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The Role of Sonority in Jargonaphasia.

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The Role of Sonority in Jargonaphasia

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Abstract

The Sonority Sequencing Principle suggests that the relative sonority rank among sounds can explain intrasyllabic and transsyllabic phoneme ordering patterns in normal speakers. The values of segments can be ranked from most to least sonority as follows: Vowels, Glides, Liquids, Nasals and Obstruents. The unmarked order of segments within an initial demisyllable is O-N-L-G from the periphery toward the peak, and G-L-N-O in a final demisyllable from the peak toward the periphery. The sonority "slope" of an initial demisyllable will be steep to maximize the perceptual saliency of syllable onset. In a final demisyllable, especially if embedded, the slope will be flatter to maintain sonority contrast between abutting syllables.

This study answered the following questions: (1) What syllable shape and sonority profile patterns (in four types of demisyllables) are present in the neologistic and legitimate English utterances of three fluent aphasics, (2) Are these patterns similar to those observed in the well-formed utterances of normal speakers, (3) Does the sonority principle facilitate neologism analysis, 4) Can sonority be incorporated further into models of sentence production and, (5) What implications for sonority theory and for theories of neology are suggested by results.

Data from three neologistic jargonaphasics were audio-recorded during expressive language tasks. Neologisms were phonemically transcribed by three independent listeners. A demisyllable data base for target-related neologisms, abstruse neologisms, and English words was compiled for each subject. Summary frequency distributions for demisyllable shapes and sonority profiles were obtained and tested for each word type.

Results from extensive demisyllable analyses suggested the following: (1) demisyllable shapes for neologisms and English words were most often of the form CV or CVC, (2) intrasyllabic and transsyllabic sonority profiles in neologisms and English words were most frequently of the preferred patterns, although some exceptions were noted, (3) demisyllable shapes and sequence preferences were similar to patterns found in legitimate English words and, (4) sonority may constrain the operation of mechanisms that create neologisms, whether viewed from a serial or parallel model of language production. Results suggest that sonority may partially govern construction of normal and impaired phonological forms.

CHAPTER ONE: INTRODUCTION

Sonority Theory

Linguists have long struggled to define the nature of the syllable. Some have considered the syllable to consist of an onset, peak and coda (Hockett, 1955; Pike and Pike, 1947). Others have preferred an analysis such as onset and rhyme, or core (e.g. Selkirk, 1982). Still others have denied the existence of any subsyllabic constituency at all (Clements and Keyser, 1983). However, common to all definitions is the concept of syllable as an entity containing a peak element; that is, without a peak, there is no syllable. Jesperson (1904, cited in Clements, 1990, p. 285), believed the following, "In every group of sounds there are just as many syllables as there are clear relative peaks of sonority." The sonority of a sound is its loudness or perceptual prominence relative to that of other sounds with the same length, stress, and pitch (Ladefoged, 1982; Clements, 1988, 1990). This loudness is due, in part, to the degree of acoustic energy that a sound possesses. Because acoustic energy can be measured, some linguists have attempted to describe sonority via an acoustic-based definition (Price, 1980). Others, however, have defined sonority via articulatory models (Keating, 1983). However, to date, no one has arrived at a satisfactory way of defining sonority, nor has anyone found an invariant phonetic parameter linked to sonority.

Fortunately, the concept of sonority as an integral aspect of syllable definition does not require a physical level of expression in order to be useful. The sonority principle represents a significant high order explanatory statement of crosslinguistic phonological trends (Clements, 1988, 1990). Sonority as a concept has historically provided explanatory power for and has motivated descriptions of preferences for certain types of syllable structures and sequences in normal users of various languages (see, for example, Greenberg, 1978). It is not unlikely that sonority may be an underlying determinant of what is considered to be marked across languages. Individual languages may, however, have independent explanations for deviations from the predicted. That is, language particular rules may take precedence over the principle (Clements, 1988, 990).

Two aspects of the sonority concept were originally explored: the sonority ranking scale and the sonority sequencing principle. Jesperson (1904, cited in Clements, 1988, 1990) and Foley (1970, 1972) both devised scales that ordered phoneme classes along a

sonority continuum from least to most sonorous. Although there are differences between the scales, both place stops and fricatives toward the "least" end of the continuum, with nasals, liquids, glides and vowels (in that order) toward the "most" end of the scale (Clements, 1988, 1990). Clements has also proposed a sonority ranking scale, constructed from analysis of the following binary features: +/- syllabic, +/- vocoid, +/- approximant, +/- sonorant.

Summation of the "plus" features across the following classes of sounds yields the ranking scale. Clements suggests that the following classes of sounds are ordered as below, from most to least sonorous: Vowels (Rank 4), Glides (Rank 3), Liquids (Rank 2), Nasals (Rank 1) and Obstruents (including stops, fricatives and affricates) (Rank 0). Since syllabic consonants can also function as syllable peaks, Rank 3 is assigned to syllabic liquids, Rank 2 is assigned to syllabic nasals, and Rank 1 is assigned to syllabic obstruents.

The original Sonority Sequencing Principle (SSP), developed primarily from the work of Sievers (1881, cited in Clements, 1988), and Jesperson (1904), depended upon the relative sonority rank among sounds to explain why certain types of syllables were permitted in languages (for ex. tra, dva, sma, mla), while others were not (ex. rta, vda, msa, lma) (Clements, 1988, 1990). This principle can also explain the intrasyllabic ordering of segments.

Thus, the original SSP may be stated as follows: "Between any member of a syllable and the syllable peak, only sounds of higher sonority rank are permitted". (Clements, 1988, p. 3). According to Clements, this principle was revived and incorporated into syllable phonology theory through the work of Hooper, 1976, Kiparsky, 1979, Steriade, 1982 and Selkirk, 1982. Hooper proposed an expanded version of the SSP, which was subsequently named the Syllable Contact Law (SCL) by Murray and Vennemann (1983). This principle holds that: "In any sequence C_a \$ C_b, there is a preference for Ca to exceed Cb in sonority" (Clements, 1988, p. 5). In this notation, "C_a " refers to the segment immediately preceding a syllable (\$) boundary , and "C_b" refers to a segment immediately following a syllable boundary. By this rule, the sonority value of syllable final consonants typically exceeds the sonority value of adjacent syllable initial consonants. Therefore, syllable final consonants typically have more sonority than do syllable initial consonants. This can be illustrated in the phrase /treIn $ keIm/, where the syllable coda /n/ clearly

possesses more sonority than the subsequent syllable onset /k/. However, the reader should attend to the word "preference" in the quote above, for certainly there are many occasions where this principle is violated in English. For example, in the phrase /treIn $ rEk/, the second syllable is initiated by a segment possessing more sonority than the segment which terminated the first syllable. Violations of this nature encourage criticism of the theory, as there has been no method of accounting for the abundance of "exceptions" to the rule.

Murray and Vennemann (1983) proposed an extended version of the SCL to describe the optimality of any two adjacent heterosyllabic segments, as follows: "The preference for a cross syllabic structure A $ B, where A and B are segments and a and b are the sonority values of A and B respectively, increases with the value of a minus b." (Clements, 1988, p. 43). This principle allows for exceptions to transsyllabic sonority patterns but indicates that they fall within the range of the "less optimal" of possibilities.

Clements suggests that sonority governs underlying syllabification processes in the lexical phonology. He states that underlying representations found in any language are syllabified in accordance with principles of core syllabification, which are sensitive to sonority constraints. Thus, the SSP holds at a more abstract level than that of simply surface representation. Placing the level of operation more abstractly accounts for crosslinguistic trends better than does a placement at the surface level alone.

