbial modifier in this last case, the model predicts afterstress, as in the type 11 *fast-móving, quick-thínking* (cf. (42)). This use of *stránge-sounding* no doubt receives forestress because *strange* is focussed and *sounding* is a redundant adjective (Walinska de Hackbeil (1986), cf. (59)), although the model at this point does not directly account for this form.

[8] I have been assuming a standard syntactic analysis of noun phrases which positions adjectives within the first phrasal projection of N; the claims in this paper would hold if adjectives were found to be located outside the minimal phrase, a position defended in Coulter (1983).

[9] Selkirk (1984) analyses some of the compounds in (54) as being argument-head. Indeed, there are other compounds which seem fairly productively derived which would need to be type 14 in order to be stressed correctly: *wáter-repellent, fóod-safe* (*pottery*). I would claim that the argument structure in these forms is a separate issue from their modificational structure, as argued for *lunar exploration.*

[10] This felicitous name, for a principle which has had many different versions and names in the literature, is the one employed in ongoing work by G. Pullum and A. Zwicky.

References

Bates, D. (1987). Templates for English Compound Stress. Delivered at the LSA Annual Meeting, San Francisco.

Bates, D. (1988). Prominence Relations and Structure in English Compounds. Doctoral Dissertation, University of Washington.

Coulter, J. (1983). *Prenominal Adjectival Modifiers in English.* Doctoral dissertation, University of Washington.

Kiparsky, P. (1973). Elsewhere in Phonology. Pp. 93-106 in *A Festschrift for Morris Halle.* S.R. Anderson and P. Kiparsky, eds. New York: Holt, Rinehart and Winston.

Kiparsky, P. (1982). From Cyclic Phonology to Lexical Phonology. Pp. 131-177 in *The Structure of Phonological Representations* (*Part I*). H. van der Hulst and N. Smith, eds. Dordrecht: Foris.

Lees, R. (1960). The Grammar of English Nominalizations. *IJAL* 26.3, Part II.

Levi, J. (1978). *The Syntax and Semantics of Complex Nominals.* New York: Academic Press.

Liberman, M. and A. Prince. (1977). On Stress and Linguistic Rhythm. *Linguistic Inquiry* 8: 249-336.

McCarthy, J. and A. Prince. (1986). Prosodic Morphology. Unpublished ms., University of Massachusetts at Amherst.

Prince, A. (1983). Relating to the Grid. *Linguistic Inquiry* 14: 19-100.

Roeper, T. and M. Siegel. (1978). A Lexical Transformation for Verbal Compounds. *Linguistic Inquiry* 9: 199-260.

Selkirk, E.O. (1982). *The Syntax of Words.* Cambridge, MA: MIT Press.

Selkirk, E. O. (1984). *Phonology and Syntax: The Relation between Sound and Structure.* Cambridge, MA: MIT Press.

Sproat, R. W. (1985). *On Deriving the Lexicon.* Doctoral dissertation, MIT.

Walinska de Hackbeil, H. (1986). *The Roots of Phrase Structure: The Syntactic Basis of English Morphology.* Doctoral Dissertation, University of Washington.

Zwicky, A. M. (1986). Forestress and Afterstress. In *Ohio State Working Papers in Linguistics* 32: 46-62.

DIALECT CONTACT AND DIALECT TRANSITION: A CASE STUDY*

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1. INTRODUCTION

Traditional areal dialectology has long recognized three types of speech areas: focal areas having a centre of prestige or power where linguistic innovation is constantly taking place and whence the innovations spread into the surrounding geographical area (e.g., London, New York, Toronto); relic areas where the unique dialect features are slowly receding in favour of an expanding neighbouring focal area, and where the dialect itself is, or is in danger of, disappearing (e.g. Appalachia, the Ottawa Valley); and transition areas where two or more dialects are in contact with the result that competing forms exist side by side. The first two have been studied extensively, and are based securely on a well-developed theoretical foundation; although transition areas have been recognized and vaguely defined since the early days of areal dialectology, study of them has largely been ignored in favour of the other two.[1] As a result, few studies of transition areas exist, and it is only within the last 20 years that these have begun to receive more detailed attention, either in the theoretical realm or in actual studies. However, the work done in this area has been piecemeal. Past researchers working in transition areas have introduced the use of theoretical devices that were originally formulated in other fields, and as a result a theoretical base and a description of study techniques are still lacking; in addition, there is a welter of terminologies that fit the original area of study but do not necessarily reflect the essential nature of dialect contact and dialect transition. It is possible, however, to adapt these theoretical constructs to the needs of transition studies and, as a result of the Point Roberts study, to add to the existing framework a series of principles and definitions that will enable us to arrive at a first approximation of a coherent transition theory. The present work centres on the Point Roberts community at the far western end of the 49th parallel area of the Canada-U.S.A. border, and it attempts to develop a theoretical base for dialect transition areas in general. Many of the techniques used are borrowed from traditional areal dialectology (e.g. the use of one informant per cell) and from sociolinguistics (e.g. the calculation of frequency of occurrence of features in the speech of an individual informant), but some of the techniques are original and have been developed specifically for dialect transition areas.

2. THE POINT ROBERTS STUDY

The course of the transition and the ultimate resolution of the dialect contact situation depends upon a number of social and demographic factors, such as whether or not the dialect contact area evolves an independent identity. For this reason, exclave (or

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*This paper is drawn from Mann's University of Victoria M.A. thesis entitled **Dialect Contact and Dialect Transition: Point Roberts, U.S.A.**

enclave) communities are ideal for dialect contact studies. Point Roberts is situated at the tip of a peninsula joined at its top end to the extreme south-western corner of the Canadian mainland and separated from the American mainland by Boundary Bay; the Forty-ninth Parallel runs across this peninsula just south of Tsawassen, B.C., effectively isolating Point Roberts from the rest of the state of Washington. Since there are no intervening land masses between the Point Roberts exclave[2] and the continental United States, and since the community is in daily contact with Canada, it is particularly well-suited for a detailed study of dialect contact. Very few residents of Point Roberts were born and raised there; many have moved into the community from Canada. In addition, there are many summer residents and weekend visitors from the metropolitan Vancouver area, as a major portion of the local economy is devoted to recreation.[3]

Most linguistic diffusion on the border has been in a northward direction, with American dialect features entering Canadian English but little flow in the opposite direction. However, because of the unique position of the Point Roberts community, the usual direction of diffusion is apparently reversed, i.e., Canadian dialect features have entered and are entering the idiolects of the speakers of American English in the community. Three trends in the type and direction of linguistic change in Point Roberts have become evident: the dialect features commonly found in the Puget Sound region of Washington state are less frequently found in the speech of the American informants in Point Roberts; the American informants in Point Roberts are using linguistic features commonly found in Canadian English; and the Canadian informants in Point Roberts do not use the linguistic features common to the Puget Sound area, and have retained their Canadian speech patterns. (These trends are discussed in detail below; see sections 2.1 through 2.3). It is tempting to say that the American speakers are **losing** the typical Puget Sound features and **acquiring** Canadian speech patterns, but we have, of course, no means of knowing to what extent these features were already present or absent in the speech of the individual speakers. All we can say, reasonably, is that judging by these speakers the speech community is tending away from the Puget Sound patterns of thirty years ago (Brengleman 1957) and towards the established B.C. Lower Mainland patterns of Canadian English (Chambers 1979, McConnell 1979, Rodman 1975). In the discussion that follows, rates for frequency of occurrence are determined as follows: less than 10% is **low**; from 10% to 20% **is fairly low**; over 30% is **common usage.**

2.1 The decline of AE features.

The "recession" of Washington features was present in all the major categories of linguistic variables, although the degree to which a feature was lacking varied from item to item. In the lexicon, for example, **flapjacks, griddlecakes,** and **spider** have gone from a low frequency of occurrence to zero usage; expressions such as **Devil's darning needle** and **baby carriage** have gone from fairly low to low, while other items such as **sawbuck, string beans,** and **curtains** have gone from common usage to low frequency of occurrence. Two other words, **skillet** and **faucet** have gone from being present in all contexts to being present in only a few, specific contexts.

Morpho-syntactically, there are two items of note. The use of **real** as a flat adverb (as in "real good"), a common feature in the speech of the Puget Sound area, is present in the speech of only a very few of the American informants in Point Roberts. This is an important item, because the American informants themselves have the subjective impression that the absence of this usage sets them apart from Lower Whatcom County, the neighbouring U.S.A. mainland area. A second morpho-syntactic item commonly found in the general Puget Sound area but only rarely in Point Roberts is the use of the prepositions **at** or **in** in the phrase **sick ___ [one's] stomach** In Point Roberts, as in Canadian English in general, **to** is the preposition of choice.

Seven phonological variables common in the speech of Puget Sound are noticeable by their absence in the speech of the American Point Roberts informants:

1. The pronunciation of **February** as [fɛbyuɛri] is not common among the men but can still be found in the speech of the American women.

2. The bisyllabic pronunciation of words such as **feel** and **real** resulting from use of a syllabic [l] after the vowel nucleus occurs only rarely.

3. The use of the lax variant [U] in the words **roof** and **root** is found only rarely and, in fact, seems to be stigmatized.

4. The frequency of the labio-velar glide [hw] (as in **which** vs. **witch)** has decreased in the American speech of Point Roberts, if Brengelman's 1957 figures are taken as the base from which we are operating.

5. Similarly, the use of [a] in the stressed syllable of words such as **cotton** has decreased in relation to years of residence such that in the case of American women residing in the community for more than 18 years, it has completely merged with [ɔ].

6. The neutralization of the non-high vowel contrasts, i.e.,[o] vs [ɔ] and [æ] or [ɛ] vs [e] which Brengleman (1957) noted as being in progress over thirty years ago, has apparently been completed among the American informants of Point Roberts.

7. In addition, the intrusive [r] sometimes found in the words **wash** or **Washington** among speakers in that state was absent from the speech of the Point Roberts informants.

2.2 The presence of Canadian features.

This trait is also seen across all the major categories of linguistic variables. There are five lexical items normally found only in Canadian English that are present to one degree or another in the speech of the American informants in Point Roberts. These include the words **toque, fry pan,** (both low frequency) and **chesterfield** (high frequency), and the lack of the definite article in the expression **to university** as in "He is going to university." Also, use of the noun **tap** has gone from a limited set of specific contexts to general usage across all contexts.

The single morpho-syntactic feature adopted from CE is the use of the preposition **to** in the phrase **a quarter to [the hour]**, at the expense of the variants **of** and **till** that are sometimes found in the Puget Sound area; thus most residents of Point Roberts would choose "a quarter **to** six" over "a quarter **of** six" or "a quarter **till** six."

There are numerous examples of the acquisition of phonological variants common to Canadian English. Among the most prominent are:

1. The use of [e] in the stressed syllable of **again.**

2. The use of the variants [ez] and [ɔz] in **vase.**

3. The use of [ay] in **(n)either** and in the unstressed syllable of **genuine** and **fertile.**

4. The use of [i] in the stressed syllable of **lever** and in the unstressed syllable of the prefix **semi-**.

5. Perhaps the most important phonological acquisition among the American informants, however, is the use of the raised diphthongs [ʌy] and [ʌw] before voiceless consonants, i.e. the presence in their speech of "Canadian Raising." This, more than anything else, points to a tendency on the part of the American informants to acquire Canadian speech patterns.

2.3 Acquisition of AE features by native speakers of Canadian English.

It was originally hypothesized that the Canadian informants in Point Roberts would make some changes in the direction of Washington state speech patterns; instead, there is no indication that they have acquired any of these variants. For example, **napkin** has retained the specific feature "paper" among the Canadian women in the community, and has not generalized to the two contexts "cloth" and "paper" as in the American pattern of usage. Nor do any of the Canadian informants appear to use AE lexical items such as **skillet**, or to have adopted the use of **real** as a flat adverb. Instead, there is a noticeable retention of many of their distinctive Canadian features. This is most marked in the realm of phonology. Some of the more prominent examples are as follows:

1. The three variants of **vase** found in British Columbia, i.e. [vɔz]:[vez]:[ves] , are all present in the speech of Canadians resident in Point Roberts.

2. [ay] is used (as described above) in **either, neither, genuine** and **fertile.**

3. [i] is commonly used in the second syllable of **semi-**.

4. All Canadian informants pronounce **shone** (past of **shine**) with the lax vowel, as opposed to the tense vowel frequently heard in Puget Sound usage, i.e. CE [ʃɔn] vs AE [ʃon].

5. Canadian speakers continue to pronounce the word **schedule** with [ʃ] rather than [sk].

6. The letter **Z** is referred to as [zɛd] rather than as [zi].

7. A high frequency of the palatal glide [y] is found in words such as **Tuesday.**

8. "Canadian Raising" is present in the speech of all the Canadian informants in all possible environments. This last feature, probably more then any other, points to the fact that the Canadian residents of Point Roberts are retaining their linguistic identity and are not accomodating their speech patterns to any great extent to those of the Puget Sound area.

3. THEORETICAL PRINCIPLES AND CONSTRUCTS

In the early '70s, although his recent focus has been on the variational aspects of social dialectology, Labov made a start towards describing the parameters of dialect transition areas when he defined three stages in the progress of change that all dialectologists must be cognizant of (Labov 1972:3): first, the origin of linguistic variation; second, the spread and propagation of linguistic change; and third, the regularity of linguistic change. His chief concern was the change involved in one particular dialect feature, i.e. diphthong raising in the speech community of Martha's Vineyard, but he failed to emphasize the point that his three stages of language change could and should be extended to include the widest possible range of features involved in dialect contact and dialect change.

More recently, Trudgill (1986) attempted to rectify the paucity of past research by formulating an extensive definition of transition areas. He noted that dialect contact, like language contact, can be either short- or long-term, and that dialect accomodation (as he calls it) can be both regional and social. The crucial requirement in long-term dialect contact situations, such as that in Point Roberts, is face-to-face interaction between the speakers of the competing dialects on a regular basis. Trudgill found that dialect transition occurs first at the individual level, and only later at the level of the speech community, the transition being an effort on the part of numbers of speakers of the competing dialects to understand each other and to be understood (1986:39). His primary claim was that the long-term transition process from one dialect to another follows a fixed route, with lexical items being the first to change, followed by morphological features,[4]. and, finally, by phonological differences (1986:25).

Differences in the lexicon are the most evident to speakers and hearers because they are non-systematic and can cause obvious problems in comprehension; also, lexical items are easy to learn one at a time. Hence, they are the first to change. Phonological differences, Trudgill's primary focus, are more difficult both because they are systematic and because they may be very subtle. Here, variable rule analysis has been invaluable in analyzing the patterns of change; according to Wang (1969), the transition process tends to be piecemeal and non-systematic, with speakers changing their pronunciation of individual words first and of entire classes of words only when the transition process is nearing its end. Or to put it more simply, speakers learn the pronunciation of individual words first and assimilate the phonological rule later (Trudgill 1986:58).

Apart from these studies, transition areas have been neglected both in the field and in the theoretical realm, and such theoretical devices and principles as there are, are scattered, originating in other areas of study such as areal dialectology and bilingualism, but there is to date no coherent theory for transition areas **per se**. Such a theory can, however, be developed by adapting these scattered theoretical devices and principles to refer specifically to transition areas. As well, a theoretical base for transition areas (hereinafter referred to as **transition theory**) can be considerably expanded by applying principles derived from the patterns of dialect shift observed in the Point Roberts study. At this point, therefore, we must turn to the theoretical constructs previously developed and their application to a coherent transition theory.