Clements (1988, 1990) has proposed a model called the Sonority Cycle that is constructed from two major components: Core Syllabification and Feature Dispersion. The primary tenet of the cycle theory is that the sonority profile of a preferred syllable rises maximally at it's beginning and drops minimally at it's end. Sonority levels therefore alternate in quasiperiodic fashion across syllable segments (See Figure 1, Appendix A, for illustration). Sonority based constraints are formulated at the core phonology level and they function in the syllabification process. In fact, the role of sonority in syllabification of underlying representations is the critical issue explored by Clements.

There is a set of Core Syllabification Rules (Clements and Keyser, 1981, 1983) that is responsible for syllabification of underlying representations. The rules reapply to the output of each phonological and morphological operation throughout the core phonology; that is, throughout that portion of the lexicon which is subject to reiterative well-formedness conditions (Kiparsky, 1985), marking conditions and language-specific phonotactics.

The Core Syllabification Principle (C.S.P.) may be stated as follows: "(a.) Associate each [+] syllabic segment to a syllable node. (b). Given P (an unsyllabified segment) adjacent to Q (a syllabified segment), if P is lower in sonority rank than Q, adjoin it to the syllable containing Q (iterative)". (Clements, 1988, p. 40). Thus, in the phrase /treIn $ keIm/, the vowels /eI/ and /eI/ would first be associated with separate [+] syllabic nodes, forming the peak sonority elements of two different syllables. Since the vowels are now syllabified, they are represented by notation "Q". Other unsyllabified segments at this point, represented by notation "P", would be the consonants. The consonants /r/ and /k/ would be attached to their respective vowels next, since each possesses less sonority than the already syllabified segment to which they are attaching. These segments are now also "Q" segments.

The phoneme /r/ is attached directly to the vowel since it has less sonority than /eI/, but more sonority than /t/. Naturally, at this point, phonotactic restraints of English interact with segment sequencing processes, since the sequence /rt/ is not permitted as a syllable onset. Syllable onsets are defined before syllable codas are determined. Thus, the phoneme /t/ would be attached next to the /r/ of train, since it possesses less sonority than /r/, while the /m/ is attached to the vowel /eI/ as the coda of /keIm/. This mechanism allows for simultaneous lexical syllabification at the level of the most abstract underlying representation.

Syllabification operates according to the "Maximal Onset Principle", which allows for segment placement into syllable slots in such a way as to maximize consonant onsets. For example, intervocalic clusters are usually syllabified into the onset position of the second syllable in a two-syllable word (ex. / ə 'plaI/). The consequence of this with respect to sonority is that the first syllable terminates with a minimal sonority slope while the second syllable obtains the preferred maximal sonority rise. Additionally, the length and perceptual salience of the second syllable onset is accentuated.

The universal sonority scale and a "complexity metric" (discussed below) facilitate selection between well-formed alternatives in situations where multiple analyses may be allowed. For example, in the case of ambisyllabic segments (ex. the /p/ in "apple"), assignment of the /p/ to the onset position of the second syllable would be the preferred analysis with respect to the above principles (ex. /'æ pə l/).

One qualification is necessary with respect to the C.S.P. as described above: the sonority profiles of syllables will vary according to the syllable's position in an utterance.

For example, any syllable which is nonfinal (adjacent to a subsequent syllable in an utterance) will exhibit a minimal post-peak sonority decrease. However, an utterance-final syllable tends to display a more significant sonority decline after the syllable peak. For example, in the word *impact*, the post-peak sonority decline in *im*, will be less than the post-peak decline in *pact*. The rationale for this is that, whereas nonfinal syllables are competing with adjacent syllables for segments, final syllables are not.

There are, however, exceptions to this tendency. For example, word-final CV syllables show no sonority decline, and yet are permitted in many languages. Alternately, some languages permit initial syllables that begin with a vowel and show no sonority rise, despite the nearly universal preference for steep sonority rise in initial syllables. However, this phenomenon is most commonly observed in word- or morpheme-initial position. Clements notes that the majority of the exceptions to sonority preferences are located at the periphery of syllables, where competing syllable divisions and alternate parsings are not an issue. He also notes that the C.S.P. is governed by language-specific operations of the core phonology. Thus, language-particular rules may occasionally take precedence over the CSP (ex. syllabifying vowels and glides together to form diphthongs).

Syllables that conform to the C.S.P. are considered to be unmarked. These are syllables that display a steep rise in the sonority profile at the onset of the syllable and show a minimal reduction in sonority at the end of a syllable. According to Clements, violations represent marked syllable types. Syllables become more marked to the degree that their sonority profiles deviate from the most unmarked case. Note that the C.S.P. only holds for the unmarked syllable types. The terms complexity and markedness are used interchangably in this dissertation, since forms that demonstrate more complexity are generally those that are more marked linguistically.

Apparent surface violations of sonority restrictions can be handled by the concepts of extrasyllabic segments and by other related explanations. Violations may include consonant sequences with sonority plateaus (ex. pt, kt, sf) and reversals (sp, st, ks, ps). Violations may also be found in syllables whose peaks are not <u>sonority</u> peaks (ex. yearn as [jr̩n]). In this example, although the segment /j/ possesses more sonority than /r/, it cannot act as a syllabic consonant, and thus cannot be the syllable peak. Violations may occur when consonants remain unsyllabified (ie. are extrasyllabic) after the core syllabification rules have applied. These consonants either become syllabified at a later point in the derivation or are deleted. For example, the syllable-final sequence [kt] in the word *act*

represents a surface violation of the sonority principle, but can be explained if the [t] is considered to be extrasyllabic during application of sonority constraints. Violations are usually found at the edges of syllabification domains (ie. are found at the outer edges of syllables) since extrasyllabic elements prefer these positions.

The second major tenet of the Clements' Sonority Cycle is the Dispersion Principle, a means of accounting for relative complexity among syllable types. The Dispersion Principle correlates markedness with complexity, such that syllables that are unmarked are also the most simple. Syllables that deviate from the unmarked case become increasingly more marked (complex) as they deviate from the unmarked case. For example, the syllable types that are in violation of the C.S.P., discussed above, would not only be considered to be marked, but would also represent more complex syllable types than the unmarked case. Sonority reversals are considered to be more complex than are sonority plateaus and the complexity of sonority reversals increases in proportion to the extent of the reversal. The C.S.P. does not address the quantitative issue of complexity directly. Rather, this is the function of the Dispersion Principle.

Clements has created a measure of dispersion that can calculate the complexity rankings of demisyllables and form a basis for determining the relative distance of a demisyllable from the most simple and unmarked case. A demisyllable is one half of a syllable. If syllables are divided into onset, peak and coda (Hockett, 1955; Pike, 1967; Davis, 1985), then initial demisyllables include onset consonants and the syllable peak. Final demisyllables include the peak (again) and coda consonants (ie. the syllable core re: Fudge, 1969, Selkirk, 1982). Thus, in the word *baseball*, the utterance-initial demisyllable is /beI/, the non-final (utterance-internal) demisyllable is /eIs/, the utterance-internal initial demisyllable is /bɔ/ and the utterance-final demisyllable is /ɔl/. The peak may function by itself as a demisyllable in the cases of syllables with no onset or coda consonants.

The dispersion measure is represented by a *D* score and is given by the following formula: $D = \sum 1/d_i^2$, where each d_i value reflects the distance in sonority rank between a pair of segments within a demisyllable. Thus, for any given demisyllable, computation of the score requires summing the inverse of each phoneme's squared distance value (obtained from subtraction of sonority ranks given above). A simple example will illustrate the method.

The following demonstrates how denominator (distance) values are obtained:

O	N	L	G	V
k		l		a

O	N	L	G	V
k			w	a

Distance from /k/ to /l/ = 2
Distance from /k/ to /a/ = 4
Distance from /l/ to /a/ = 2

Distance from /k/ to /w/ = 3
Distance from /k/ to /a/ = 4
Distance from /w/ to /a/ = 1

Thus, for the demisyllable /kla/, the following figures will be summed: $1/2^2 + 1/4^2 + 1/2^2 = .27$. However, the demisyllable /kwa/ requires summation of: $1/3^2 + 1/4^2 + 1/1^2 = 1.12$.

Low *D* scores indicate that sonority distances of demisyllables in question are maximized and are evenly distributed. A higher *D* score indicates that sonority distances of demisyllables in question are minimized and are poorly distributed. Therefore, the Dispersion Principle indicates that the preferred initial demisyllable (whether utterance-initial or utterance-internal) minimizes *D*, whereas the preferred final demisyllable maximizes *D* (especially in the case of utterance-internal contexts). The Dispersion Principle is defined only upon syllables that accord with the CSP. Marked syllables require an extension of the complexity metric (discussed below).

Clements has computed the relationship of the dispersion score *D* to complexity for various types of syllables. Complexity is proportional to the ranking defined by *D*. The Complexity Metric is given as follows: "For any initial demisyllable of length *l*, the complexity ranking *C* increases as its ranking in terms of *D* increases. The complexity ranking *C* for a final demisyllable increases as it's ranking in terms of *D* decreases". (Clements, 1988, p. 27). The Complexity Metric makes the following statement about core phonological systems: Core Syllabification Rules do not create more complex syllable types unless they also create the more simple syllable types.

Clements (1988, 1990) has summarized complexity scores (*C*) in a convenient set of tables. Thus, to compute the relative complexity of, for example, a CVC syllable, one must first analyze the syllable into CV and VC demisyllables, and determine the sequence of phoneme classes within each demisyllable. Then, one need only look up the complexity values for that demisyllable type as compared to other demisyllable types. Use of the Clements tables would allow determination of the proportions of simple vs. complex

syllable types present, for example, in a language sample. This may illuminate sonority patterns evident in the language of an individual and may allow comparisons of actual language patterns to predictions made from the theory.

Thus, in summary, Clements has predicted that (1) the unmarked order of segment types within initial demisyllables is ONLGV, and within final demisyllables is VGLNO, (2) segments within initial demisyllables tend to be equally and maximally distributed in sonority and (3) final demisyllables tend to show a minimal decrease in sonority, although the effect is more pronounced in the utterance-internal context. The extrasyllabicity notion accounts for some surface violations to this (eg. marked clusters /st/) in utterance-final demisyllables. Note that this interpretation is different from that proposed by Donegan and Stampe, (1978), whose theory of Maximal Prominence Contrast predicted that the preferred slope toward and from the vowel would be steep. Additionally, Clements predicts that contrast in continuancy is favored over its absence such that sequences differing in their specification for [continuant] are preferred to sequences agreeing in this specification. Finally, if the Complexity Metric is allowed to extend to sequences differing in length, Clements predicts that syllabifications will be selected in accordance with the Maximal Onset Principle (mentioned above) over syllabifications that violate it.

The above discussion of the Sonority Cycle and its attendant principles, the CSP and the Dispersion Principle, have addressed sonority patterns within and across syllables and have attempted to explain why certain types of syllable contacts are preferred over others. Clements' primary purpose in his sonority discussion is to make statements about the nature of syllabification processes in the core phonology, and to determine what generalizations can be drawn about language as a result. He raises questions about the types of data to accept as primary evidence that would support or invalidate principles of syllable formalization. By far, most evidence has been obtained from external evidence such as language games, speech errors and historical language change. Other evidence has resulted from phonological or phonetic analyses. Regardless, and with few exceptions, the majority of the evidence to date has been collected from the behavior of normal language producers. However, those interested in studying the nature of disordered language systems are currently examining the role that sonority plays in determining the phonological mechanisms operating in, for example, fluent aphasia.

Sonority and Aphasia

Some investigators are beginning to examine the role that sonority might play in explaining phonological error patterns noted in fluent aphasia. Blumstein (1978) invoked the sonority concept to explain addition paraphasias during cluster formation. For example, she noted that when clusters were formed from addition errors, liquid elements were added to the right of the initial obstruent element but to the left of the peak element. This, of course, follows the placement expected along any of the sonority hierarchy scales mentioned above (generally, ONLGV). Buckingham (1987) makes the point, however, that sonority operates in tandem with language specific phonotactic rules, so that, for example, clusters that are not permissible in a language would not be formed, even if they represented a preferred sonority sequence. This explanation acounts for the production of, for example, initial /st/ clusters, but not initial /ts/ clusters in English. Clements (1988, 1990) agrees that, with respect to segment sequencing and syllable parsing, language-particular rules may supercede sonority preferences.

Belan, Caplan and Nespoulous (1985) and Beland and Nespoulous (1985) (both cited in Buckingham, 1987) have also incorporated sonority into explanations of phoneme deletion and perseveration. They noted that these types of errors often result in the production of syllables with steeper slopes pre-vocalically and post-vocalically (Donegan and Stampe, 1978). Clements' (1988, 1990) analysis of sonority, suggests that steeper slopes represent the unmarked case only with initial and utterance-final demisyllable production. Steep slopes produced in utterance-internal post-peak environments represent the more marked case. However, if aphasic sonority patterns are determined on the basis of analyses of single word utterances, then the pattern observed by Donegan and Stampe would be the same as that predicted by Clements.

Markedness theory alone might explain production of some paraphasias in the speech of fluent aphasics since these types of errors often result in the construction of less marked syllable types than would normally be produced. Buckingham (1987) developed this concept by exploring the role that sonority plays in doublet creation. After examination of a corpus of doublet-creation errors, he noted that where phoneme deletion would have left behind a more marked sequence of segments, an anticipatory or perseverative error often occurred to create a doublet instead. For example, the French /deabyla/, was produced as /debabyla/. In this case, the /b/ segment was not only anticipated to the onset position of

the second syllable, but also was not deleted from its original site in the word. A /VV/ sequence in a target represents a very marked situation according to the sonority theory described above. Addition of the first /b/ segment created a less marked situation by breaking up the target /e$a/ sequence into /e$ba/ Additionally, retaining the /b/ in its original position prevented the marked sequence /a$y/. Therefore, not only do the resulting sequences align better with preferences along the sonority hierarchy, but the error has also resulted in resyllabification of the target toward the less marked case.

Analysis along the lines of Clements' proposals above would suggest that the final demisyllable in Syllable 1 still retains a minimal sonority slope. However, the doublet error has now created a steeply sloping onset to the initial demisyllable of Syllable 2. Maintenance of the /b/ in its original site has preserved the slope contrast between syllables two and three. The result is that the two sets of adjacent demisyllables in question are in sharp perceptual contrast. In this case, the sonority principle (e.g. the Syllable Contact Law) provides a principled analysis of certain segment sequence and syllabification patterns seen in fluent aphasia.

One crucial characteristic of the evidence cited above is that intended production targets were recoverable. Thus, investigators were able to compare actual productions to what were most likely intended targets and were thereby able to employ sonority to analyze and explain observed segment movements. That is, actual productions, while paraphasic, were not so distorted that they rendered intended targets unrecoverable. However, it is often the case that actual productions might not be recognizable as real words in the language even though they may phonologically resemble <u>some</u> words in the language. This situation arises in neologistic jargonaphasia, a syndrome of the fluent but contentless speech created by damage to Wernicke's area of the brain (posterior lesion in the dominant language hemisphere) (Schwartz, 1987). In this disorder, patients typically manifest difficulties with auditory comprehension (Buckingham & Kertesz, 1976; Naeser, 1974; Lesser, 1978). They often produce bizzarre words (neologisms) in place of nouns, verbs or adjectives (Buckingham & Kertesz, 1976; Butterworth, 1979; Lecours, 1982; Lecours & Rouillon, 1976).