3.1 Isoglosses and Heteroglosses.

Iso/heteroglosses have been used for decades to define the boundaries or show the divisions between dialect areas, and, in fact, a dialect boundary is usually defined as a bundle of iso/heteroglosses. Their use as a theoretical device has, however, not been without problems, the major one being that the isogloss is, by and large, an arbitrary line, and its appearance on a map implies that dialect variation is geographically abrupt. The use of the heterogloss avoids this particular problem but creates a problem of its own in that it can indicate nothing about the linguistic variation that exists between the two lines of which it is composed. Both these problems result in a degree of imprecision, or as Chambers and Trudgill (1980:125) put it:

Bundles cohere only approximately, there are apparently no general principles for grading a set of isoglosses, and they correlate with other cultural features only roughly.

In the past, the major theoretical efforts have been in the direction of categorizing different types of iso/heteroglosses (lexical, morpho-syntactic, phonetic, semantic), and attempting to weigh their respective prominence in order to arrive at a degree of differentiation between two dialects. Dialectologists have not yet reached a consensus on these attempts as more than one system exists, and these studies have still not come to grips with the problem of defining isoglosses and heteroglosses accurately or of confirming their theoretical validity.

The following discussion is based on Chambers and Trudgill's (1980) treatment of the use of iso- and heteroglosses in transition areas, with data from the Point Roberts study used to support or refute their delineation of the problems involved. These are four:

1. Many previous dialect studies have used only one category of informant, thus restricting the number of independent variables (i.e. social factors affecting speech patterns were often ignored), and it was from the results of these investigations that the dialect boundaries were drawn. For example, the Survey of English Dialects (SED) used only non-mobile elderly rural males (or NORMs). However, the Point Roberts study and other studies in social dialectology have shown that linguistic variation occurs across a wide range of independent variables in the informant population, including sex, nationality, and socio-economic status as well as age; this makes the drawing of whatever kind of "-gloss" so complex as to be practically impossible because it must include all the independent variables in its representation in order to represent the dialect boundaries accurately.

2. The second problem is a phonological one and applies especially to transition areas. Traditionally, only one word such as **some** or **out** is tested as representative of an entire class. This implies that the use of a particular vowel is uniform across the entire class of words in which it can appear. However, the theory of lexical diffusion shows that a vowel that is in competition with a second vowel (e.g. [ʌ] and [u] in the SED materials or [aw] and [ʌw] in the Point Roberts data) does **not** occur uniformly across the class of potential words in the speech of any one particular informant; in the Point Roberts study, this principle is illustrated by some American informants who use [aw] in **clout** but [ʌw] in **out.**

3. A similar phonological problem arises in the case, particularly common in transition areas, where a single informant may use competing sounds interchangeably in the same word (what is traditionally called "free variation"). In the transition area of Central England, this is seen in the use of both [ʌ] and [u] in separate occurrences of the word **duck** in the speech of the same informant. In the Point Roberts data, **out** was frequently pronounced first as [awt] and then as [ʌwt] by American informants (this word was purposely tested twice in the course of the tape-recorded interviews).

4. The last problem is peculiar to transition areas. Some researchers have tried to adapt the principle of the isogloss or heterogloss to the variation found in transition areas by determining the frequency of occurrence of a particular feature and then drawing an isogloss such that the the low frequencies are on one side and the high frequencies on the other. Unfortunately, this often results in discontinuous lines or none at all.

As a result of these problems, Chambers and Trudgill (1980:132) came to the conclusion that the existence of transitional dialects seems to render the notion of "isogloss" obsolete. This abandonment seems premature, however, because isoglosses do seem to have a certain value as a first step in any dialect survey covering a large geographic area, in that thay can serve to define the boundaries of a transition area (see Mann, 1988). In the case of the heterogloss, its very presence would indicate the existence of a transition area, and its two lines would define the outer boundaries of that area. With the more complex heteroglosses that are joined together in order to arrive at an isogloss (see Kurath 1972), the two outermost lines of the heterogloss bundle would define the transition area. The same basic principle holds true for the isogloss bundle; its presence indicates the presence of a transition area, and its outer limits are defined by the outermost isoglossic lines (see Mann 1988:284). Everything between the lines can thus be defined as the transition area, and the lines themselves make no prediction as to the variation found between them.

3.2. Principles of lexical transition.

In 1963, Weinreich published his seminal work on language contact, in which he noted that the basic theoretical constructs and patterns he was outlining for lexical interference between languages were equally applicable to dialect contact. However, because of his immediate concern with bilingualism, he noted only briefly the applicability of his theories to bidialectalism and did not explore the notion further.

A decade later, Allen (1973) applied Weinreich's theoretical constructs to the dialect contact situation he had discovered in the Upper Midwest of the United States, where the Midland and South Midland dialects had come in contact with the Northern dialect. The crux of Allen's article was his outline of the five possible speaker reactions to competing lexical items in a dialect contact area. These lexical principles as set forth by Weinreich dealt essentially with lexical **interference**, a term which seems imprecise in reference to a dialect contact situation, as all informants already have a command of the language whereas in bilingualism they initially do not. However, the five principles themselves are of great value in explaining the lexical variation present in a dialect transition area. They are as follows (see Allen 1973:56-66):

1. One of two competing terms gains a new meaning from the other term. For example, the Midland term **bellybuster** only means throwing oneself on a sled in order to get a running start downhill, while the competing Northern term **bellyflop** has the additional meaning of diving flat into a pool; as a result of the contact situation, this second meaning has been added to **bellybuster**, making the two completely synonymous. Allen represents this schematically as **Xa,b + Ya = Y(a)b.**[5]

2. A term with two meanings comes in contact with a competing term having only one of these meanings (a partial synonym), and drops the meaning which the two do not have in common, again resulting in complete synonymity (Xa,b + Xa, Yb = Xa). In the Point Roberts study, The word **holiday** had, for the Canadian informants, the two meanings 'a single day ' (as in "the July 1st holiday") and 'a longer period of time' (as in "my summer holiday[s]"). As a result of contact with the American **vacation, holiday** lost the second meaning, thus becoming synonymous with the American usage.

3. A semantic differentiation occurs between two competing terms which were synonymous; both terms are retained with the differentiated meanings (Xa + Ya = Xb, Ya). Thus in Point Roberts, **depot, station,** and **terminus** are now differentiated, each referring to a different type of transportation.

4. Competing compounds become hybridized (X1,X2 + Y1,Y2 = Y1,X2). Allen noted the hybrid **slop pail** resulting from a combination of Northern **swill pail** and Midland **slop bucket.** The single example of this in the Point Roberts study is the use of **chesterbed** resulting from hybridization of **sofa bed** and **chesterfield.**

5. The most severe reaction, from a sociolinguistic point of view, is that which occurs when two competing forms are labelled as "correct" and "incorrect." Of the competing forms **bundle** and **sheaf** [of wheat], Allen's informants insisted that the latter was the "correct" term because it is the one used in the Bible. Again, there was only one example of this found in Point Roberts; a single Canadian informant labelled **holiday** "incorrect" and **vacation** "correct" in the context of a long period of time.

3.3 Principles of phonological transition.

Trudgill (1986) introduced three types of what he referred to as "phonological accomodation", but the term **accomodation** is misleading when applied to transition studies; it was introduced in the work of social psychologists (Giles 1973) to account for linguistic convergence and divergence in short-term contacts along the social dimension. Trudgill, however, uses **accomodation** with reference to long-term dialect contact along the geographic dimension without presenting any arguments for the term's validity in this context; although valid when referring to a speaker-hearer relationship and short-term contact, **accomodation** seems imprecise in the context of long-term dialect contact and permanent changes in speakers' idiolects. Again, **transition** reflects the situation more accurately, thus enabling us to speak of three principles of dialect transition.

Using Trudgill's (1986) schema, long-term phonological transition for individual speakers can be shown to follow three main paths:

1. Alternation of the frequency of occurrence of a particular feature over which the speaker already has control; if the original dialect has a low-frequency usage of a particular feature, and the contact dialect has a high-frequency usage of the same feature, speakers of the original dialect will gradually increase their usage of this feature to the point where they may match the frequency of the contact dialect. It may even be the case that speakers having no control over a particular feature may adopt it as a result of contact, using it at first with a low frequency which will increase as the speakers gain control over its use. In the Point Roberts study, this was seen most markedly among the American informants in the decrease of frequency of [a] and its ultimate merger with [ɔ]. Trudgill fails to point out, however, that the opposite process is equally possible, i.e. that high frequency features may decrease in usage and even ultimately disappear as a result of contact with a dialect having no or low frequency occurrences of those features.

2. Change in a particular feature in a word-by-word manner, i.e., lexical diffusion. For instance, if a particular dialect 'X' having only [ɔ] as a low back vowel comes into contact with another dialect 'Y' having only [a], speakers of 'X' may say [hɔg] [frɔg] [an] [pa] [ma] for **hog, frog, on, pa, ma.** If the transition process continues, these speakers may ultimately use [a] in all the contexts in which it is used by speakers of 'Y'. In Point Roberts, this was seen among the American informants in the acquisition of the raised diphthongs [ʌy] and [ʌw] , first in words such as **like** and **out,** and later in **wife** and **lout.**

3. The third pattern, the "development of an interdialect" (Trudgill 1986:62), is the use of pronunciations intermediate between two competing forms. He gives the example of the Oslo Norwegian diphthong [øy] that resulted from the contact between the upper-class use fo the monophthong [øː] and the lower-class use of the diphthong [æʉ]. As a general rule, this form of transition occurs when the phonological distance between the competing forms is not very great, and the resulting compromise vowel already exists in other contexts in the language; this situation was not evident in the Point Roberts data.

3.4 Transition Courses

These principles regarding dialect accomodation in individuals can, of course, be equally well applied to whole speech communities. Surprisingly, no scholar has, to date, developed a model of diachronic dialect contact, but such a model could be very simply represented thus:

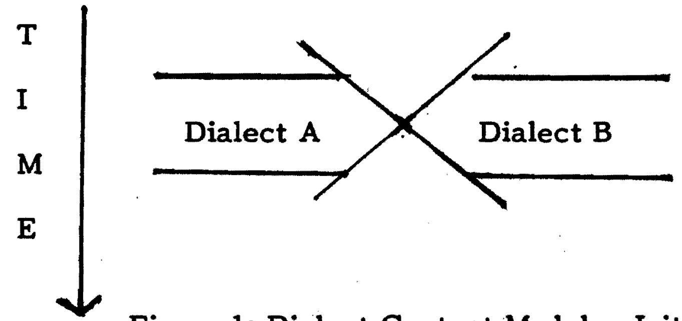

Figure 1: Dialect Contact Model — Initial Contact

At this point, the question is raised of what occurs between the two dialects if they remain in contact with each other over a long period of time, that is, which course of transition will occur.

1. By far the most common process is illustrated in Fig. 2, where two dialects, A and B, of equal strength initially, are in contact over a long period of time with the result that A first becomes dominant and finally engulfs B, although it may retain some of its features (in this and all succeeding figures, uppercase labels indicate greater prominence and lowercase labels indicate lesser prominence).

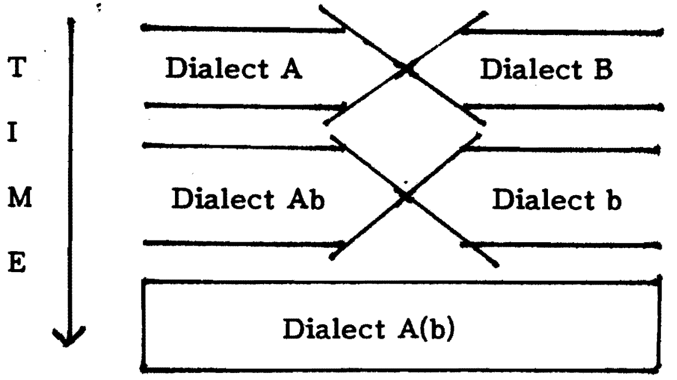

Figure 2:Dialect Contact Model -- First Transition Course

Examples of this transition course can be found in Northwestern Ohio, where the northern dialect came into contact with the North Midland dialect and ultimately overtook it, and in South Dakota, where these same two dialects have again come into contact with apparently similar results. The primary characteristic of this transition course is that the speakers from the dominant dialect (A) retain their original speech patterns.

2. The second, less common but equally possible, transition course results in the emergence of a third, and different, dialect using features of both the parent dialects, but also having developed some unique features of its own (see Fig. 3).

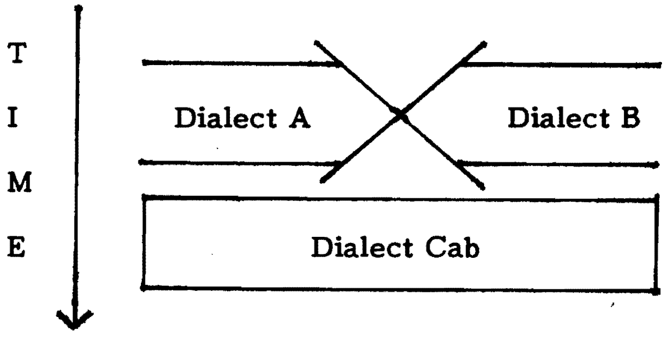

Figure 3:Dialect Contact Model — Second Transition Course

In the context of Canadian English, this second transition course can be seen in the complex speech patterns of the Ottawa Valley, where various dialects of English, notably

Scots-Irish, and other languages such as French and Gaelic were in contact from the time of the original settlement of the area. The result has been the emergence of the distinctive Ottawa Valley dialect of Canadian English, now in danger of itself being taken over by the more standard dialect of the metropolitan capital region.

3. The third transition course is followed when two dialects in contact retain their essential identity but may borrow features from each other, thus remaining, in a sense, co-dominant (see Fig. 4). This situation commonly occurs along national borders where the dialects in contact are intimately bound up with the national identity of the speakers. The most obvious example of this case, for English, is the Canada-United States border area, where Canadian English has been in contact with American dialects for nearly 150 years[6], and they have retained their individuality while borrowing freely from each other (especially in the realm of the lexicon). This is the situation in the Point Roberts area, and, of course, the focus of the present study.

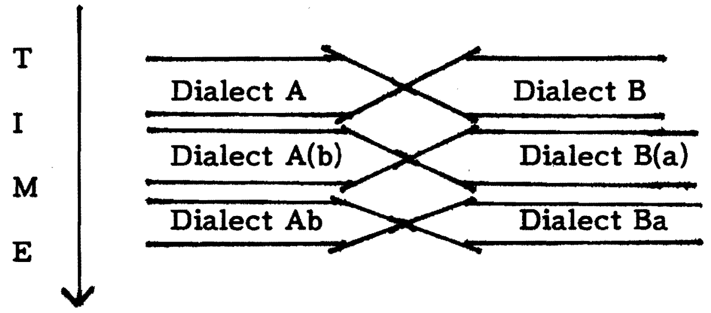

Figure 4:Dialect Contact Model — Third Transition Course

3.5 Principles of dialect transition

In the Point Roberts study, certain patterns of a change in dialect were observed to have occurred more than once, and these observations led to the formulation of five principles of dialect transition.