The linguistic aspects of jargonaphasia have been studied from many perspectives. Neologistic behavior has been described and often explained in terms of the following: phoneme frequency patterns (Butterworth, 1979), word frequency patterns (Buckingham, 1982a; Miller & Ellis, 1987), accessibility of underlying phonological form (Buckingham

& Kertesz, 1974, 1976; Buckingham, 1977a, 1979, 1981, 1982b; Pick, 1931), and perseveration mechanisms (Buckingham & Kertesz, 1976; Buckingham, 1985; Buckingham, Whitaker & Whitaker, 1978, 1979; Brown, 1972; Butterworth, 1979; Green, 1969; Lecours & Lhermitte, 1969). Aside from the sources cited at the beginning of this section, there has been comparatively little investigation into the relationship between sonority patterns seen in the normal case and sonority patterns seen in fluent aphasia. Few, if any, severe jargon productions have been analyzed along these lines.

One difficulty with conducting such analyses arises from the above-mentioned frequent inability of the investigator to recover the jargonaphasic's intended targets. In some cases, surface neologisms resemble targets sufficiently to allow recoverability. However, in the case of abstruse neologisms (Lecours, 1982), targets are often unclear. Clements (1988, 1990) made a strong argument for the operation of the sonority cycle at the level of the core phonology, the most abstract level of lexical underlying representations. Derivation of surface patterns from deep structures allowed him to account not only for regular and predicted sonority patterns, but also for apparent surface exceptions to expected patterns. Without knowledge of a speaker's intended targets, it is difficult to determine the processes that could be at work in the derivation of given items with respect to sonority-governed operations.

An additional complication is that jargonaphasics may not even have access to the underlying representations for their intended targets. That is, it is not clear whether they correctly access target representations and then distort them via severe phonemic paraphasia (Brown, 1977; Ellis, 1985; Kertesz & Benson, 1970; Lecours, 1982; Luria, 1970) or whether they are unable to access targets due to an underlying anomia (Buckingham & Kertesz, 1974, 1976; Buckingham, 1977a, 1979, 1981, 1982b; Pick, 1931). In the latter situation, neologisms result from the operation of a device that randomly combines segments into novel words that fill the gaps created by anomic blocks (Butterworth, 1979). Buckingham (1981, 1982b, 1987) has conceptualized this mechanism as a random syllable generator, which contains and provides minimal syllabic units designed to obey the phonotactic constraints of the native language of the aphasic.

Several interesting questions arise from this discussion. First, how might the sonority principles presented above be employed to provide either descriptive, predictive or explanatory power for language behaviors in the case of jargonaphasic speakers whose intended targets are unrecoverable? In this case, investigators would be limited to

producing descriptive and quantitative accounts of surface phoneme sequence and syllabification patterns. Interpretations and predictions drawn from sonority principles would necessarily be made with a certain amount of information missing, rendering analyses a bit less conclusive than they might otherwise be. Nevertheless, such an analysis has not been done to date. Second, what implications do observed sonority patterns in such speakers hold for understanding (1) the nature of the sonority theory given above, (2) the nature of language breakdown in fluent aphasia and (3) the nature of the mechanisms employed in the generation of neologisms? For example, patterns of surface sonority preferences may allow investigators to infer whether or not speakers had underlying representations of intended targets in mind at the time of production. If demisyllable shapes and sonority sequences of segments in a neologism were similar to those patterns in the intended word, then this information could provide evidence for one of the theories describing possible mechanisms underlying neologism production.

Patterns of surface sonority preferences might also provide answers to questions about the mental constructs governing the operation of random segment or syllable generating devices. For example, does sonority appear to constrain operation of the generating device, and if so, at what point in a sentence production model should those constraints be said to operate? Additionally, one might speculate as to the nature of sonority violations and as to the "why" of observed surface violations.

The next section of this paper reports the results from a pilot case study conducted to address these questions and to determine whether a subsequent and more rigorous study was feasable. The subject was a severe jargonaphasic whose language was described and analyzed with respect to certain aspects of the sonority theory described above. Since the majority of this individual's underlying representations usually were not recoverable, discussion and analysis was limited to the information obtainable from a surface analysis of sonority patterns.

Case Study

Subject

The subject, H.V., received a speech and language diagnostic evaluation at the L.S.U. Speech and Hearing Clinic, Baton Rouge, Louisiana, on 10-20-87 and 10-26-87. The following information was obtained from the medical and speech/language diagnostic

reports available at the clinic.

H.V. was a 53 year old, right-handed, white female who developed a severe fluent aphasia subsequent to two strokes. In October, 1985, she experienced both strokes after undergoing surgery to clip a left posterior communicating artery aneurysm. Post-operatively, she developed an infarction and became left-hemiparetic and aphasic. Subsequent CT Scans showed that H.V. incurred additional infarcts in the left middle cerebral artery, in the left thalamic area and in the region of the genu of the internal capsule. By April, 1987, H.V. displayed encephalomalacia (softening of the brain) at the following sites: in the inferior aspect of the left frontal lobe, in a large portion of the left temporal lobe and in the left parietal lobe. At this time, H.V. displayed a right hemiparesis and, although she was able to walk unassisted, her right hand was very weak and was nonfunctional for writing tasks. Although facial nerve paralysis rendered the right side of her face weak, H.V. did not display specific articulation problems.

Administration of the Porch Index of Communicative Ability (PICA) and the Boston Diagnostic Aphasia Examination (BDAE) yielded the following communication profile. H.V.'s spontaneous speech was characterized by numerous literal and semantic paraphasias and by neologisms that rendered the majority of her utterances unintelligible under most speaking conditions. In fact, 90% of her verbal productions were differentiated but unintelligible. H.V. frequently used automatic speech (Yes, No, I don't know) to reply to direct questions requiring simple responses. She was unable to recite rote sequences (such as the alphabet) or to intelligibly repeat words or phrases. Pictures were named with verbal paraphasias; number and letter identifications were replaced by semantic paraphasias. When asked to read single words, H.V. replied by spelling them with unpredictable letter sequences. Sentence reading tasks elicited paragrammatisms.

H.V. displayed a significant deficit in auditory comprehension, despite a superficial appearance of understanding. Although all language modalities were severely impaired, the examiners felt that the visual and gestural modalities represented her strongest input and output modes. Her visual matching and pointing skills were good and she appeared to appreciate the visual humor in pictures. Her overall PICA score placed her in the 27th percentile with a variability score of 339.

H.V. received 4 months of speech/language therapy at a local hospital immediately after her initial surgery. However, she did not receive any additional therapy for the 20 months immediately preceding the LSU evaluation. H.V. began speech therapy at the LSU Clinic

in Fall, 1987, and continued until Spring, 1988.

Procedure

In November, 1987, the author met with H.V. at the LSU Clinic to collect a sample of her speech under the following conditions: picture naming, word repetition and reading (single words). These conditions were selected because of the unintelligibility of H.V.'s spontaneous speech. It was felt that intended targets would be completely unknowable during conversation and, because of H.V.'s very fast speech rate, subsequent phonemic transcription might be difficult at best. The structured stimulus conditions allowed the examiner to know at the very least what H.V.'s intended targets should have been.

Five (5) high, five (5) mid, and five (5) low frequency words for each of the 3 stimulus conditions were selected from among those listed in Dahl's Word Frequencies of Spoken American English (1979). Visual stimuli were kept as simple as possible. Uncluttered, colorful, representative pictures were selected for use in the picture naming task. Words to be read were clearly written on individual 3 x 5 inch index cards in large print. Words to be repeated were uttered in a normal fashion. Repetitions and prompts were given upon request and as needed.

The session was begun by explaining the purpose and nature of the speech tasks. H.V. appeared to understand the various tasks and she was alert and cooperative throughout. A good quality audio recording was made of all data collected in the sound treated room (Sony Tapecorder, Model TC 110B, with Sony Dynamic Microphone, Model F V2M). The recording of H.V.'s utterances was later phonemically transcribed by the author. The pilot study did not include a second transcriber for verification. The dissertation did.

Method of Analysis

The entire corpus of H.V.'s utterances (neologistic and otherwise) was subjected to the following methods of analysis:

(1). A syllable inventory was compiled by segmenting every utterance into syllable units.

(2). Each syllable was identified by type (shape) and was placed in that category within the following inventory of observed syllable types: CV, CVC, V, VC, CVCC, VCC, CCV, CCVC, CCVCC, C̩C, C̩).

(3). Tally totals were obtained for each syllable type. These were converted to percentages to determine the frequency with which each syllable type occurred.

(4). Each syllable was broken into it's initial and final demisyllable components. For example, regarding the syllables CV or CVC, the initial demisyllables consisted of CV, whereas the final demisyllables consisted of V and VC, respectively.

(5). Each type of observed demisyllable was assigned a complexity ranking based on the procedures described by Clements (1988, 1990) above. Interpretation of the complexity scores allowed determination of the degree to which H.V.'s syllables were constructed according to the preferred sonority patterns.

(6). The frequencies with which all initial and final demisyllables began or ended with obstruents, nasals, liquids or glides were computed per syllable type and across collapsed types. Analysis was also performed on V-only and syllabic peak syllables as well. This information permitted analysis of demisyllable sonority profiles, including determination of slope direction (ie. segment sequence patterns) and steepness (degree of sonority contrast between vocalic element and other classes of sounds).

The above represented the methods of intrasyllabic sonority analysis for the pilot study. Since sonority dependencies are not as significant across syllables, transsyllabic analysis was not conducted at that time.

Results

The data presented in Table 1 of Appendix A represent the frequency of occurrence scores for each of the observed syllable types across all words (ie. neologisms and English). Analysis of these results reveals that the most frequently occurring syllable type is the CV form, described by Clements as the universally preferred syllable shape among languages of the world. Other commonly ocurring shapes above include CVC, V and VC, in descending frequency of occurrence. According to Clements and Keyser (1983), syllables may be described by markedness theory as organized into a hierarchy progressing from least to most marked as follows: CV, V, CVC, and VC. H.V. appeared to produce the least marked syllable type most frequently. Her other frequent productions appeared to follow the markedness hierarchy in general, even though she produced a larger quantity of the more marked CVC productions than the less marked V productions.

However, with respect to sonority theory, syllables beginning with consonants, such as CV and CVC, would be considered less marked than those beginning with V because syllables beginning with any class of consonant would generate at least some degree of sonority rise toward the syllable peak. However, syllables beginning with the vowel,

would display no sonority rise, a less preferred and thus more marked, pattern. H.V.'s syllable forms appeared to follow the markedness predictions made by Clements' sonority theory.

Analysis of the phoneme sequences within all observed types of demisyllables yielded patterns of sonority profiles across syllable types. Although statistical analyses were not performed on these data at that time, the following is a synthesis of findings:

H.V produced a total of 456 initial demisyllables. Of these, 71% were initiated by a consonant onset and 28% were initiated by the vowel itself. These proportions represented a trend toward production of a steep sonority slope toward the peak in initial demisyllables as would be predicted by the theory.

Of the 322 initial demisyllables characterized by consonant onsets, 221 (69%) began with obstruents, 58 (18%) began with nasals, 21 (7%) began with liquids and 40 (12%) began with glides. However, when the perseverative productions of /jEs/ and /wən/ were removed, the count for glide production was reduced by half. Results indicated that H.V.'s production of initial demisyllables followed the predictions made by Clements' sonority cycle theory. That is, when consonants functioned as syllable onsets, they were produced in the proportions predicted by the sonority hierarchy (O > N > L > G > V) and created a steep initial sonority rise toward the vowel peak on most occasions.

H.V also produced 134 initial demisyllables beginning with a vowel (the vowel itself acts as the initial demisyllable here). In these cases, of course, there was no rise in sonority toward the peak. Although this is not the preferred initial sonority slope, Clements states that this form is permissible in many languages and is an example of a language-specific rule taking precedence over the sonority cycle. Nevertheless, in total, H.V. appeared to produce initial demisyllables in such forms and proportions as would be predicted by the sonority theory.

H.V. produced 3 syllables that were initiated by a syllabic element and terminated with an obstruent coda (/n̩t/). Her use of the syllabic /n̩/ represented the universal choice in languages that allow syllabic peaks. That is, syllables with nasals as peaks are reported more frequently across languages than are syllables with liquids as peaks (Clements, 1988, 1990). H.V.'s single production of the utterance /m̩/, was not noteworthy.

Again, according to Clements, the preferred syllable pattern contains a steep rise in the sonority profile (from the periphery toward the vocalic peak) within initial demisyllables. On the other hand, final demisyllables exhibit a minimal decrease in the sonority slope

from the peak toward the periphery. Clements claims that this minimal slope is especially typical of embedded-final demisyllables, those that compete with adjacent syllables for segments during syllabification processes. A high sonority coda in a final demisyllable adjacent to a low sonority onset in a subsequent initial demisyllable sets up the situation of maximal perceptual contrast between syllables, a concept discussed earlier in this chapter. Clements notes that steep downward slopes are more characteristic of utterance-final demisyllables, ie. those at the ends of words or phrases that are not adjacent to subsequent syllables. He states that whereas a minimal sonority drop appears to be the universally preferred sonority profile in final demisyllables, certain languages (such as English) permit steep slopes in that context. This represents another example of a language-specific rule taking precedence over the sonority cycle.

With respect to final demisyllables in the pilot study, however, distinctions were not made as to patterns of sonority slopes in embedded vs. non-embedded situations. Since the context factor was not critical for the purposes of this study, analysis was conducted across both utterance-final and embedded-final demisyllable environments as a group. Results indicated that H.V produced 527 final demisyllables containing a vocalic peak. Of these, 60% were terminated by a vowel and were thus characterized by no sonority drop. The remaining 40% of final demisyllables were terminated by a consonant coda and thus displayed a post-peak sonority drop.

Of the 213 final demisyllables that ended in consonants, 135 (63%) terminated with obstruents, 48 (23%) ended in nasals, 30 (14%) ended with liquids and 0% ended with glides. Interestingly, this production pattern is the reverse of the overall preference for minimal post-peak slopes. That is, if a minimal post-peak sonority drop is generally preferred (compared to steep initial slopes), then there should be a high percentage of liquids acting as demisyllable codas, followed by nasals and then obstruents in descending frequency of occurrence. This was not the case in H.V.'s sample. However, the theory also predicts that utterance-final demisyllables may have somewhat more steep slopes than utterance-internal final demisyllables. Since this study did not separate final syllables by context to examine their patterns, it is difficult to interpret these results.

A few points should be made about the above information. First, it might appear that the trend towards steep slopes evidenced in final demisyllables with consonant codas was more concordant with the symmetrical steep slope pattern discussed by Buckingham (1987) and by Donegan and Stampe (1978), than with the steep/minimal pattern described by

Clements. However, whereas Buckingham and Donegan & Stampe speak in terms of slopes across entire syllables, Clements discusses slopes in the context of demisyllables, a factor that may alter the nature of comparisons. Second, Clements has mentioned that obstruent codas are permissible in English and do not represent the abnormal case. Additionally, with respect to the general trends described above, these figures support the preferred pattern of more numerous final demisyllables terminated by vowels (no slope) as opposed to consonants (steeper slope).

Finally, H.V.'s demisyllables were subjected to analysis according to Clements' procedures for use of the Complexity Metric described above. Following is a synthesis of these computations.