1. If a dialect with two competing lexical items (A,B) comes into contact with a second dialect that also has two competing terms for the same referent (B,C), and one of these terms (B) is the same in both dialects, then this shared term will become the preferred term in the transition area (B,a,c). This was observed in the Point Roberts study in the case where the terms **curtains** and **blinds** in competition in AE came into contacts with CE **blinds** and **shades**, and **blinds** has become the preferred term for all informants in the area.

2. If a particular lexical item or phonological feature is receding in one of the two contact dialects (b), it is highly unlikely to diffuse into the other contact dialect, and will continue to recede in the usage of its original dialect. In Point Roberts, this was noted with regard to the term **braces** 'suspenders', and the variant [ɛ] in **zebra**, features that are recessive in CE and have thus failed to diffuse into the speech of the American informants.

3. If a particular feature (b) that is less prominent or is recessive is in competition with a second feature (A), and the same situation exists in the second contact dialect (A,b; A,b), then this feature will continue to recede in both dialects; in fact, its recession may be accelerated to the point where the feature rapidly disappears from both dialects (A:A). In the Point Roberts data, this is found in the neutralization of the contrast of the non-high vowels [æ:e:ɛ] and [o:ɔ] bfore [r] that had been gradually occurring on both sides of the border in British Columbia and Washington,but was nearly complete in the spech of all informants in Point Roberts. This pattern was also observed in the decrease of occurrence of the preposition **in** in the phrase **sick (to/at/in) [one's] stomach.**

4. If a particular feature (b) co-occurs but is less prominent than another feature in each of the contact dialects (A,b:C,b), its usage may increase in prominence in the transition area while the competing features decrease (a,B:c,B). There was only one example of this in the Point Roberts data, where the term [fruit] **pits,** in competition with **stones** and **pips** in both contact dialects, gained in prominence in the Point Roberts transition area.

5. This is the most complex of the five contact patterns. If the same two terms are in competition in each of the contact dialects so that one term is present in the majority of contexts in one dialect but only in specific contexts in the second dialect, and the reverse is true of the other term (A,b:a,B), then over time the two terms will become interchangeable in all contexts for one of the dialects but retain their respective degrees of prominence in the second contact dialect (a,b:a,B). After a further period of time, the relatively less prominent term will be confined to specific contexts in both dialects (a,B:a:B). There were two main examples of this pattern in the Point Roberts data in the speech of the American informants. Tap went from being present only in specific contexts to being interchangeable with faucet to being used in the majority of contexts (as in CE); similarly, **icing** has gone from being used only in specific contexts to being interchangeable with **frosting.** In a sense, this last principle is the lexical equivalent of phonological change seen in the theory of lexical diffusion (Labov 1981). In both cases, a variant form is first used in a specific context or a specific word, then is used interchangeably with its competing variant, and finally becomes the preferred usage.

3.6 Years of Residence as an Independent Variable.

Linguistic studies in general are divided into two major categories, synchronic and diachronic. Dialectologists are often involved in synchronic studies comtemporaneous with the researcher, but try to incorporate the factor of linguistic change by including age of the informant as an independent variable. Thus, a differnce in usage bewteen older and younger informants is regarded as an indication of change in apparent time. Two other methods of looking at change are both known as "revisiting", i.e. repeating the study at five or ten year intervals with the same population, and repeating it at similiar intervals with the same type of population consisting of different individual informants.

A fourth technique, particularly useful for the study of transition areas, is to include the length of time an informant has been resident in the area as an independent variable; like age, length of residence can give some indication of dialect change in apparent time. In the Point Roberts study, the inclusion of this variable proved its worth many times for the American informants, as the following examples indicate:

1. **Seesaw** becomes **teeter-totter** between five and ten years of residence.

2. **Faucet** becomes **tap** between five and twenty-five years of residence.
3. In the word **blouse,** [s] changes to [z] between seven and twenty-four years of residence.
4. In the words **either, neither,** [i] starts to become [ay] at fourteen years of residence.
5. In **fertile,** syllabic [l] in the unstressed syllable starts to change to [ayl] after seven years of residence.

Thus, the addition of "years of residence" as an independent variable gives an additional indication of dialect change and accomodation occurring in apparent time.

4. CONCLUSION

In the past, studies in CE have addressed the issue of linguistic diffusion from the various dialects of AE into CE (e.g., Avis 1955a, 1955b, 1957), but no similar studies have specifically addressed the complementary issue of diffusion in the other direction. The Point Roberts study indicates that such diffusion does indeed exist, at least in this transition area, especially in such features as Canadian Raising and the merger of the low back vowels. There are hints that diffusion from Canadian English exists elsewhere along the Canada-U.S.A. border. Vance (1987) reports that Canadian Raising is present in such northern American cities as Rochester, N.Y. and Chicago, but he gives no information as to its distribution. Both these cities are well within what may be considered the border transition area, and the presence of Canadian Raising in these cities as well as in the Point Roberts area represents an important diffusion from CE into AE. Evidently, there is a great need for further studies concerned with diffusion in both directions along the border, modeled on a theoretical base such as we have suggested here, specifically designed for the investigation of transition areas. Ideally, such studies would test for a variety of linguistic variables along the full reaches of the border, but this is a totally unrealistic goal for obvious geographic and demographic reasons. Two possibilities present themselves: the examination of a limited set of variables across the entire border area; and the examination of several variables over a limited area such as the "double cities" (Windsor-Detroit, Niagara Falls-Buffalo, Sault Ste. Marie, Ont.-Sault St. Marie, Mich.). In any case, it is suggested that future research into transition dialects be conducted in the light of the more coherent transition theory that the Point Roberts study has given rise to.

NOTES

[1] Areal dialectologists have defended their preoccupation with relic areas on the grounds that it is more important at the present time to record a dialect before it disappears than to record a developing one; later social dialectologists (such as Labov) have concentrated on focal areas in order to document social variation and continuing linguistic innovation.

[2] An **exclave** is a geographic territory that is politically, linguistically, or culturally cut off from its mother territory, and is completely surrounded by another political, linguistic, or cultural entity to which its relationship is that of **enclave**. Thus, Point Roberts is an American exclave, but a Canadian enclave.

[3] This situation is analagous in some respects to the one described by Labov (1963) for Martha's Vineyard.

[4] This change applies mainly to languages other than English, since there are few if any morphological differences among the various dialects of English

[5] The upper-case **X** and **Y** refer to the lexical items in each of the two dialects, and the lower-case **a** and **b** refer to the meanings attached to the items; the plus (+) symbol refers to the dialect contact situation and can be expressed as "is in contact with"; the equal (=) symbol refers to the result of the dialect contact.

[6] This assumes that Canadian English had become a distinctive form of English by approximately 1850; since the first writings on CE **per se** date from 1857, this seems a reasonable date to assign as an arbitrary starting-point.

REFERENCES

Allen, Harold B. (1973). Two Dialects in Contact. American Speech 48, 54-66.

Avis, Walter (1955a). Speech Differences Along the Ontario-United States Border: I. Vocabulary. Canadian Journal of Linguistics 1, 13-18.

Avis, Walter (1955b). Speech Differences Along the Ontario-United States Border: II. Grammar and Syntax. Canadian Journal of Linguistics1 (#1 regular series), 14-19.

Avis, Walter (1957). Speech Differences Along the Ontario-United States Border: III. Pronunciation. Canadian Journal of Linguistics 2, 41-59.

Brengelman, Frederick H. (1957). The Native American English Spoken in the Puget Sound Area. Ph. D. Dissertation, University of Washington.

Chambers, J.K. (1979). Canadian English. In The Languages of Canada, ed. J.K. Chambers. Ottawa: Marcel Didier.

Chambers, J.K. and Trudgill, Peter (1980). Dialectology. Cambridge: Cambridge University Press.

Giles, H. (1973). Accent Mobility: A Model and Some Data. Anthropological Linguistics 15, 87-105.

Kurath, Hans (1972). Studies in Areal Linguistics Bloomington: Indiana University Press.

Labov, William (1963). The Social Motivation of a Sound Change. Word 19, 273-309. In Labov (1972).

Labov, William (1972). Sociolinguistic Patterns. Philadelphia: University of Pennsylvania Press.

Labov, William (1981). Resolving the Neogrammarian Controversy. Language 57, 267-308.

Mann, Marjorie F. (1988). Dialect Contact and Dialect Transition: Point Roberts, U.S.A. M.A. Thesis, University of Victoria.

McConnell, R.E. (1979). Our Own Voice: Canadian English and How It Is Studied. Toronto: Gage Educational Publishing Ltd.

Rodman, Lilita (1975). Characteristics of B.C. English. English Quarterly 7, 49-82.

Trudgill, Peter (1986). Dialects in Contact. New York: Basil Blackwell Inc.

Vance, Timothy J. (1987). Canadian Raising in Some Dialects of the Northern United States. American Speech 62, 195-210.

Wang, William S-Y (1969). Competing Sound Changes as a Cause of Residue. Language 45, 9-25.

Weinreich, Uriel (1963). Languages in Contact. The Hague: Mouton and Co.

PROSODIC STRUCTURE IN SPOKANE MORPHOLOGY

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1. Introduction.

The interaction of phonological and morphological rules has been a major area of inquiry in the generative linguistics of this decade (cf. Kiparsky 1982), Selkirk (1984)). Studies of reduplication form a natural focus of this work (cf. Marantz (1982), Clements (1985), McCarthy and Prince (1986)). We propose to contribute to this discussion with an analysis of stress and reduplication in Spokane, an Interior Salish language of Eastern Washington. Of particular interest for the debate is Spokane's morphologically-determined stress placement and the relation of such a stress system to a complex morphological system; Salishan languages are sometimes described as polysynthetic (cf. Thompson (1979:731)).

We begin with an outline of a metrical account of stress in the language, drawing heavily on previous work by Carlson (1980, 1989). The stress analysis has implications for the description of four productive reduplication patterns, each of which is detailed and discussed in turn.

2.1. Morphological stress and the grid in Spokane.

Carlson (1989) summarizes previous work on Spokane stress (Carlson (1972, 1980)), illustrating that stress is morphologically determined. Root and suffix morphemes fall into classes which form a stress hierarchy:

(1) strong suffixes
strong roots
variable suffixes
weak roots
weak suffixes

When morphemes are combined to form words, stress falls on that morpheme which bears the features of the highest place in the stress hierarchy. This analysis enjoys a fair degree of agreement among Salishanists and several descriptions of other Interior Salish languages employ something like the hierarchy in (1) (cf. Mattina (1973), Gibson (1973)). Spokane is typical among Salishan languages in that prefixes are unstressed, but unlike some related languages in having no secondary stress.

As a rule, Salishan unstressed vowels are reduced, but Spokane extends this into a general rule deleting unstressed vowels, subject to certain conditions to which we will return.

The following data illustrate these processes. The strong reflexive suffix -sut will be stressed even if it appears with a strong root like k̓ʷul̓ 'make, do'. Weak suffixes (e.g., transitive -nt) contain no vowels and therefore never receive stress.

(2) strong root + weak suffixes + strong suffix:
k̓ʷul̓-nt-sut -> k̓ʷl̓ncút 'He made himself.'
make-TRANS-REFL

The difference between strong roots and a weak root like šil 'chop' is demonstrated below, where each appears with the variable suffix -exʷ '2nd singular subject', but the suffix retracts stress only off of the weak root:

(3) strong root + weak suffixes + variable suffix:
k̓ʷul̓-nt-exʷ -> k̓ʷúl̓ntxʷ 'You made it.'
make-TRANS-2S

(4) weak root + weak suffixes + variable suffix:
šil-nt-exʷ -> šlntéxʷ 'You chopped it.'
chop-TRANS-2S

Carlson (1989) does not analyze (4) as an instance of stress shift, but only notes that variable suffixes fall between strong and weak roots in the hierarchy of (1). We analyze (4) as a result of stress shift on the basis of a generalization not discussed in Carlson (1989) but implicit in Carlson (1980): when a weak root is followed by a number of variable suffixes, stress goes on the first of these:

(5) weak root ... variable suffix ... variable suffix:
šil-nt-si-en -> šlncín 'I chopped you (up).'
chop-TRANS-2obj-1S

Stress is realized on a weak root only if no suffix is present; this is consistent with (1) or a stress shift analysis:

(6) prefix + weak root
hec-šíl 'It's chopped.'
PROG-chop

A stress shift analysis is attractive for two more reasons: first, it reconciles Spokane to the general Salishan tendency for stress to be a lexical property of roots (Thompson (1979:721)). Second, it is initially tempting to retain (1) and analyze (5) as expressing a generalization about what happens when a word contains two or more morphemes marked for identical values in the hierarchy, a contingency not discussed in Carlson (1989). Perhaps the first in a string of such morphemes receives stress by a general principle. However, a stress shift analysis wins out for (5); the following data show that when a word contains two strong suffixes, or a compound consists of two strong roots, the last of two like-valued elements receives the stress:

(7) strong root ... strong suffix ... strong suffix:
?amx̌ʷ-us-nt-sut-tn-eye?-y -> ?amx̌ʷsncutnéy?ey
shave-face-TRANS-REFL-INSTR-seem to-CONT
'He's pretending to shave his face.'

The surface form of (7) is the result of some phonological processes irrelevant to our point here; the thing to notice is the strong suffix -eye? being stressed over the strong suffix sut. The compound in (8) below derives from the strong roots k̓ʷen 'try, choose' and tew 'to transact business':[1]

(8) strong root + strong root compound:
ꝁʷen-s-tew-cin -> ꝁʷistéwcn 'He went after groceries.'
try,choose-NOM-transact business-mouth,food,etc.

The data in (7) and (8) argue against the putative generalization supported by (5), in fact showing the need for a general principle targeting the final element in a string ambiguous with respect to the hierarchy in (1). This leaves (5) with no explanation but a stress shift analysis, supported by the distribution facts above: nothing in Carlson's (1989) analysis predicts the fact that the only position in which variable suffixes surface with stress is in immediate post-weak root position (ignoring weak suffixes). By generating stress in the weak root and retracting it to the nearest vowel, the distribution of variable stress is explained.

The addition of a stress shift rule to the phonology of Spokane requires a representation for stress which can be modified during the course of a derivation. We suggest the metrical grid as the proper formalism (cf. Prince (1983), Selkirk (1984)). The rule would be stated as follows, where the bracket would be labeled with the features of a weak root:

(9) Weak Shift:

```
x ]              ]  x
x ]  x  --->   x ]  x
```

This rule has the advantage of correctly showing the suffixal vowel as adjacent to the root vowel at the relevant level of representation; alternative rule statements lacking some nonlinear representation for stress would employ crucial variables and require two rules:[2]

(10) straw-man linear stress shift rules:

a. V -> [+str] / [+str] X] Y ___
b. V -> [-str] / ____ X] Y [+str]

Seminal work in metrical theory (cf. Liberman and Prince (1977), Hayes (1981)) conclusively demonstrates the inadequacy of approaches like (10); we will not review those arguments here, but will assume a grid model henceforth.[3]

The move to adopt metrical theory is further supported because it allows considerable simplification of the analysis in (1). The five categories in the stress hierarchy are primitive in Carlson's (1989) treatment. However, if stress assignment is viewed as the creation of a grid from the lexical properties of the morphemes in a word, only two features are required. All roots and those suffixes which can bear unshifted stress share a feature [+stressable]. Second, strong roots and strong suffixes carry a feature [+strong].[4] The default value for each of these features is minus. Prefixes, since they do not interact with any of the prosodic rules, can be considered extrametrical as a class (cf. Hayes (1981)).