With respect to initial demisyllables, the majority produced were of the least complex (ie. least marked) type. That is, 66% of all initial two-member demisyllables (CV) and 100% of all three-member demisyllables (CCV) were produced with preferred obstruent onsets and steep sonority slopes toward the vocalic peak. With respect to final demisyllables, the majority produced were of the most complex (ie. most marked) type. That is, 65% of all two-member demisyllables (VC) were terminated by an obstruent coda and 96% of all three-member demisyllables (VCC) were terminated by an obstruent coda. These results indicated that final demisyllables were produced most often with the more marked steep post-vocalic sonority slope and reversed direction along the sonority scale. Future study should examine dispersion patterns in initial and final clusters, and they should show which of the V-Oral stop codas were in utterance-final position. Given Clements' minimal final demisyllable slope theory for embedded demisyllables, it is crucial to know how many were not embedded.

With respect to the 372 syllables that either began or ended with a vowel segment, the one-member demisyllable situation was used to determine relative complexity and markedness of initial or final demisyllables. Results indicated that H.V. used a vowel as a final demisyllable in 65% of these syllables. She used a vowel to open initial demisyllables in 36% of these syllables. Thus, for syllables either beginning or ending in a vowel, H.V. selected single vowels more often in final demisyllable context than in initial demisyllable context. This general trend represented operation of the least complex, least marked and most preferred sonority pattern available, given these two options.

With respect to the four (consonantal) syllabic productions, all of the three /C̩C/ forms were constructed of a more complex segment sequence (N̩O), given the range of possible sequences. There is no metric for complexity analysis of the segment /m̩/.

Discussion

Analysis of the above results suggested that the surface sonority patterns displayed by H.V. followed those that would have been predicted by Clements' theory. Additionally, there did not appear to be any significantly abnormal deviation from behaviors explained either by the theory or by commonly accepted crosslinguistic principles. Finally, word frequency did not appear to play any role in H.V.'s ability to correctly produce target stimuli on the confrontation tasks.

These conclusions were limited, however, by the caveat that all analyses were performed on surface data. The majority of intended targets were not discernable to the author. Even though it was clear what the stimulus item was and what H.V.'s intended underlying representation <u>should</u> have been, the author could not be sure what her underlying representations actually were solely from examination of the surface data. Since Clements' sonority cycle was intended to be interpreted with respect to activities at the level of the core phonology, conclusions about the nature of activity at that level of abstraction are made difficult. Future analysis would be facilitated by using subjects whose productions more closely resemble known targets, and would substantially strengthen conclusions made from surface data. However, further investigations of H.V's particular behaviors might address, among other topics, patterns of sonority profiles in transsyllabic environments and patterns of sonority alternations in paraphasias.

It did not appear that H.V. had the stimulus target in mind on the majority of occasions in which she attempted to complete the examiner's tasks. Evidence for this is that (1) the stress patterns and number of syllables for surface productions typically did not resemble the stress patterns and number of syllables of stimulus targets (e.g. kə mǽtɚ/mʌ́ni), (2) the phoneme inventory of most surface productions often did not even remotely resemble the inventories of stimulus targets (e.g. θrí zu meɪs / kæt), and pauses were evident prior to attempts to produce targets . These data support a theory of neology that assumes an underlying anomic component to jargonaphasia (Butterworth, 1979, Kohn, 1988).

Apparently, the sonority principle must comprise a very fundamental aspect of language computation such that it is not noticeably disturbed even in the instance of severe jargonaphasia. Perhaps it could be considered a "hard-wired" aspect of syllable formation (see Sussman, 1984). Evidence for this is that (1) it's principles appear to operate crosslinguistically and (2) it's operation does not appear to be substantially altered by severe brain damage. Perhaps the sonority cycle operates during the computational processes that map one representational level to the next during word and sentence production. The following section will address this issue.

Sonority and The Garrett Model

Merrill Garrett (1975, 1976, 1980a, 1980b, 1982, 1984) has developed a model of sentence production characterized by a series of computational processes that map one level of linguistic representation to another (Figure 2, Appendix A). Although these representations have not been formalized, inferences can still be made about the nature of underlying mental operations.

According to Garrett's model, Inferential Processes map conceptual structures to the Message Level of representation and determine the most abstract form of sentence-level constructions (Garrett 1982). Logical/Syntactic Processes then map the Message Level to the Functional Level in 3 steps: Functional argument structures for propositions are determined, the first lexical lookup (meaning-based) is activated to obtain word meanings for arguments and predicates and meaning-based lexical items are assigned to appropriate slots in functional argument structure (logical order) (Figure 3, Appendix A).

Syntactic/Phonological Processes subsequently map the Functional Level to the Positional Level of representation (Figures 4 and 5, Appendix A). The second lexical lookup (form based) is activated and lexical items are placed into utterance ordered sentence slots. Words fill the matrix as phonemes are placed into onset, peak and coda segment positions. Bound and free closed class morphemes are selected from a separate part of the lexicon and are placed in the frame after content word assignment.

It is at this level that phrasal stress is also assigned to the utterance order. Since the underlying stress pattern is not altered by Regular Phonolgical Processes, then surface stress patterns represent those present in the underlying forms created at the Positional Level.

Regular Phonological Processes map the Positional Level to the Phonetic Level of representation. These assure that the appropriate allophonic and morphophonemic accomodation processes operate to produce the correct surface forms for underlying phonological representations. Finally, Motor Coding Processes map the Phonetic Level to the Articulatory Level of representation.

Of primary interest for a discussion of sonority is the nature of the Syntactic and Phonological Processes, ie. those that operate to construct the Positional Level of representation (Figure 5, Appendix A). At this level, phonological forms for contentives are selected from the second lexical lookup and are placed into a holding buffer with space sufficient for roughly one clause at a time. An error monitor checks for unusual segment patterns, such as inappropriately doubled or tripled phoneme sequences. Suspicious elements are removed from the buffer when the monitor is triggered. A scan copier selects phonemes from the buffer and places them into appropriate segment slots. After positioning, a checkoff monitor removes copied items from the buffer to ensure that repeated copying does not occur. This process is repeated for each word in the intended sentence. See Buckingham (1986) for a proposal of how the segmental ordering mechanisms suggested independently by Shattuck-Hufnagel (1979) might be incorporated in the overall model of Garrett.

Since it is here that ambisyllabic consonant positions are specified and syllable markedness principles operate, it would appear that syllabification processes might be placed at this level, as well as in the lexicon. It may be here that sonority constraints govern phrasal syllabification at a very abstract level prior to operation of the lower level Regular Phonological Processes. If this is the case, then sonority constraints would help determine scan-copier selections and would help guide the ordering of segments into sequenced syllable slots (ie. the scan-copier must have a knowledge base). Phonotactic constraints, also operating here, would prevent production of an acceptable sonority sequence that was nevertheless not permitted in the language.

The above description considers sentence production operations in the normal case. However, these processes may derail in aphasia and cause creation of neologisms. Although there are various theories about the nature of these derailments, selection of one often depends on which process of neology is assumed to be governing output. For the purpose of this study, a theory of underlying anomia will be explored with regard to the role that sonority might play in neologism production.

Neologisms may be created through operation of the previously-mentioned random generating device in the following ways. First, if meaning-based lexical retrieval from Lookup #1 is blocked, then a speaker will be unable to select a correct phonological form and will thus lack input to the buffer. No phonemes will be available for the positional frame. The random generator may then produce various syllable strings that function as alternate buffer input (Figure 5, Appendix A). These strings will be positioned into onset, peak and coda slots in the frame and will be realized as neologisms. Stress will be assigned, in a pattern appropriate for the language. Alternately, even if correct Lookup #1 activation is possible, retrieval of form from Lookup #2 may be blocked. With no phoneme input to the buffer, the random generator will create abstruse neologisms in the same manner described above.