Our rules for building the grid are based on Selkirk's universal typology of such rules (Selkirk (1984:52-71); no special addenda to the theory are required. The basic procedure may be outlined as follows:

(11) i. create first grid level
ii. realize lexical stress
iii. move stress off weak roots
iv. in a series of same-level columns,
make the last one most prominent

These rules will serve to determine the placement of primary stress; since the language does not display secondary stress, at some point non-crucial contrasts between grid columns will be neutralized. Below we formulate rule statements for each of the processes in (11).

The first grid level is created by a rule which delineates the stress-bearing unit of the language in question; our formulation designates vowels as the relevant unit, although further research could implicate the syllable as the stress-bearer in Spokane.

(12) Demibeat Alignment:
Align just one demibeat with every vowel.

This is rule is taken from Selkirk (1984:57); she argues that it is a universal rule, and is always the first grid-construction rule to apply.

The rules realizing lexical stress are Selkirk's Basic Beat Rules, which "align syllables with beats on the second metrical level by virtue of (a) their composition (i.e., the composition of their rime) and/or (b) their position with respect to a particular syntactic domain" (1984:54). She gives the following sample rule, on which the Spokane rule in (14) is modelled:

(13) Beat Addition:
Align a (basic) beat with the {first,last} syllable
on the domain Word. Selkirk (1984:54)

The basic generalization about Spokane is that roots carry stress (cf. other Salishan languages); the fact that some suffixes must also be marked for stress is related to the root-like properties of those suffixes, which may be connected to their historical source as roots. The beat addition rule for Spokane must be sensitive to the two features mentioned above in order to derive all of the distinctions in (1):

(14) Spokane Beat Addition:
i. Align a beat with a morpheme marked [+stressable].
ii. Align a beat with a morpheme marked [+strong].

Note that there is no specification in (14) governing whether the beat aligns with the beginning or the end of the morpheme (cf. (13)). Spokane morphemes are usually monosyllabic, and there is some evidence that uncommon polysyllabic morphemes are lexically specified as to which vowel is targeted by the beat addition rules. The suffix -éye? 'seems to be' has two vowels, and the first is stressed, while it is the second vowel of the bisyllabic strong root ?ax̌íl 'be a certain way' which is stressed.[5]

A few derivations will serve to illustrate the system as it stands. The following sample lexicon recasts the data in (2) - (6) in terms of our new features.

(15) Sample lexical entries

ꝁʷul̓	'make, do', root, [+stressable], [+strong]
šil	'chop', root, [+stressable]
sut	'reflexive', suffix, [+stressable], [+strong]
eye?	'seem to be', suffix, [+stressable], [+strong]
exʷ	'second person singular subject', suffix
nt	transitive stem-forming suffix
hec	'progressive', prefix [+extrametrical]
cin	'mouth, food, language, tongue' lexical suffix, [+stressable]

We have included in (15) the lexical suffix -<u>cin</u> shown in (8); this addition is to illustrate that the two features are distributed evenly among roots and suffixes. Lexical suffixes, a common feature of Salishan, have semantic properties typical of free morphemes and have a historical source as roots.[6] It could be that there is a unified semantic feature common to all [+stressable] morphemes, but we will not pursue this possibility here.

The lexical entries in (15), plus the rules of Demibeat Alignment and Beat Addition, will create the following representations for the data in (2), (3) and (4):[7]

```
        (16)
  a.     x       x   b.  x           c.               Beat Addition ii
         x       x       x                 x          Beat Addition i
         x       x       x     x           x     x    Demibeat Alignment
        ꝁʷul̓-nt-sut     ꝁʷul̓-nt-exʷ      šil-nt-exʷ
```

Most of the distinctions implied in (1) are present in (16), but it remains to resolve the conflict between the same-height columns in (a) and account for the behavior of the weak root in (c). Taking the second task first, if we assume a default rule applies to fill in [-strong] to all morphemes unmarked for that feature underlyingly, Weak Shift can be stated in terms of [-strong], and can employ the formalism introduced in (9). Compare the examples in (18) below. The first continues the derivation for (16.c), while the second provides the grid for (6) above.

```
(18) a.             b.
                                 Weak Shift ->
      (x) -> x              x    Beat Addition i (gives (x))
       x     x              x    Demibeat Alignment
      šil-nt-exʷ      hec-šil
     [-strong]             [-strong]
```

Since there is no grid column after <u>šil</u> in (18.b), the structural description of Weak Shift is not met. Stress is moved off the root in (18.a), correctly deriving the contrast between (4) and (6) above.

Weak Shift will move stress off of a root, or off of the combination of a root plus certain stem-building suffixes, but will not move stress from the combination of a root plus other suffixes. We attribute this to the latter's lack of ability to percolate the [-strong] feature.

One last rule is required to resolve the "stress conflict" in (16.a); this rule was hinted at with regard to (7) and (8), and is formalized in (19).

```
(19)                                          x
                Clash Avoidance:  x  x  ->  x  x
```

The Clash Avoidance rule creates the desired grids below, continuing (16.a) and deriving (7)); Weak Shift is not applicable.

```
   (20)
  a.          x   b.                  x        Clash Avoidance
     x        x      x           x    x        Beat Addition ii
     x        x      x    x      x    x        Beat Addition i
     x        x      x    x      x    x x      Demibeat Alignment
   ꝁʷul̕-nt-sut      ?amx̌ʷ-us-nt-sut-tn-eye?-y
```

The system can now derive the results of Carlson's (1989) analysis, as well as accounting for several generalizations not discussed in that work. The various grid levels created by the four rules are further motivated by an investigation into the prosodic properties of lexical suffixes, presented in the next section. Since Carlson (1989) does not discuss lexical suffixes, they provide a perfect testing ground for the present analysis.

2.2. Stress and lexical suffixes.

The prosodic behavior of weak roots mandates the use of two features, rather than a simple binary opposition governing lexical stress. A morpheme can be plus or minus [stressable], and if it is [+stressable], it may be [+strong]. Lexical suffixes comprise another category, which, like weak roots, must be specified as being able to bear unshifted stress, but which defer prosodically to a [+strong] morpheme. There are also a few strong lexical suffixes, which behave like the strong grammatical suffix in (2). Some more lexical entries serve to illustrate these points, augmenting the list in (15) and providing the basis for derivations to follow:

(21) Sample lexical entries, continued:
ičn 'back', lexical suffix, [+stressable]
ewl 'vehicle', lexical suffix, [+stressable][8]
ečst 'hand', lexical suffix, [+stressable]
qinšn 'leg', lexical suffix, [+stressable][9]
cin 'mouth, words', lexical suffix, [+stressable]
utye? 'around on a surface' lexical suffix, [+stressable], [+strong]
compare:
ƭas 'hard', root, [+stressable]
ćiq́ 'throw it', root, [+stressable]
caq 'put, place', root, [+stressable]
en 'first person singular subject', suffix

The present analysis predicts that a [+stressable] lexical suffix will receive stress if it appears with a weak root, but not with a strong root. This prediction is met, as shown below in the stress derivations for the surface forms <u>šléwln</u> 'I chopped down a tree to make a boat for him' and <u>ꝁʷúl̕uɬn</u> 'I made a vehicle for him', continuing with our practice of abstracting away from the effects of productive phonological rules like Unstressed Vowel Deletion.[10]

```
(22) a. weak root          b. strong root
          x                   x               Clash Avoidance
          |                   x               Beat Addition ii
        x x                   x  x            Beat Addition i
        x x      x            x  x      x     Demibeat Addition
       šil-ewl-nt-en       k̓ʷul̓-ewł-nt-en
   chop-vehicle-TRANS-1S  do-vehicle-TRANS-1S
```

The correct results are derived in the derivations of (22), but this contrast could have been effected by Weak Shift if lexical suffixes were analyzed as having no underlying stress features. Motivation for the feature values in (21) is provided by the following generalization: when multiple lexical suffixes follow a weak root, stress falls on the final lexical suffix. Surface nƚsčnéčst 'callous' is an example, showing that Clash Avoidance must be operative, and therefore that lexical suffixes are [+stressable]:

```
(23)
                     x                 Clash Avoidance
                     |                 Beat Addition ii
             x   x   x                 Beat Addition i
             x   x   x                 Demibeat Addition
          n-ƚas-ičn-ečst
          in-hard-back-hand
```

Weak Shift is (correctly) non-applicable in this derivation only if ičn and ečst are analyzed as being [+stressable]; if they did not bear this feature, stress would incorrectly retract onto the first suffix, deriving the ungrammatical *n-ƚas-íčn-ečst.

The lexical suffix facts support the present analysis because they show that [+/- stressable] and [+/- strong] are distributed freely among morpheme types, as would be expected of lexical features. The following examples show that [+strong] is distributed among lexical suffixes; a strong lexical suffix takes the stress over sixʷ 'pour', a strong root, in snsexʷmútye? 'pancake'.[11] The derivation is shown in (24.a) below; (24.b) provides a simpler example sułtúmš 'He asks people (for information)'.

```
(24) a.
                      x                 Clash Avoidance
                  x   x                 Beat Addition ii
                  x   x                 Beat Addition i
                  x   x  x              Demibeat Addition
             s-n-sixʷ-m-utye?
        NOM-in-pour-REP-DER'm'-around on a surface

     b.
             x                          Clash Avoidance
         x   x                          Beat Addition ii
         x   x                          Beat Addition i
         x   x                          Demibeat Addition
        sew-łtumš
        ask-people
```

While the lexical suffixes support our feature characterization of Spokane prominence, there are some grammatical suffixes which provide further evidence for our other central claim, that a rule of beat movement is responsible for the difference in behavior of the strong versus weak roots. This evidence is presented in the next section.

2.3. Weak shift and epenthesis.

With the Weak Shift rule, the present analysis can help account for some otherwise puzzling facts about a set of stem-forming suffixes; the -nt suffix of (15), the 'inchoative' -p, and the 'middle' -m, (and a few others) surface with a vowel only when they attach to a weak root and no other vowel-containing suffixes are present. This is demonstrated with the imperatives, which are formed without person markers:

(25) a. weak root imperative:
šil-nt -> šlínt 'Chop it!'
chop-TRANS

čuw-p-š -> čwúpš 'Shut up!'
quiet-inchoative-IMP,sg

n-čr-p-š -> nčrípš 'Swim!'
in-swim-inchoative-IMP,sg

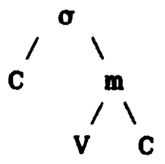
cax̌ʷ-nt -> cx̌ʷúnt 'Head it off!'
headed off-TRANS

b. strong root imperative:
ćew̓-nt -> ćéw̓nt 'Wash it!'
wash-TRANS

Now, the vowel in (25.a) is clearly epenthetic; its quality is predictable and there is no evidence that it is underlyingly part of the suffixes in question. Weak Shift takes place in (25.a); compare (25.b), which shows a strong root taking the stress, as we would expect.

When these vowelless suffixes (-nt, -p, etc.) attach to roots, they occasion a certain kind of prosodic illformedness with regard to Spokane stem structure. In Spokane, as in other Salish languages, the overwhelming majority of roots are of the shape CVC. Historically, this shape was probably the only one allowed, but at present the languages display a number of CVCC roots which cannot be analyzed with reference to the historical suffixation process which originally created the consonant cluster. But even in the synchronic grammar, such roots exhibit strange prosodic properties which we cannot review here. We suggest that what was once a lexical constraint on CVC roots has shifted to a prosodic constraint on roots and stems: they are subject to syllabification rules which value the CVC structure. The syllabification rules create the following configuration:[12]

(26) Syllabification:



Elements not incorporated into this prosodic structure are extrasyllabic and are subject to rules which conspire to reduce extrasyllabicity within stems. One such rule is given below, where an extrasyllabic consonant is abbreviated C':

(27) Stem Epenthesis: $\emptyset \rightarrow V \,/\,]_{root} \;\_\_\_\_\; C'$

Stem Epenthesis operates to incorporate the stem-building suffixes into the prosodic structure of the stem. The derivation in (28) illustrates the operation of Stem Epenthesis and Weak Shift to derive the imperative forms of weak roots.

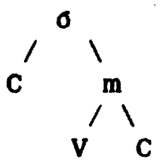
```
(28)  a.   šil-nt  ->  šilVnt     Stem Epenthesis

           x                      Beat Addition i
           x x                    Demibeat Alignment
      b.   šilVnt

             x
           x x                    Weak Shift
      c.   šilVnt

      d.   šlínt                  Vowel Quality,
                                   Unstressed Vowel Deletion
```

2.4. Summary of rules.

The following summarizes the relevant phonological rules of Spokane. They apply cyclically, in the order given. Unstressed Vowel Deletion, is given but not formalized in (29); the stress rules are repeated informally. Resonant Glottalization will be treated in later sections.

(29) Rules:

Syllabification:



Stem Epenthesis: $\emptyset \rightarrow V \,/\,]_{root} \;\_\_\_\_\; C'$

Demibeat Alignment: V gets a beat

Beat Addition i: [+stressable] gets a beat

Beat Addition ii: [+strong] gets a beat

(29, continued)

Weak Shift: Move stress off a [-strong] constituent.

Clash Avoidance: $\begin{array}{c} \\ x\ x \end{array} \rightarrow \begin{array}{c} \quad x \\ x\ x \end{array}$

Unstressed Vowel Deletion: (informal)
Delete a V dominated by a non-maximal grid column.
Condition: A vowel adjacent to a laryngeal does not delete.

Resonant Glottalization: (informal)
Spread the lexically marked feature [+glott] to all resonants in a word.

3. Reduplication.

Having introduced the analysis of Spokane phonology, we can now turn to a discussion of reduplicative forms in the language, again taking Carlson's (1989) analysis as a point of departure. Particular attention will be paid to the interaction of the morphological aspects of the reduplications and their phonology as defined by the rules in (29).

3.1. Out of control.

The first kind of reduplication we will review provides more evidence for the rule of Weak Shift. The following data exemplify the reduplication, which copies the first vowel and second consonant of the base and is glossed as 'out of control':[13]

(30) a. strong root with VC out-of-control reduplication:
k̓ʷul̓-ul -> k̓ʷúl̓l̓ 'It was born, created, baptised'
make-OC

miƛ̓-iƛ̓ -> miƛ̓ƛ̓ 'it got smeared on by accident'
smear-OC

b. weak root OC reduplication
šil-il -> šlíl 'It accidently got cut'
chop-OC

t̓uk̓ʷ-uk̓ʷ -> t̓k̓ʷúk̓ʷ 'It fell over by accident'
lie-OC

The OC reduplicated data in (30) exhibit the now familiar asymmetry between strong and weak roots, with stress once again falling one vowel further to the right in weak forms than in strong forms. We know from this that Weak Shift is operating in (30.b), so we turn first to the simpler derivation for (30.a) in order to focus on the description of the reduplication.

The analysis of (30.a) is not without issues for phonological theory.

Broselow and McCarthy (1983) outline how Marantz' (1982) model for reduplication encounters some difficulties in accounting for the cognate reduplication in Lushootseed; the reduplicated material does not come from the periphery of the root, which is the normal case. The problems with internal reduplication of this type have also been described in Davis (1988) and Sloan (1989). McCarthy and Prince (1986) provide a framework in which OC can be analysed as copying peripheral segments, as long as a prosodic constituent, rather than the root, is identified as the base for the reduplication. The relevant prosodic constituent, we claim, is the mora, described in (26) above.[14] With this assumption, we can simply say that OC involves suffixation of VC to the (initial) mora of the root.[15]

In the widely accepted analysis of reduplication provided by Marantz (1982), reduplicative patterns are treated as empty skeletal affixes arising from normal word-formation rules, and are filled out autosegmentally. The derivation of the forms in (30.a) would proceed as follows under this framework. Broselow and McCarthy (1983) and McCarthy and Prince (1986) argue that the copying procedure which creates the new phonemic material for the reduplication only copies the melody of the constituent which forms the base for the affixation. Thus, in the derivation below, only the phonemic melody of the base mora has been copied. Right-to-left association is the normal case for suffixal reduplication (cf. Marantz (1982)).

(31)

```
C V C
| | |     ---> syllabification --->
ꝁʷu ƚ

  σ
 / \
C  m
  / \
  V C
| | |     ---> affix OC --->
ꝁʷu ƚ

  σ
 / \
C  m
  / \
  V C
| | |              ---> Demibeat Alignment, Beat Addition i, ii, copying --->
ꝁʷu ƚ

          u ƚ
   m
  / \
C V C V C
| | |               ---> Associate  R-L  --->
ꝁʷu ƚ
  x   x
  x
  x
```

(31, continued)

```
           u r̓
   m      / /
  / \   / /
C V C V C
| | |                   ---> Unstressed Vowel Deletion --->   k̓ʷúr̓r̓
k̓ʷu r̓
  x   x
  x
  x
```

The assumption that only the mora melody copies is justified by strong roots of the form CVCC, for example, <u>?ac̓x̌</u> 'watch, look at': the OC form is <u>?ac̓c̓x̌</u> 'observe'. If the entire root melody copied, right-to-left association would render the illformed *<u>?ac̓x̌x̌</u>.

Now that the operation of OC reduplication has been illustrated, the derivation for (30.b) is a straightforward matter; as (32) shows, Weak Shift applies to the output of OC reduplication, and the reduplicated vowel ends up being stressed.

(32)

```
C V C
| | |     ---> syllabification --->
š i l

  σ
 / \
C  m
  / \
  V C
| | |     ---> affix OC --->
š i l

  σ
 / \
C  m
  / \
  V C + V C
| | |                 ---> Demibeat Alignment, Beat Addition i, copying --->
š i l


          i l
   m
  / \
C V C V C
| | |                   ---> Associate R-L  --->
š i l
  x   x
  x
```

(32,continued)

```
             i l
   m        / /
  / \      / /
C V C V C
| | |                ---> Weak Shift --->
š i l
  x   x
  x
             i l
   m        / /
  / \      / /
C V C V C
| | |                ---> Unstressed Vowel Deletion  --->  šlíl
š i l
```

Weak roots of the shape CVCC serve to motivate both Weak Shift and the restriction on the copying procedure; <u>calx̌ʷ</u> 'clustered' produces the OC form <u>cllx̌ʷntén</u> 'I laid a bunch of round things down accidentally'. The suffix -<u>en</u> receives the stress by Weak Shift.[16] Only the <u>l</u> is reduplicated, as is expected if the copying procedure only affects the melody of the mora, and the reduplicated vowel deletes after stress moves off the weak root.

3.2. Plural.

The next kind of reduplication is prefixal, and as such does not interact with the stress analysis. The plural reduplication (PL) constitutes a copy of the first CVC of the base.

(33) strong and weak roots with CVC Plural:

k̓ʷul̓-k̓ʷul̓ -> k̓ʷl̓k̓ʷúl̓ 'A bunch of people are working,
 PL-do   doing something'

šil-šil -> šlšíl 'A bunch of things are chopped'
 PL-chop

The stress analysis of these is straightforward - stress is generated on, and remains on, the root vowel. The extrametrical status of all prefixes in the language, including PL, predicts that the reduplication process will be unaffected by the presence of stress-attracting suffixes; this prediction is borne out by the surface forms below:

(34) šl-šl-nt-éxʷ 'You chopped some things.'
PL-chop-TRANS-2S

kʷn-kʷn-m-útye?-st-n 'I embraced them.'
PL-take-DER-around-CAUS-1S

3.3. Diminutive.

The diminutive reduplication (DIM) deserves more comment, however. Carlson (1989) analyzes the diminutive as prefixal reduplication of the first CV; glottalization of the resonants in the resulting word accompanies this reduplication:

(35) DIM surface forms:
a. strong root
k̓ʷúk̓ʷl̓ 'Something small is created, made.'

b. weak root
ššíl̓ 'A small thing is chopped.'

Here we have the familiar asymmetry between strong and weak roots, with the stress showing up one syllable to the right in the weak roots; Weak Shift must be at play. But Weak Shift cannot be operable if the reduplication is prefixal, as Carlson (1989) claims; stress wouldn't interact with the diminutive any more than it does with the plural in (33). In fact, Carlson (1989) must stipulate the diminutive morpheme as idiosyncratically taking the stress off a strong root only.[17] Our solution to this problem is to claim that DIM is a CV infix inserted after the first V. This is a case of what Broselow and McCarthy term "true infixing reduplication", in which a copy of root-peripheral material is inserted into the middle of a base.

(36) k̓ʷú-k̓ʷu-l̓ -> k̓ʷúk̓ʷl̓
make-DIM 'Something small is created, made'

(37) ší-ši-l -> ši-ší-l -> ššíl̓
chop-DIM 'A small thing is chopped'

The stress rules apply regularly to derive initial stress with a strong root, and Weak Shift will correctly stress the reduplicated vowel after a weak root, as illustrated in (36) and (37).[18]

3.4. Repetitive.

The fourth and final reduplication discussed in Carlson (1989) is the Repetitive (REP). It has two surface allomorphs: an infix -e-, and this -e- preceded by a copy of the first root consonant. Like DIM, it triggers resonant glottalization:

(38) a. š-e-l̓n̓tén̓ 'I chopped it up repeatedly'
b. k̓ʷ-e-k̓ʷúl̓ 'Something is made over and over.'
š-e-šíl̓ 'Something is chopped repeatedly'

In exploring REP forms, we first consider the unusual disjunction in the shape of the two allomorphs, and second, the distribution of these allomorphs. With any case of differing surface shapes for a single morpheme, it is reasonable to ask which form bears closest resemblance to the basic form of the morpheme. Carlson (1989) in effect treats the reduplicative form as basic; we suggest instead that the infix is the basic form of REP in Spokane, and the reduplication of the initial consonant arises only when the conditions for infixation are not met. This suggestion will be supported to the extent that we can provide a cogent analysis which relies on it.

First, consider the behavior of the infix -e- in (38.a). It is similar to other infixes in the language, for example, the infix -?- which signals a type of plural. This plural infix is inserted after the stressed vowel, wherever it appears in the word; compare xʷúy 'He went' with xʷúʔy 'They went'. Where is the REP -e- inserted within a word? A look at its distribution will help answer this question.

The REP infix appears within weak roots which have shifted stress to a suffix, as shown in (38.a) and the following, in which the infix is lowered to -a- before a following uvular:

(39) c̓-a-p̓q̓-n̓t-én̓ 'I stuck it in more than one place'
stick-REP-TRANS-1S

It also appears within strong roots that have lost their stress to a strong suffix:

(40) hec-k̓ʷ-e-ʕ̓-m̓-éy̓ʔe-y̓ 'He's just passing the time.'
PROG-do-REP-DER-seem to-CONT

w̓-e-č-m̓tús 'He's having hallucinations.'
see-REP-visions

Finally, the infix occurs with the small number of roots of the shape CCVC, regardless of where the stress falls; the following examples show the weak root q̓sip 'long time ago', and the strong root ptax̌ʷ 'spit', the final consonant of which conditions the lowering of the infix.

(41) s-n-q̓-e-sp-ʕs-cút-n̓ 'second-hand store'
NOM-in-long time ago-REP-feeling-REFL-INSTR

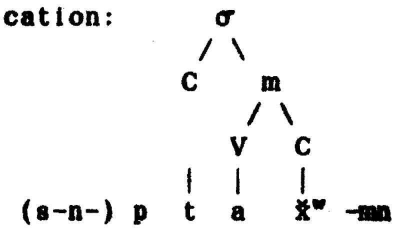
s-n-p-a-táx̌ʷ-m̓n̓ 'spitoon'
NOM-in-spit-REP-INSTR

If the effects of the stress rules and Unstressed Vowel Deletion are taken into account before the application of REP, the unifying feature of the three environments in (39) - (41) becomes clear: the infix targets a root-initial extrasyllabic consonant. It was noted earlier that the unmarked syllable structure of Spokane stems is CVC; application of the syllabification rules to the underlying CCVC roots in (41) would render the first C extrasyllabic, and Unstressed Vowel Deletion would derive the same prosodic configuration for the underlying CVC roots of (39) and (40).[19] The following derivations illustrate; recall that prefixes are extrametrical, and as such neither participate in the syllabification process or in the resonant glottalization triggered by REP.

(42) a. /ptax̌ʷ/

Earlier cycles: s-n-ptáx̌ʷ-mn

Syllabification:

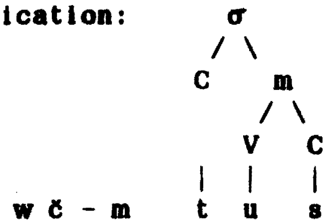


REP infixation: (s-n-)p-e-táx̌ʷ-mn
Glottalization: (s-n-)p-e-táx̌ʷ-m̓n̓
Lowering: s-n-p-a-táx̌ʷ-m̓n̓ 'spitoon'

b. /wič/

Earlier cycles: wč-mtús

Syllabification:



REP infixation: w-e-č-mtus
Glottalization: w̓-e-č-m̓tús 'He's having hallucinations.'

Cyclic derivation of (42.b) is required to allow Unstressed Vowel Deletion to correctly create an extrasyllabic C which the infix may be inserted after; further research will support the implicit claim that REP applies late in the list of word-building processes of Spokane. The derivation in (42.a) shows that the extrasyllabic segment is occasioned by the application of the structure-building syllabification rules to a nonderived root with an initial consonant cluster. Each creates the target environment for REP infixation.

A few factors can combine, however, to create forms which lack an extrasyllabic segment available to the infix. When stress falls on a CVC root, strong or weak, Unstressed Vowel Deletion is inapplicable and all stem segments are syllabified. When a root vowel is adjacent to a laryngeal, it cannot delete due to the protective qualities of the latter, discussed above. In this case, too, a root-initial consonant will be syllabified prior to the application of REP infixation. Two examples appear in (38.b), more appear below; the weak root qʷe? 'familiar with', has a glottal stop which protects its root vowel from deletion, and a uvular which conditions the lowering of the infix:

(43) qʷ-a-qʷe?-m̓n̓-cút REP-familiar with-INSTR-REFL	'He practiced.'
n̓-e-n̓íč REP-cut	'Something is cut repeatedly.'
ł-e-łúk̓ʷ-s REP-wood-face	'wooden mask'

These forms lack an anchor for the REP -e-, and in these forms only, a process of reduplication copies the root-initial consonant, manufacturing the requisite extrasyllabic segment. REP infixation can then proceed normally, as shown in the derivation below:

```
(44)                        /nič/
            Syllabification:     σ
                                / \
                               C   m
                                  / \
                                 V   C
                               |  |  |
                               n  i  č
            (no extrasyllabic segment)
            Reduplication:   nnič
            Syllabification:     σ
                                / \
                               C   m
                                  / \
                                 V   C
                               |  |  |
                           n   n  i  č

            REP infixation:   n-e-nič
            Glottalization:   n̓-e-n̓íč    'Something is cut
                                           repeatedly.'
```

The analysis now accounts for the distributional facts regarding repetitive forms. Note that Unstressed Vowel Deletion never deletes the infix -e-, even though it is unstressed. We tentatively suggest that the infix is protected by a glottal stop at the relevant level of representation; the protective segment surfaces in the cognate -a?- infix in the closely related language Colville-Okanagan: cf. ɬəčɬ-a?-čáp 'he jumps up and down' (Mattina (1987a)). Perhaps in Spokane the glottalization of resonants is the surface realization of the protective glottal stop. We will not pursue this suggestion here, however, since DIM triggers the same glottalization, but lacks the protective quality, and as yet it is unclear what distinguishes the two affixes in terms of their underlying representation of this feature. Neither are we able to provide a completely unified underlying representation for the two allomorphs of REP, leaving open the question of whether the reduplicative C template forms part of the UR for the infix, or some other mechanism is involved. At this point we are content to give the following lexical entry for the REP morpheme, comparing it with the plural infix -?- and the true reduplications discussed earlier:

(45) lexicon, revisted. (cf. (15), (21))

?	'plural',	infix, inserted after stressed vowel
e | [+glott]	'repetitive',	infix, inserted after C' If C_1 not C', then reduplicate C_1.
CVC	'plural',	prefix, [+extrametrical]
VC	'out of control',	suffix on root mora
CV | [+glott]	'diminutive',	infix, inserted after root V

NOTES

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[1] The unstressed [i] in the surface form k̓ʷịstéwcn is the result of a phonological rule changing certain nasals to vowels, ordered after unstressed vowel deletion. See Carlson (1976) for details.

[2] (10.b) would not be required under a theory which included a Stress Subordination Convention (cf. Chomsky and Halle (1968)). However, standard arguments in metrical theory rally against the validity of such a convention, supporting our grid theory for Spokane.

[3] Since Spokane does not require reference to metrical feet, we have chosen the simple grids of Selkirk (1984) for our model; the analysis would be equally compatible with the augmented grid representations of Hammond (1984) and Halle and Vergnaud (1987).

[4] [+/- strong] seems to us the logical heuristic for this feature, given the history of the analysis of Spokane stress (cf. (1)); this name is not to be confused with the s(trong) label employed in Liberman and Prince (1977), Hayes (1981) and related work. The latter expresses a local relation of relative prominence between metrical constituents, and is always paired with a w(eak) sister. The Spokane label is the type of lexical feature needed in any system in which stress is morphologically determined.

[5] This is not unreasonable, given the history of such forms; for example, the e? in éye? clearly derives from a historical suffix, probably -m̓ which vocalized. The strong root púte? 'be exact, be able, be correct, to honor' contains the same element, as does the weak root ?ócqe? 'go out'.

[6] A number of Salishanists (including Egesdal (1981) and Mattina (1987b)) have traced the development of lexical suffixes from roots. Carlson (in press) presents evidence internal to Spokane which suggests that productive

compounding, especially of nominal objects and locatives led to the set of bound morphemes referred to as lexical suffixes.

[7] The derivations in (16) are presented as though the stress rules apply noncyclically; this is for ease of exposition. There is reason to believe that all of the phonological rules discussed in this paper actually apply cyclically, a possibility which we will not discuss here. In any case, cyclic derivation is not crucial for the forms cited in this section.

[8] The suffix -ewl has a variant form -ewɫ, which is not phonologically predictable and will be treated as a UR.

[9] The form -qiṅšn 'leg' is historically a compound lexical suffix composed of -qin 'head' and -šin 'foot'; the vowel of the second is lost in the fused form and does not participate in the prosody of -qiṅšn. There are other complex lexical suffixes of this type.

[10] The vertical line in (22.a) is intended to show that it is Weak Shift, not Beat Addition II which makes ewl the most prominent in its domain; wellformedness conditions on grid structures prevent "holes" in grids (cf. Selkirk (1984)), and the resulting column over ewl has only three levels. We will continue to use the vertical line as a placeholder for the exposition of grid derivations.