Of interest here is the observation that the neologisms produced by H.V. have appeared to obey sonority constraints. Therefore, if a random generating device does indeed exist, then it, too, must be constrained by sonority principles. In fact, there is evidence that the random generator is a component of normal human cognition prior to brain damage. Buckingham (1987) has stated that normal speakers know the phonemic inventory of their language and the phonotactic rules that constrain its use. According to Sussman (1984), phonotactics may be considered a "hard-wired" aspect of the language system and thus relatively resistant to loss from brain damage when compared to other aspects of cognition. Speakers are able to use this information to create permissible new words (Aronoff, 1976; Butterworth, 1983; Halle, 1973; Vennemann, 1974).

This knowledge of word formation rules is the probable data base for operation of the random generator. Sonority is likely to be part of the data base operating the device as well. The rationale for this is that (1) since phonotactics and sonority constrain each other and (2) since both govern core syllabification and segment sequencing operations and (3) since both principles are not disrupted during neologism production by the random generator, then it is logical to locate both within the same mental data base. Therefore, since phonotactics operate in the computations that map the Functional to the Positional Level, and since syllabification and segment sequencing operations are located at the Positional Level, it is logical to locate sonority information at this point in the Garrett model.

Just as normal speakers may create nonsensical strings at will (Garrett, 1982), aphasic patients who are unable to retrieve phonological forms for intended words might draw upon their intact knowledge of word formation rules and create novel items in place of targets. This normally little-used but nevertheless inherent component of cognition could be released into accelerated activity under circumstances of lexical access difficulties subsequent to brain damage (Buckingham, 1987). Thus, if this is the case, and if evidence shows that neologisms produced by a random generating device obey sonority principles, then a theory of neology via random generator operation constrained by sonority is well-motivated. That is, it would explain why sonority principles are obeyed even in the case of severe language disruption: a normal mechanism (random generator) coded with normal syllable formation and segment sequence rules (sonority and phonotactics) simply has come into uninhibited operation.

Additionally, it should be noted that the checkoff monitor may represent another computational mechansim governed by sonority principles. According to Buckingham (1990) the checkoff monitor may or may not function, depending on whether it's activity would create more or less marked phoneme sequences. Checkoff monitor activity could account for the doublet-creation phenomena discussed earlier in this paper. If so, and if the checkoff monitor is thought to function in the Syntactic/Phonological Processes, then this suggests placement of sonority constraints at this level of Garrett's model (see Buckingham, 1990). However, this model is not the only one with explanatory capability for the phenomena under discussion. Following is a discussion of neology and sonority from the perspective of the interactive activation model.

Sonority and the Interactive Activation Model

The parallel model developed by McClelland and Rumelhart (1981), described with respect to aphasia by Stemberger (1985) and Miller & Ellis (1987) was developed, in part, to capture the simultaneous nature of cognitive processing that had not been adequately represented in so-called serial processing models. Two weaknesses of serial models were that, first, they failed to provide an account of interactions between levels in the form of feedback, and second, they postulated that processing at one level of complexity must be completed before processing at the next level could begin (Stemberger, 1985). Garrett's model, it should be noted, does not rule out the possibility of feedback mechanisms,

although feedback is not explicitly described in his work. In fact, when assessing any model such as Garrett's, one must not fail to realize that, acording to Flores d' Arcais (1988, p. 114), "...the notion of interaction is not incompatible with the idea of specific processing at a given level. The question is whether the interaction is restricted to the output of the processing level or is necessary for the processing at a given level."

Following is an introduction to some of the concepts underlying the interactive activation model. An intriguing number of the conceptual underpinnings of the parallel processing model match notions from centuries-old association psychology (Buckingham, 1984). The careful reader will note a good degree of similarity between descriptions in the parallel model and those of A. R. Luria (1977, and other sources). This is to be expected, however, since association psychology has shown up in Soviet neuropsychology through the work of Pavlov (Young, 1970, p. 193). See Buckingham (1977b) for a short evaluation of Luria's work in this context.

Within a parallel processing framework, all cognitive systems including language, are the product of the coordinated activities of an activated network composed of units whose only purpose is to collect, sum and transmit activation to each other along their interconnecting links. The analogy is drawn between units/links and neurons/synapses without necessarily any claim for isomorphism (researchers disagree on this question). Activation is the force that drives the system and determines which pathways will be traversed during any particular operation. System complexity is determined by the nature of the interconnections and interactions between units (Stemberger, 1985).

Activation levels may vary from very low (no processing) to intermediate (partial activation) to very high (execution) for each unit. A characteristic resting level of activation (determined in part by frequency of unit use) must be exceeded before a unit can be excited and it is to this level that a unit returns afterward. Highly activated units have powerful activation and inhibition effects on other units, and vice versa, so that activation is eventually spread proportionately throughout the system along the most highly activated pathways from target node to target node. Pathway routings mediate the strength of the effect of one particular node upon another. The patterns of weighted activating and inhibiting pathways chosen during language processing will ultimately lead to the production of different language behaviors (Stemberger, 1985). Language production results from parallel interactions among the pathways linking nodes at semantic, lexical, segmental, featural and motoric levels of processing (Figure 6a, Appendix A). The entire

process originates when a speaker's communicative intents feed into the permanent memory system (where language information is stored) in chunks that may be as large as a clause or a sentence. Semantic and pragmatic units are activated, which in turn activate words at the lexical level (McClelland, 1979). Once a word is selected, it passes its activation to all other units connected to it in a cascading manner such that associated phonemes and features are activated as well (Figure 6b, Appendix A). Appropriate motor units will eventually be chosen to effect articulation of intended words. Activation also spreads to prior levels in the system in the form of positive feedback. This basic pattern of activity recurs for every word in the intended utterance (Stemberger, 1985; Miller & Ellis, 1987).

It is crucial to note that inhibition of non-target nodes is just as important as the activation of target nodes. During lexical access, for example, all words containing any of the intended semantic features will be activated to some degree. However, only a word containing all of the required semantic features will receive activation levels high enough to trigger execution. Those words, in turn, will inhibit all other partially activated words so that only intended targets will ultimately be produced (Stemberger, 1985).

The level of lexical access at this point appears primarily and initially to be meaning-based. If the activation procedure were disrupted in some way, as would likely be the case with brain damage, then lexical access would be difficult or faulty. If activation pathways were destroyed or completely blocked, lexical retrieval might be impossible, at least until alternate pathways could be established. This situation resembles that of underlying anomia for meaning-based lexical retrieval. If, however, target words were able to receive activation, but at weakened levels, then they may not have sufficient activation strength to inhibit retrieval of unwanted but similar lexical items. This situation could account for the creation of semantic paraphasias (Luria, 1977; Stemberger, 1985).

Analogous processes operate at the phonological level, which is composed of segmental and featural sublevels. Normally, highly activated lexical items will simultaneously activate the appropriate sets of segments, phonetic features and motor units associated with them as language production progresses. Likewise, as activation reaches the phonological level, it can flow back to the lexicon and influence word retrieval even as it is occurring. Thus the parallel nature of the system is revealed by this interaction among levels. However, if a disrupted system prevented access from the meaning-based lexicon, then activation of phonemes, features and motor units would be disrupted for intended words.

If access to the meaning-based lexicon were possible, but weak, then activated words would send weak levels of activation to segment, featural and motoric levels. In that case, two possibilities exist. The first is that correct arrays of segments and features may still be activated, in which case no error would be created. But if weak levels of activation for phoneme targets not only reduced the accuracy with which they were selected but also reduced their ability to inhibit minimally distinct phonemes, then a mechanism for the creation of phonemic paraphasias would exist.