[11] The first vowel in the surface form snsexʷṁútẏe? 'pancake' is the Repetitive infix -e-, to which we return in Section 3.4.

[12] This is a relatively uncontroversial syllable structure for CVC, which we will not justify here. The vowel forms a constituent with a single following consonant; we label this constituent m for Mora, following McCarthy and Prince (1986), although Rime would serve as well for our purposes.

[13] A number of linguists have recognized control as a category in Salish languages. Morphemes indicate whether an agent is in control of a situation or not. OC reduplication in Spokane indicates that something has happened by accident, by spontaneous occurrence, as a result of natural phenomena, or simply by the lack of control an entity has in a situation (cf. Carlson and Thompson (1982)).

[14] Sloan (1989) suggests a similar account for the cognate reduplication in Lushootseed.

[15] The template itself could also be analysed as consisting of an empty mora, instead of the VC template we suggest. The former would be more in keeping with suggestions of McCarthy and Prince (1986) and Sloan (1989).

[16] This requires cyclic application of Weak Shift. See Footnote 7.

[17] Further, Carlson (1989) notes some truly exceptional stress facts involving PL forms which take stress on the prefix, the problem with such a treatment is that it is impossible to formally distinguish the normal behavior of the DIM from these manifestly exceptional cases in the PL.

[18] As noted in Carlson (1989), some strong root diminutives have an

optional form in which stress appears on the infix; along with the expected n̓ín̓č 'Something small is cut', the form n̓n̓íč is also attested.

[19] It should be kept in mind that the CVC syllable structure is primarily a constraint on stem structure, and that extrasyllabic consonants are allowable in Spokane surface representations, especially as the result of non-stem-building morphology; the surface forms in (41) serve to illustrate Spokane's tolerance for surface consonant sequences.

REFERENCES

Broselow, Ellen, and John McCarthy. 1983. A theory of internal reduplication. The Linguistic Review 3.25-88.

Campbell, Lyle, and Marianne Mithun. 1979. The languages of Native America: Historical and comparative assessment. Austin: University of Texas Press.

Carlson, Barry F. 1972a. Unstressed root vowels in Spokane. Working Papers in Linguistics 4, No. 3:25-36. Honolulu: Department of Linguistics University of Hawaii.

_______. 1972b. A grammar of Spokane: A Salish language of eastern Washington. Working Papers in Linguistics 4.4. Honolulu: Department of Linguistics University of Hawaii.

_______. 1976. The n-shift in Spokane Salishan. IJAL 42.133-139.

_______. 1980. Spokane -e-. IJAL 46.78-84.

_______. 1989. Reduplication and stress in Spokane. IJAL.55.

_______. In press. Compounding and lexical affixation in Spokane. Anthropological Linguistics.

_______, and Laurence C. Thompson. 1982. Out of control in two (maybe more) Salish languages. Anthropological Linguistics 24:51-65.

Chomsky, Noam and Morris Halle. 1968. The sound pattern of English. New York: Harper and Row.

Clements, G. N. 1985. The problem of transfer in nonlinear morphology. Cornell Working Papers in Linguistics 7.1-36.

Davis, Stuart. 1988. On the nature of internal reduplication. In Theoretical Morphology. New York: Academic Press.

Egesdal, Stephen. 1981. Some ideas on the origin of Salish lexical substantive suffixes. Working Papers in Linguistics 13:4-19. Honolulu: Department of Linguistics University of Hawaii.

Gibson, James A. 1973. Shuswap grammatical structure. Working Papers in Linguistics 5:5. Honolulu: Department of Linguistics University of Hawaii.

Halle, Morris and J.-R. Vergnaud. 1987. A Essay on Stress. Cambridge, MA: MIT Press.

Hammond, Michael. 1984. Constraining metrical theory. Bloomington: Indiana University Linguistics Club.

Hayes, Bruce. 1981. A metrical theory of stress rules. Bloomington: Indiana University Linguistics Club.

Kiparsky, Paul. 1982. Lexical Morphology and Phonology. In Linguistics in the Morning Calm. Seoul:Hanshin.

Liberman, Mark and Alan Prince. 1977. On stress and linguistic rhythm. Linguistic Inquiry 8:249-336.

Marantz, Alec. 1982. Re Reduplication. Linguistic Inquiry 13.435-482.

Mattina, Anthony. 1973. Colville grammatical structure. Working Papers in Linguistics 5:4. Honolulu: Department of Linguistics University of Hawaii.

_______. 1987a. Colville-Okanagan Dictionary. University of Montana Occasional Papers in Linguistics 5. Missoula: Department of Anthropology University of Montana.

______. 1987b. On the origin of Salish lexical affixes. Paper presented at the Twenty-sixth Conference on American Indian Languages, Chicago.

McCarthy, John and Alan Prince. 1986. Prosodic Morphology. Unpublished manuscript, University of Massachusetts, Amherst and Brandeis.

Prince, Alan. 1983. Relating to the grid. Linguistic Inquiry 14.19-100.

Selkirk, Elisabeth O. 1984. Phonology and syntax: The relation between sound and structure. Cambridge, MA: MIT Press.

Sloan, Kelly. 1989. Affixation to the mora. Paper presented at the 8th Annual West Coast Conference on Formal Linguistics, Vancouver, British Columbia.

Thompson, Laurence C. 1979. Salishan and the Northwest. In Campbell and Mithun 1979, 692-765.

DEVELOPMENT OF A DEMISYLLABLE-BASED SPEECH SYNTHESIS SYSTEM

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This paper describes the development of a microcomputer-based voice output system for English that uses prerecorded demisyllables as units of synthesis. With an inventory of approximately 950 demisyllables, the system is capable of producing all possible syllables and words of English. By combining these units to form continuous speech, the system can produce any English sentence.

1. INTRODUCTION

Synthesis of English speech by computer can be accomplished in several different ways, depending on the size of the speech units that are used to produce voice output. The most widely used units for speech synthesis are phonemes (i.e., small speech units corresponding to individual phonetic items). An alternate method of producing computer-generated speech is to concatenate entire words of English in a method called "word-concatenation" synthesis. A third strategy, the one described in this paper, is to use intermediate-sized units corresponding to half syllables, called "demisyllables".

1.1 Demisyllables as Units of Synthesis

The rationale for the use of demisyllables as a unit for speech synthesis is that they strike a balance between the relatively high quality, but inflexible and memory-intensive nature of word-level synthesis, and the low memory load, but rule-intensive nature of phoneme-level synthesis. In fact, demisyllables maintain most of the positive attributes of both systems, with few of their weaknesses. Demisyllables are flexible in that the present selection is sufficient to produce any English word or sentence. The memory load is relatively low, with only 950 demisyllables (250 Kbytes of storage) necessary to produce that flexibility. Furthermore, the fact that demisyllables include all consonant vowel transitions and most consonant clusters in the data, ensures accurate coarticulatory effects and hence more natural sounding speech synthesis, all with a minimum of rules.

In demisyllable synthesis, each syllable of a word is composed of an initial demisyllable, which comprises the initial consonant and the first part of the following vowel, plus a final demisyllable, which includes the remaining portion of the vowel and any following consonants. The examples below illustrate this point:

Table 1.

SYLLABLE	INITIAL DEMISYLLABLE	FINAL DEMISYLLABLE
"bet"	BE	ET
"set"	SE	ET
"quench"	KWE	ENCH

Since all words of English are composed of syllables, and all syllables can be created from demisyllables, then it follows that this method can be used to produce any English word. This paper describes the various components that have been developed for microcomputer-based speech synthesis using demisyllables.

2. HARDWARE REQUIREMENTS

The Demisyllable Synthesis System is designed for use on an IBM XT/AT or compatible with a minimum of 512K of RAM. In addition, a TMS-32020 development board (with digital-to-analog converter) must be mounted in the host computer. Speech output from this board may be filtered and amplified before being passed to an audio speaker.

3. DEMISYLLABLE INVENTORY

The inventory of demisyllable speech units consists of approximately 950 prerecorded items that were produced in monosyllabic words by a male speaker of English. The recorded demisyllables were then digitized and encoded using pitch-synchronous LPC (10-pole, covariance method).

Each encoded demisyllable unit consists of a number of 10-msec speech frames, and each frame contains quantized values for energy, pitch and 10 LPC reflection coefficients. Quantization of these values results in a storage requirement of 14 bytes per frame, and a corresponding transmission rate of 1400 bytes per second. The entire demisyllable inventory requires about 250 Kbytes of storage.

4. TEXT INPUT

Voice output from the demisyllable synthesis system is initiated through a text-input module that accepts English orthographic text, as well as special diacritics that are used to indicate sentence-level intonation patterns and the location of any pauses in a sentence. An example of the text-input module is displayed in Figure 1.

```
THIS + IS THE MAIN +  MENU.//////

TOUCH THE SQUARE, NEXT TO THEE ITEM YOU WANT.//////

THE TOP ITEM,-\ IS AIRPORT - INFORMATION.//////

THE SECOND ITEM,-\ IS GROUND TRANSPORTATION -.//////

THIRD ITEM,-// ASSOCIATIONS - FOR THE DISABLED.//////

LAST ITEM,-// HOTEL INFORMATION -.
```

FIGURE 1: An example of input text for the demisyllable synthesis system. Standard English orthography is augmented with diacritics to indicate pauses (/ \), emphasized and deemphasized words (+ -), continuation rise (,) and statement intonation patterns (.).

5. TEXT-TO-DEMISYLLABLE CONVERSION

At the present time, the conversion of English text into a demisyllable representation is accomplished by means of a "Lexicon" file, which is created and modified by the user. This file contains a separate entry for every English word that is to be synthesized in a particular application. An example of a Lexicon file is displayed in Figure 2.

AIRPORT	E ER 40 @ PA ORT 30 #
INFORMATION	I IN FEO EORM ME EI 35 @ SHOE OEN 30 #
ITEM	A AIT 10 @ TE OEM #
MAIN	ME EIN 0 @#
MENU	ME EN @ NYU UU #

FIGURE 2: An example of a Lexicon file, containing word items for the demisyllable synthesis system. Each word item contains its English orthography (on the left) and a demisyllable translation (on the right). The demisyllable translation consists of an initial and final demisyllable for each syllable, an optional duration reduction value for each syllable (30,40,etc.), an indication of the syllable that bears primary stress (@), and a symbol to indicate the end of a lexicon item (#).

As this figure illustrates, each entry of the Lexicon consists of the English orthography for a word (on the left), plus a transcription of the word in demisyllable notation (on the right). The demisyllable notation includes a listing of the initial and final demisyllable items for each syllable, an indication of which syllable of the word carries primary stress (designated by an "@" symbol following the primary-stressed syllable), and an optional number listed after each syllable which determines syllable duration (see below).

The Lexicon is created by an interactive program that allows the user to create lexicon items, listen to their pronunciation and modify them as necessary. This provides a flexible method for specifying the pronunciation of English words.

The Lexicon approach, while providing great flexibility, does impose limitations on voice output. That is, before a word can be synthesized, it must occur in the Lexicon. In order to overcome this limitation, an algorithm is being developed that will automatically convert English text into demisyllable notation. This component will allow for unlimited text-to-speech capability, and it will be implemented in the near future.

6. DEMISYLLABLE-TO-SPEECH RULES

When an English sentence is entered into the text-input module described above, its constituent words are automatically translated into demisyllable units by means of the Lexicon. The designated demisyllable units are then retrieved from the demisyllable inventory files.

Demisyllables are then transformed into complete sentences of English by means of a set of rules that are summarized below and described in greater detail elsewhere. The rules are applied in the order given. The general strategy is to work from the smallest units (i.e., demisyllables) to progressively larger, more complex units (i.e., syllables, words and sentences).

6.1 Syllable Creation

The first step in the conversion from demisyllables to sentences is the creation of syllables. Each syllable is created by concatenating an initial and a final demisyllable from the demisyllable inventory. Since all initial demisyllables end in a vowel and all final demisyllables begin with a vowel, this concatenation is achieved quite simply by joining the two vocalic segments together and performing a spectral smoothing across the boundary between them. Spectral smoothing is done by an algorithm that calculates a weighted average of LPC reflection coefficients for 5 frames (i.e., 50 msec) on both sides of the boundary between the initial and final demisyllable items.

6.2 Word Creation

Words are produced from the newly-created syllables by means of three different steps (i.e., Syllable Linking, Syllable Duration Adjustment, and Word-Level Pitch Assignment). The first step is designed to ensure that coarticulation effects at syllable boundaries are adequately modelled. The last two steps are intended to produce appropriate prosodic features to account for the different syllable-stress patterns of English words.

6.3 Syllable Linking

The syllable-linking rules are used to modify phonetic segments at syllable boundaries within a word. These rules are formulated in terms of ten phonetic classes (i.e., voiced and voiceless stops, affricates and fricatives, as well as nasals, liquids, semivowels and vowels). Each item in the demisyllable inventory is coded with respect to one of these ten classes.

The particular rule that will apply at a given syllable boundary depends on the phonetic items that are present at that boundary. Depending on the phonetic classes involved, the syllable-linking rules may act to delete certain speech frames, to smooth the energy contour at the boundary or to perform a spectral smoothing (i.e., smoothing of LPC reflection coefficients) at the syllable boundary.

6.4 Adjustment of Syllable Durations

The second stage in word creation is the adjustment in the length of each syllable in a word. This duration adjustment is required so that the syllables will have lengths that are appropriate for the stress pattern of the word in question.

Syllable stress is an important component of English words. It can be illustrated by the difference in the noun "SUBject" versus the verb "subJECT". The noun has primary stress on the first syllable, while the verb has it on the second. The difference in stress is realized acoustically by differences in syllable duration and also pitch contour (see below for details about pitch contour). In particular, a syllable that has primary stress will be longer than when it is unstressed. Thus, modification of syllable durations is an important component in word creation.

The strategy for modifying syllable durations has been to record the original demisyllable speech items with relatively long durations (i.e., longer than required for most primary-stressed syllables), and then to shorten them when required. Shortening of syllables is achieved by an algorithm that selectively deletes up to 66 percent of the voiced frames from each syllable (see Urbanczyck, S.C. et al for a more detailed description).

The amount of duration reduction that is applied to each syllable of a word is thus expressed as a percentage of the number of voiced frames in the syllable. The percent reduction in syllable duration is determined automatically, depending on the stress pattern and the number of syllables in a word. Primary-stressed syllables typically have reduction values of 20-25%, while unstressed syllables are reduced by 40-50% in duration.

6.5 Word-Level Pitch Assignment

The final step in the creation of words from demisyllables, is the assignment of appropriate pitch contours. As indicated above, the pitch contour of an English word is determined primarily by the stress pattern of its constituent syllables. That is, in general, a syllable with primary stress will have a higher pitch value than unstressed syllables. An algorithm has been developed that assigns pitch contours so that the highest pitch of a word is always on the primary-stressed syllable (i.e., the first syllable of the noun "SUBject", but the second syllable of the verb "subJECT"). Unstressed syllables are assigned lower pitch values.

7. SENTENCE CREATION

After words have been created from demisyllable units, the next task is to produce complete sentences from these words. This process involves three different steps.

7.1 Word Concatenation

The first step is to join together the word units that have been created by the components described above. When the words are concatenated, a set of word-linking rules is applied. These rules are very similar to the syllable-linking rules described above, in that they act to modify phonetic segments at syllable boundaries. In this case, however, the syllables in question are at word boundaries.

The particular rules that apply at a given word boundary depend on the phonetic items that are present. The rules are formulated in terms of the ten phonetic classes described above, and they operate to delete certain speech frames, to smooth the energy contour or to perform spectral smoothing at the word boundary.

7.2 Sentence-Level Pitch Contour

This component is designed to provide an appropriate intonation pattern for each synthesized sentence. The method used here is very similar to that previously developed for a word-concatenation synthesis system. In short, it works by overlaying a sentence-level pitch contour on top of the word-level pitch contours that are produced during the word-creation stage. The pitch level of each word is adjusted, depending on its function in the sentence. In addition, certain "tonic" pitch contours are applied at the end of each sentence to differentiate statements (which end in a falling pitch) from questions (which have rising terminal pitch contours). A third tonic contour, called a continuation rise, is also available, and may be used in the middle of a sentence at major clause boundaries.

7.3 Sentence-Level Timing Adjustments

The final step in sentence creation is the adjustment of word durations at different locations in a sentence. This primarily involves an increase in duration on the final word of a sentence or on any word within a sentence that occurs before a pause.

This "pre-pausal" lengthening is accomplished by adjusting the frame size of the demisyllable items that constitute the word in question. As noted above, the default frame size is 10 msec. By increasing this value to 15 msec, we can effect a 50%

increase in the duration of a word or syllable. Frame-size adjustment of this magnitude is used to produce a duration increase for words that occur before a pause.

8. SUMMARY

The speech synthesis system described here can be used to produce computer-generated voice output for English. At present, this output is produced with the aid of a separate user-specified Lexicon file that determines the pronunciation of each word. We are currently proceeding with development of a text-to-demisyllable component that will eliminate the need for the Lexicon and will allow unlimited text-to-speech capability. Work is also underway to create a new demisyllable inventory produced using a female speaker. This will enable us to produce synthesized voice output with either a male or a female voice.

NOTES

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REFERENCES

Eady, S. J. and Dickson, B. C. (1987). Speech synthesis of sentence focus in English declaratives. Proceedings of the 11th International Congress of Phonetic Sciences, 3, 262-265.

Eady, S.J., Dickson, B.C., Urbanczyk, S.C., Clayards, J.A.W. and Wynrib, A.G. (1987). Pitch assignment rules for speech synthesis by word concatenation. Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing, 3, 1473-1476.

Hemphill, T. (1988). The DEMI320 Program: An interim report on development of a demisyllable-based speech synthesis system. CSTR Technical Report No. SS8802.

Hunt, M.J. and Harvenberg, C.E. (1986). Generation of controlled speech stimuli by pitch-synchronous LPC analysis of natural utterances, Proceedings of the 12th International Congress on Acoustics, paper A4-2.

Klatt, D.H. (1987). Review of text-to-speech conversion for English. Journal of the Acoustical Society of America, **82**, 737-793.

Lovins, J. B., Macchi, M. J. and Fujimura, O. (1979). A demisyllable inventory for speech synthesis, Speech Communication Papers Presented at the 97th Meeting of the Acoustical Society of America, J.J. Wolf and D.H. Klatt (eds.), 519-522.

Urbanczyk, S. C., Eady, S. J. and Dickson, B. C. (1987). Durational adjustment in a demisyllable-based speech synthesis system. Proceedings of the Canadian Acoustical Association, 79-84.

THE EVOLUTION OF THE SOUND SYSTEM OF PORTUGUESE

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1. INTRODUCTION[1]

The population of Romance speakers is approximately 487 million. Portuguese (including Galician) is spoken by 110 million people, which makes it second only to Spanish in the size of its speakership (Spanish has 215 million speakers)[2]. In terms of geographic distribution, the Romance languages cover almost 20% of the surface of the earth which is about 10 million square miles out of 52 million square miles. As far as Portuguese is concerned, it is spoken in Europe as a matter of course, on the South American continent (Brazil), in Africa (Angola, Mozambique, etc.), and also in Asia (Goa, Macao, part of Timor, etc.) either in the form of standard language or in the form of Creole.

The purpose of this paper is to describe the sound system of Portuguese of each period and sound changes the language has gone through. Portuguese, 'o latim com pouca corrupção (Latin with little corruption)', is generally considered to be one of the most conservative languages in the Romance branch. It, however, possesses some innovative aspects as is demonstrated in this paper.

2. THE HISTORY OF EUROPEAN PORTUGUESE

There are several ways of dividing the history of Portuguese into stages from Vulgar Latin to modern Portuguese. If we were to follow the history of this language in the strict sense, we should not ignore some important phonological changes which took place in Vulgar Latin, such as 1) the change of the vowel system, 2) deletion of vowels (/i,u/) between consonants, 3) voicing of intervocalic stops (/p,t,k/) and of intervocalic fricative /s/, 4) palatalization of velars (/k,g/) before /i/ and /e/, and so forth. However, I do not intend to pay much attention to what happened in the Iberian Peninsula before Galego-Português, which is a mother language of both Portuguese and Galician, arose. This 'Época Proto-Histórica' in which the very origin of Portuguese was established is the point from which I would like to start.

2.1. Época Proto-Histórica (EPH)

EPH started in the late 9th century and continued until the beginning of the 13th century. The language in the western part of the Iberian Peninsula had already experienced several characteristic changes in the preceding period. Those changes are quite important in that they did not occur in other parts of the Peninsula. In other words, such changes kept Portuguese and Galician distinct from other languages which we could find in the Iberian Peninsula. Changes such as 1) velarization of intervocalic /l/, 2) nasalization of the vowel preceding the nasal consonant and 3) /kl-,fl-,pl-/ > /tʃ/ are known. These changes went further and in the EPH, velarized /l/ was deleted, as was an intervocalic nasal. The following are some examples:

2.1.1. deletion of intervocalic /l/

Lat.	
dolore > do-or (later in Po. and G. > dor cf. Sp. dolor)	'pain'
filu > fi-o (later in Po. and G. > fio cf. Sp. hilo)	'thread'

2.1.2. deletion of intervocalic /n/

Lat.	
bonu > bõno > bõ-o (later > bõ=bom cf. Sp. bueno)	'good (masc.)'
manu > mãno > mã-o (later > mão cf. Sp. mano)	'hand'
luna > lũna > lũ-a (later > lua cf. Sp. luna)	'moon', etc.

2.1.3. /kl-,fl-,pl-/ > /tʃ/

Lat.	Sp.	
clave > chave	llave	'key'
flamma > chama	llama	'flame'
plicare > chegar	llegar	'to arrive'

Let me briefly refer to the Arabic influence in this period. Although there was quite a number of Arabic words which came into Portuguese, they impinged only on the lexicon, that is, they did not affect the phonology or syntax of Portuguese. And the number of these words is smaller than in Spanish. Probably this is due to the historical fact that in Portugal the Reconquest was already accomplished in 1249, which is 250 years ahead of Spain (the Reconquest was completed only in 1492 in Spain), and also to the geographical fact that Portugal was far from the centre of Islamic culture. Below are some words of Arabic origin which penetrated in the Iberian Peninsula:

Po.	Sp.	
açúcar < as-sukkar	azúcar	'sugar'
algodão < al-qutum	algodón	'cotton'
arroz < ar-ruz	arroz	'rice'

Note that when these Arabic words were introduced into French or Italian, they took a form without the article al or its assimilated variant. For example:

Fr.	It.	
sucre	zucchero	'sugar'
coton	cotone	'cotton'
riz	riso	'rice'

2.2. Período Arcaico 1 (PA1)

The period from the early 13th century to the middle of the 14th century is referred to as Período Arcaico 1. This is often called the period of Galego-Português because there are no phonological or syntactical differences which would enable us to distinguish these two languages. The relationship between Portuguese and Galician is that of co-dialects and we could call them 'línguas gémeas', which literally means 'twin languages'. The following are some of the features of this period, starting with vowels:

2.2.1. Vowels

(1) oral vowels

(a) in stressed position:

i		u
e		o
ɛ		ɔ
	a	

(b) in pretonic position:

i		u
e		o
	a	

The system (a) is identical to that of Vulgar Latin. In the pretonic position, E, O in Latin became not [ɛ], [ɔ] but [e], [o].

(c) in unstressed, final position:

e		o
	a	

At the beginning of this period, [i] was also possible. However, later on, a three-vowel system was established.

(2) nasalized vowels

(a) in stressed/pretonic position:

ĩ		ũ
ẽ		õ
	ã	

(b) in unstressed, final position:

ẽ		õ
	ã	

(3) diphthongs

		ui	iu		
ei		oi	eu		ou
	ai			au	

It is during the next period that the language shows an increase in diphthongs. Nasalized diphthongs which are fairly characteristic of Portuguese did not occur in this period.

2.2.2. Consonants

stops: p, b, t, d, k, g
nasals: m, n, ɲ
laterals: l, ľ
trill: r
flap: ɾ
fricatives: f, v, ś, ź, ʃ, (d)ʒ
affricates: ts, dz, tʃ

Some of these consonants did not exist in Latin. Below are such consonants.

[ɲ] < nj < ni, ne + vowel, -gn-

seniore > senhor 'Lord'
cognoscere > conhocer (> conhecer) 'to know by experience'
linea > linha 'line'

The orthographic symbol <-nh-> appeared in a document of 1267 (Archivo Historico Portuguez, vol.6).

[ľ] < lj < li, le + vowel, -cl-

filiu > filho 'son'
oclu (< oculu) > olho 'eye'
palea > palha 'straw'
apicla > abelha 'bee'

The orthographic symbol <-lh-> appeared in 1265 (Archivo Historico Portuguez, vol.4). It is generally accepted that these graphs, <-lh-> and <-nh->, are borrowed from Provençal.

[r]: r-, -rr-

rumpere > romper 'to break'
terra > terra 'earth'
riuu > rio 'river'
ferru > ferro 'iron'

[v] < u+vowel, b, f

uacca > vaca 'cow'
debere > dever 'duty, must'
uita > vida 'life'
profecto > proveito 'profit'

[ś] < s-, -ss, -s; [ź] < -s-

solo > so-o > só 'only'
ossu > osso 'bone'
passu > passo 'step'
mense > mês 'month'

[ś], [ź] are apico-alveolar fricatives.

[ʃ] < -x-, sj < si, se+vowel

saxu > seixo 'pebble'
basseu > baixo 'low'
passione > paixão 'passion'

[(d)ʒ] < g(+e,i), i+vowel, dj < di, de+vowel

gelare > gear 'to freeze'
iocu > jogo 'game, play'
video > vejo 'I see'
fugio > fujo 'I escape'
hodie > hoje 'today'
ianuariu > janeiro 'January'

[ts] < c(+e,i), tj < ti, te+vowel

caecu > cego 'blind'
facio > faço 'I do'
civitate > cidade 'city'
oratione > oraçon (> oração) 'prayer'

[dz] < -c(+e,i)

facere > fazer 'to do' uicinu > vizĩ-o (> vizinho) 'neighbour'
cocina (< coquina) > cozĩ-a (> cozinha) 'kitchen'

[tʃ] < pl-, cl-, fl-

See section 2.1.3.

2.2.3. Hiatus

Frequent occurrence of hiatus is another characteristic of Portuguese (Galego-Português). The reason is that in addition to the deletion of intervocalic /d/, /g/[3], intervocalic /l/ and /n/ also underwent syncope. As a result of this /n/-deletion, a nasalized vowel came to be adjacent to an oral vowel, and they constituted the hiatus, which prevented the nasalized diphthong from appearing. For instance:

Lat.	
malu > ma-o (> mao=mau)	'bad (masc.)'
mala > ma-a (> má)	'bad (fem.)'
bonu > bõ-o (> bõ=bom)	'good (masc.)'
bona > bõ-a (> boa)	'good (fem.)'
germanu > irmã-o (> irmão)	'brother'

As mentioned earlier, during this PA1 the Reconquest of Portugal was concluded (1249). However, we cannot expect a language to change rapidly. There is always a transitional stage. Let us see how Portuguese was established as a koiné. As the Christians regained their power and exiled the Arabs from the Iberian Peninsula, the political centre moved south. So did the Christians who had been evacuated to the northern part of the Peninsula (the north of the Douro River[4]). So the language of the moçárabe[5] and the language which was spoken by the northern Christians became mixed. They interacted with each other, and as a result, koiné or common Portuguese came into being. The role of poetry written in Galego-Português should not be neglected. Previous scholars seem to agree that in the 12th and 13th centuries, in the Iberian Peninsula, poetry was written almost exclusively in Galego-Português. This was the cultural norm which was accepted throughout the Iberian Peninsula. In other words, even Castilian poets chose this language over their own which was still in the process of being established as a national language. Rodrigues Lapa, M. (1973) states that '...até essa época tudo indica que não há dois, apenas um lirísmo, e esse indiscutivelmente galego-português (...until this period everything indicates that there are not two, but only one type of lyricism, and that this is unquestionably Galego-Português). The Galego-Português culture was not inferior to the Arabic culture, which was considered to be highly sophisticated at that time.

2.3. Período Arcaico 2 (PA2)

The period from the middle of the 14th century to the middle of the 16th century is referred to as Período Arcaico 2. This is the period in which Portuguese became separate from Galician and started to establish its own position firmly. During this period, a number of hiatus were lost. Generally speaking, monophthongization and nasal-diphthongization were completed by the end of the 15th century.

2.3.1. Vowels

(1) monophthongization

(a) hiatus made up of oral vowels:

If vowels are identical, they monophthongized.

le-er (< legere) > ler	'to read'
cre-er (< credere) > crer	'to believe'
ma-a (< mala) > má	'bad (fem.)'
do-or (< dolore) > dor	'pain'
pa-aço (< palatiu) > paço	'palace'

The combination of two a's resulted in an open [ɑ], which contrasts phonemically with [a]. So the vowel system in stressed position became different from that in Galego-Português. This is the same as the modern Portuguese vowel system.

i		u
e		o
	a	
ɛ		ɔ
	ɑ	

In the pretonic position, the same thing happened. So,

i		u		i		u
e		o		e		o
	a		became		a	
				ɛ		ɔ
					ɑ	

This is also a result of monophthongization of e-e, a-a, o-o, which became [ɛ], [ɑ], [ɔ], respectively. This system remained for a long time until the language experienced a reduction, that is, e > ə, o > u. Since there is some fluctuation in the orthography, it is not easy to specify when these changes took place. According to Ikegami (1984), however, both e > ə and o > u are the changes that occurred in the Período Moderno 2.

In unstressed, final position, hiatus a-a, o-o became [a], [o]. e.g. Braga-a > Braga 'Braga (the name of the city which is located in the north of Portugal)', pobo-o > povo 'people'.

e		o
	a	

This system is identical to that of the preceding period.

(b) hiatus which contains a nasalized vowel:

When the stress was on the nasalized vowel, hiatus reduced to a nasalized monophthong as opposed to a nasalized diphthong.

fĩes (< fines) > fĩis > fĩs (=fins)	'end (pl.)'
bẽes (< benes) > bẽs (=bens)	'well (pl.)'
lãa (< lana) > lã	'wool'

When the nasalized vowel is not stressed, it lost its nasality and became an oral monophthong.

tẽer (< tenere) > teer > ter	'to have'
vĩir (< venire) > viir > vir	'to come'

(2) diphthongization

(a) hiatus made up of oral vowels:

If the first element is stressed, a-e, a-o diphthongized to ae(=ai), ao(=au), respectively.

sina-es (< sinales) > sinaes (=sinais)	'sign (pl.)'
ma-o (< malu) > mao (=mau)	'bad (masc.)'

These diphthongs merged with those which had already existed. Some new diphthongs appeared as a result of this diphthongization.

sɔ-es (< soles) > sɔes (=sóis)	'sun, sunshine (pl.)'
cruɛ-es (< crudeles) > cruɛes (=cruéis)	'cruel (pl.)'
cɛ-o (< caelu) > cɛo (=céu)	'sky'

After the language gained these three diphthongs, the system of this period became

		ui	iu		
ei		oi	eu		ou
ɛi		ɔi	ɛu		
	ai			au	

However, hiatus i-es with stress on i went through the following change and became a monophthong: i-es > i-is > is

civi-es (< civiles) > civi-is > civis	'civil (pl.)'

e-a, e-o stayed hiatus and in the next period, went through the change e-a > ei-a, e-o > ei-o.

che-a (< chẽ-a < plena) > cheia	'full (fem.)'
cre-o (<credo) > creio	'I believe'

This epenthesis did not take place until the beginning of the 16th century.

(b) hiatus which contains a nasalized vowel:

When the nasal is more open, hiatus became a nasal diphthong. That is, ã-o > ão (=ãũ), õ-e > õe (=õĩ), and ã-e > ãe (=ãĩ).

irmã-o (< germanu) > irmão	'brother'
razõ-es (< rationes) > razões	'reason (pl.)'
pã-es (< panes) > pães	'bread (pl.)'

A nasalized diphthong is one of the most conspicuous features of Portuguese. This period is fairly important in that the language knew ãĩ, õĩ, ãũ for the first time.

(3) 'new' hiatus (loss of nasality)

In the sequence of a nasal vowel + an oral vowel, when the nasal sound is more closed, it lost its nasality and became hiatus. Formerly, hiatus was due to the deletion of the intervocalic consonant. But this one could be regarded as new, because it was created by the loss of nasality.

arẽ-a (< arena) > are-a (> areia)	'sand'
chẽ-a (< plena) > che-a (> cheia)	'full (fem.)'

As for ĩ-o and ĩ-a, not only the loss of nasality, but also a palatalized [ɲ] sound appeared. This phenomenon is considered to result from the influence of ĩ. So ĩ-o > inho, ĩ-a > inha as in

vĩ-o (< vino) > vinho	'wine'
vizĩ-o (< vicinu) > vizinho	'neighbour'

[ɲ] itself is not a new sound, as the language already had it in the period of Galego-Português. This loss of nasality is thought to have taken place in the 16th century or even later. Incidentally, in the northern part of Portugal, speakers still use the nasalized sound. This type of denasalization was not so radical in Portuguese as in French and when it did occur, the nasal consonant did not reappear. In other words, in French, the distinction between a nasal vowel and a vowel followed by a nasal consonant was retained as in <u>bon</u> /bɔ̃/ 'good (masc.)' versus <u>bonne</u> /bɔn/ 'good (fem.)'.

(4) ã > ão, õ > ão

In this period, -ã-o, -ã and -õ merged into -ão. This started in the central and the southern part of Portugal and later became a standard. But the plural adhered to the original form, so that we are left with three different types of plural when the singular form of the words ends in -ão.

	period 1	period 2
sg.	mã-o (< manu)	mão
	pã (< *pãe < pane)	pão
	razõ (< *razõe < ratione)	razão
pl.	mã-os (< manos)	mãos
	pã-es (< panes)	pães
	razõ-es (< rationes)	razões

2.3.2. Consonants

ts	ś		s	ś
dz	ź	became	z	ź

In the late 15th century, the language lost the affrication part and the contrast turned into that of voiced and voiceless fricatives. In the preceding period, there was no confusion in the orthography.

[s] was represented by	ç, c(+e,i)
[ś]	s-, -ss-, -s
[z]	z-, -z-
[ź]	-s-

Thus the constituents of the system changed, but the system itself remained the same, by which I mean that Portuguese of this period still possessed this rectangular system. [ś], being apical, differs from [s] in terms of the point of articulation.

2.4. Período Moderno 1 (PM1)

PM1 started in the middle of the 16th century and continued until the middle of the 18th century. One of the characteristics of the PM1 is that starting from the middle of the 15th century, for about 200 years, there was a period of bilingualism involving the Portuguese intellectuals. For these intellectuals, Castilian, being the prestigious language, was more than just a foreign language. Historical events such as intermarriage between the Royal families of Portugal and Spain and the annexation of Portugal by Spain from 1580 to 1640 also influenced their attitudes towards the Castilian language. Portuguese grammarians were the only people who took the view that Portuguese is a distinct language from Castilian.

2.4.1. Vowels

(1) in stressed position

orals			nasals		
i		u	ĩ		ũ
e		o	ẽ		õ
	a			ã	
ɛ		ɔ			
	ɑ				

Both of these are identical to the system of the preceding period and to that of modern continental Portuguese.

(2) in unstressed position

(a) pretonic:

i		u	ĩ		ũ
e		o	ẽ		õ
	a			ã	
ɛ		ɔ			
	ɑ				

Because of some instability in the orthography, it is possible to assume that [e], [o] did not occur in this position, and [i], [u] were represented by <e>, <o>, respectively. However, such instability can only be seen in some limited words and is not a common phenomenon. Thus it is reasonable to assume that it does not concern the vowel system.

(b) final

It is even more difficult to decide the phonetic value of the unstressed, final vowels. The most plausible system that we could postulate would be

e o i u
a became a

That is, mid vowels were raised in the early 18th century. And later, the change i > ə took place only in continental Portuguese. This claim is partially supported by evidence from Japanese, in which Christian doctrine was transcribed in the syllabary towards the end of the 16th century. For instance, Portuguese words ending with <-e> or <-o> such as caridade 'charity', Cristo 'Christ' are consistently transcribed using /e/ or /o/ in the Japanese syllabary (karidaade, kirishito, respectively).

(3) ou > o

This change is assumed to have occurred in the 17th century in the central and southern part of the country. In the northern area (and in Galicia, too), speakers still use the diphthong [ou]. At the same time, some of the words experienced the change ou > oi. For example:

cousa : coisa	'thing'
louro : loiro	'blond (masc.)'
tesouro : tesoiro	'treasure'

However, it is only some of the words that have two forms, because the change did not apply to the whole lexical item. So the indicative, preterite, 3rd person, singular form of a verb whose infinitive ending is -ar, comprou '3rd (sg.) bought', for example, was never affected by this change. The language also had the change ei > e, which is thought to have taken place in the late 18th century. This happened only in the southern part of the country and did not include the area from Lisboa (Lisbon) to Coimbra. Therefore to pronounce [ei] as [e] is regarded as being 'incorrect' and dialectal.

(4) ea > eia, eo > eio

When /e/ was stressed in hiatus, there was an insertion of /i/ by vowel epenthesis, which probably took place in the middle of the 16th century.

crea (< creda) > creia	'that I believe (subj.)'
lea (< lega) > leia	'that I read (subj.)'
creo (< credo) > creio	'I believe'
leo (< lego) > leio	'I read'

2.4.2. Consonants

(1) loss of the contrast between s and ś, z and ź

The system of the preceding period existed at least until the middle of the 16th century, because no confusion in the orthography could be discerned. But later the language started to lose the contrast between these two pairs of fricatives. In northern Portuguese, there still remains the 4-fricative system. After the loss of the contrast, the system was split into two parts. On the north (upper) side of the isogloss, ś-ź is kept and on the south side, s-z is kept. The latter is considered to be the standard pronunciation. For example:

saber [s]	'to know by practice'
passo [s]	'step'
casa [z]	'house'

(2) contrast between b and v

At present, in the central and southern part of Portugal, /b/ has two different phonetic values, that is [b] and [β]. They are in complementary distribution. /v/ represents [v] and constitutes the different phoneme from /b/. Whereas in the northern part, both /b/ and /v/ represent [b], [β] and there is no contrast between the two phonemes. In the late 16th century, this confusion was regarded as a peculiar feature of the northern (Galician) speech and in standard Portuguese, speakers already distinguished /b/ from /v/.

(3) tʃ > ʃ

In Galego-Português, [tʃ] and [ʃ] were represented by <ch>, <x>, respectively. There was no orthographic confusion until the beginning or middle of the 17th century. The change from tʃ to ʃ is considered to have been completed by the early 18th century and ʃ has been the standard sound since then. Since the confusion started in the south and did not influence the northern (Galician) speech, [tʃ] can still be heard in those areas. The present distribution of these two sounds has remained almost the same.

Christian missionaries who went to Japan in the 16th and 17th centuries used both ch [tʃ] and x [ʃ]. When they transcribed Japanese words in the Roman alphabet, two symbols---ch and x---always had a different sound and there was a clear distinction. That is the reason why the change tʃ > ʃ serves to tell the phonetic values of Japanese in those days. When the missionaries wanted to transcribe the [ts](=[c]) sound which they had already lost, they invented the spelling of <tç>.

(4) s, z in syllable final position

In modern, standard, continental Portuguese (and Brazilian Portuguese spoken in Rio de Janeiro, especially), s, z are palato-alveolarized to [ʃ], [ʒ] when they occur at the end of the syllable.

três̲ [ʃ]	'three'
todos̲ [ʃ]	'all (pl., masc.)'
es̲tar [ʃ]	'to be (temporary)'

The 15th and 16th centuries are an important period when Portuguese spread to Asia and Africa. The study of various types of Creole helps us to examine the phonetic value of Portuguese of this period. It is reported that Portuguese spoken in Africa has a lot more in common with that of Brazil, as both of them retain the conservative aspects which the language has already lost in Europe.

2.5. Período Moderno 2 (PM2)

PM2 started in the middle of the 18th century and has lasted to the present day. Most of the features which enable us to distinguish continental Portuguese from the

Brazilian counterpart are attributed to the phonological changes which took place in this period.

2.5.1.Vowels

(1) in stressed position:

i u
e o
a
ɛ ɔ
ɑ

This system has not changed since PA2. However, there were some important changes in terms of the distribution of each sound.

(a) e > a

Until PM1, [e] could occur before palatals such as [ɲ], [ʃ], [ʒ], [ľ]. It is not clear when [e] changed to [a] in this position, because it never affected the orthography. Probably this [a] sound had become popular around Lisbon by the end of the 19th century. Although speakers who use [a] in this position are the minority, it is regarded as being standard.

tenho [a]	'I have'
vejo [a]	'I see'
coelho [a]	'rabbit'

(b) ei > ai, ẽĩ > ãĩ

These changes also started around Lisbon. The area where speakers use [ei], [ẽĩ] is a lot wider but still it is considered to be standard to pronounce them [ai], [ãĩ].

tem 'to have (3rd., pers., sg., pl., pres.)', being pronounced [tãĩ], rhymes with *mãe* 'mother'.

(2) in pretonic position

(a) o > u

This change is thought to have occurred toward the late 18th century and by the end of the same century, [u] in this position had become a standard sound. According to Paul Teyssier (*Histoire de la langue portugaise*), Luís do Monte Carmelo pointed out in his *Compendio de Ortografia* (1767) that 'errors' had arisen in pronunciation such as *cutovelo* for *cotovelo* 'elbow', *tucar* for *tocar* 'to touch', *xuver* for *chover* 'to rain' and so forth. From this fact, we assume that [u] was becoming the popular pronunciation in the late 18th century.

(b) e > ə

The distribution of [ə] was quite unstable when it first appeared in the language. We cannot tell the origin of this sound from the orthography, because both [e] and [ə] were represented by <e> consistently. The assumption is that this [ə], which is peculiar to European Portuguese, began to exist in the late 18th century, and more specifically after 1750.

The pretonic vowel system is as follows:

i		u
	ə	
e		o
	a	
ɛ		ɔ
	ɑ	

(3) in unstressed, final position

Período Moderno 1 Período Moderno 2

i		u			u
	a		became	ə	
				a	

In PM2, only [i] underwent change to [ə]. But even now, in southern Portugal or in Brazil, speakers still have [i] in this position. It is very likely that [ə] is deleted regardless of where it may appear. This phenomenon could possibly represent the beginnings of a new syllable structure.

2.5.2. Consonants

As for consonants, there was only one major change in this period.

In modern Portuguese, the alveolar trill is sometimes replaced by a uvular trill, or by a velar fricative. It is said that these sounds appeared somewhere around the late 19th century. Although [R], [x] are heard in Brazil, as well, it is unknown whether they are inherited from continental Portuguese or started on their own.

The reason why European Portuguese sounds are so different from their Brazilian counterparts is that almost none of the changes which took place in PM2 spread to Brazil, but remained inside Portugal. Brazilian Portuguese could be regarded as phonologically conservative in that it reflects the older form of continental Portuguese. However, we should never ignore the innovative aspects which the language in Brazil possesses.

3. FURTHER CONSIDERATIONS

As far as I am concerned, I would like to examine the Portuguese language more deeply in terms of (a) the phonetic differences between continental Portuguese and Brazilian or African Portuguese, (b) more detailed reconstruction of the older state of the language by examining Portuguese Creole spoken in Sri Lanka, Malacca, etc., (c) peripheral aspects common to Rumanian and Portuguese as the easternmost and westernmost outliers of Romance in Europe, if there are any, (d) comparison between Galician and Portuguese, (e) study of the values of 16th century Japanese by examining the transcription used in the Christian doctrine, and (f) Japanese spoken by those who first emigrated to Brazil and by their descendants.

NOTES

[1] I would like to thank my graduate committee members and WPLC editors for their careful reading of this paper.

[2] The figure does not include the speakers who reside permanently abroad and non-native, cultural speakers.

[3] This took place in the passage from Vulgar Latin to Galego-Português and so did the spirantization of intervocalic stops and their deletion except /b/.

[4] This river is the border between the Islamic and the Christian power.

[5] At the beginning of the 8th century, the Arabs attacked the Iberian Peninsula. Some of the inhabitants left for the north or the northwest mountainous area, some remained where they lived before and surrendered. There were also people who never gave up their religion and refused to convert to Islam. They are called moçárabe which literally means those who pretend to be Arabs. Moçárabe (Mozarabic) is romance spoken by the Christians in Arab territories. It is highly arabicised.

REFERENCES

Azevedo, M.A. (1981). A contrastive phonology of Portuguese and English. pp. 1-40. Washington: Georgetown University Press.

Camara, J.M., Jr. (1972). The Portuguese language. Translated by Naro, A.J. pp. 1-57. Chicago: University of Chicago Press.

Camproux, C. (1974). Les langues romaines. Translated by Shimaoka, S. and Torii, M. Tokyo: Hakusuisha.

Ikegami, M. (1984). Portuguese and Galician---their establishment and expansion. Tokyo: Daigakushorin Publishing Co.

Pei, M.A. (1976). The story of Latin and the Romance languages. pp. 115-123, pp. 207-215. New York: Harper&Row.

Posner, R. (1966). The Romance languages. Translated by Kazama, K. and Nagami, S. (1982). Tokyo: Taishukan Publishing Co.

Shimaoka, S. (1970). The story of the Romance languages. Tokyo: Daigakushorin.

Williams, E.B. (1968). From Latin to Portuguese. pp. 1-115. Philadelphia: University of Pennsylvania Press.