Varying degrees of paraphasia could account for the creation of both target-related and abstruse neologisms. Miller and Ellis (1987) describe neologisms as the product of difficulty activating lexical items in the speech lexicon. Reduced activation levels yield weakened activations at all lower levels in the system as well. As repeated attempts at low frequency words are made, some phonemes in targets will be correct, proper segments having been discriminable from interfering background noise in the system. Other phoneme slots, however, will be filled with incorrect segments that could not be inhibited. According to Miller & Ellis, these substitutions will be somewhat random though consonants and vowels will remain in appropriate syllabic positions.

Miller & Ellis account for the commonly observed perseveration phenomena in jargon patients by suggesting that non-target phonemes will, once selected, acquire increasing amounts of activation and thus become dominant over other nontarget phonemes in the inventory. If a patient is unable to activate phonemes for a particular word, then previously used incorrect alternates will still have relatively high levels of activation from prior use and will most likely be repeatedly selected.

The above account supports the theory that neology results from paraphasic distortion of correctly but very weakly accessed targets. However, discussion has not addressed the occasion where phonological arrays are not available even though a lexical selection has been made. In that case, activation cascading from the lexical levels could randomly activate those phonemes having the highest resting levels at the time of need. Initially, the phoneme strength settings would correlate directly with phoneme frequency counts of the language. But we know from Butterworth (1979) and Code (1982) that abstruse neologisms are comprised of phonemes that do not accord with the frequency statistic. So interactive activation theories would have to come up with a non-phoneme frequency explanation for the segmental composition of neologisms.

One thing interactive accounts could look for would be on-line momentary high levels of strength at the nodes of phonemes very recently produced, prior to the lexical semantic access block. Undirected vollies of activation would then find their way to these nodes and they would reach activation, a neologism thereby unfolding. The perseverative nature of neologisms would fit this account fairly well, even more so as the jargon responding becomes increasingly alliterative and assonantial (Green, 1969; Buckingham, Whitaker & Whitaker, 1978).

How is it that weak vollies in a disordered system cause selection of non-target segments that yield syllable sonority profiles similar to those produced by normals (as in the case of H.V. above)? There must be a mechanism at some level of the system that constrains phoneme selection with regard to sonority restrictions. Perhaps this mechanism is located in the lexicon, where core syllabification occurs and where feedback loops from lower levels return. Then, in the case of accurate lexical selection but disrupted phoneme access, on-line adjustments in segment selection could be mediated via feedback channels. Corrections would not involve selection of appropriate individual target phonemes, because there is damage to the pathways linking the lexical target with its associated phonemes. Rather, correction would direct the choice of a sound <u>class</u>, from among those represented by the inventory of recently activated phonemes.

Sound class choice would be based on the sonority sequencing principle (discussed earlier) depending on the position of the intended phoneme in the syllable being formed. The selection of a class of phoneme in any given instance would affect the options for subsequent sound class choices during syllable formation. The particular phoneme selected to fill a syllable position would not matter, as long as it represented an acceptable class of sound along the sonority hierarchy and as long as the resulting neologism obeyed the phonotactics of the language.

For example, suppose the target is /twIn/ and the error is /trIs/. Perhaps the peak is chosen correctly, the vowel /I/. A feedback loop would send this information to the lexicon, where a mechanism orders activation of any phonotactically permissible, highly activated segment with lower sonority value than that of the vowel. Thus, any other nasal, liquid or glide (phonotactics permitting) could be chosen as the second segment in the first demisyllable. If a liquid (ex. /r/) were selected next, the subsequent order would be to activate any phonotactically permissible, highly activated segment with lower sonority value than that of liquid (ex. /t/).

For the coda target /n/ in the final demisyllable, the order would be to activate any phonotactically permissible, highly activated segment with a lower sonority value than vowel. Selection of a liquid or nasal vs. selection of an obstruent would depend on whether the final demisyllable were utterance-internal or utterance-final. If /s/ were selected, the resulting neologism would be /trIs/. If another extrasyllabic /t/ had a high level of activation, it could be attached to the final demisyllable to create a sonority plateau (/Ist/), and form the neologism /trIst/. This is also an example of how fortuitous real words can occur in neology. This process resembles Clement's (1988, 1990) description of the core syllabification prodedure, but also explains how that mechanism could operate in the construction of neologisms within this parallel model.

Of course the segment /s/ presents a problem in general, since Clements (1988, 1990) groups plosives and obstruents into the single category of obstruent. Thus, according to the reasoning above, after selection of an /s/ onset, another segment with equal sonority value could not be chosen. However, English permits sonority plateaus and even reversals, as in /æpt/ and /stap/. Therefore, as mentioned above, sonority must interact with the phonotactics of a particular language, since a neologism could very likely be of the form /stit/, but not /tsit/. Phonotactic rules are also the likely explanation for why forms that obey sonority constrictions (ex. /swad/) are produced, whereas other forms that obey sonority constrictions (ex. /srap/) are not produced.

If, however, lexical targets cannot be accessed or if targets can be accessed but feedback loops are disrupted, then how can one account for the non-random sonority profiles of the resultant neologisms? There must be some additional mechanism mediating sonority that operates at a lower level than the lexicon. This is not unlike the proposed redundant coding of sonority constraints in the lexicon, scan copier, checkoff monitor and random generator discussed in Garrett's model above.

For example, suppose a jargon patient recently produced the segments /f, r, a, I, d, ɝ, f, I, ə and ʃ /. If he cannot access a subsequent lexical target, then what is to prevent production of neologisms like /Íd fəʃ raI/, which are phonotactically permissible, but which contain more marked and less preferable sonority profiles in syllables, as opposed to production of neologisms like /fÍr ɝI ʃraId/, which are also phonotactically permissible, but which contain syllables with preferred profiles? If lexical access is blocked, then syllabification procedures based on sonority principle information located there will not be of help. Since neither of the neologisms (above) violate language-specific

segment sequencing rules, there must be some independent sonority mechanism operating to govern these constructions.

Perhaps there is a low-level mechanism in this system that resembles the one that Stemberger (1985) proposed above to explain processes underlying inhibition of non-intended targets during lexical selection. There may be a metric by which activation of a particular segment node triggers the inhibition of other linked nodes representing the same <u>class</u> of segment. At the same time, this causes activation of nodes representing <u>other</u> segment classes with less sonority, the specifics of which would depend on whether an initial or final demisyllable was being constructed. Thus, after the vocalic segment of a demisyllable was selected, the only segment choices available for subsequent selection would be those of a class having less sonority value, depending upon syllable context. Selection of an onset segment class, for example, might be random from among all activated classes. Similarly, selection of a <u>particular</u> phoneme for that onset could also be random (from among all recently activated phonemes in that class). However, selection would be guided by both phonotactic and sonority constraints. Thus, the only aspect of syllable construction at any given time that would not be random would be the available <u>classes</u> of phonemes from which any particular selection could be made.

So, for example, to form an initial demisyllable from the inventory /f, r, a, I, d, ǯ, ə f, I, ʃ /, any vowel segment could be chosen as syllable peak. If the segment /I/ is chosen, then all other vowel nodes would be inhibited and all other phonemes of a class having less sonority would become more activated. If the activation were proportionately distributed along the sonority scale (so that obstruents now received the most activation, nasals less, liquids less, and glides the least), then that would explain the tendency for neologisms to be constructed according to similar patterns seen in normal speakers. Similar sequence procedures, in reverse, would hold for formation of final demisyllables. Sequencing would still be subject to phonotactic constraints, so that a CCV syllable like /fna/ could not be made from items in the inventory of recently activated segments. At this point, however, all of these theories are somewhat speculative since there have been no major studies conducted to quantify and to describe the sonority patterns of neologisms in fluent aphasics.

Summary

Investigators have long studied the role that sonority plays in normal language production. Even today, modern linguists are examining the original theory and are searching for new applications of sonority principles to crosslinguistic puzzles. As a result, this "re-discovery" of sonority has motivated others to explore it's explanatory potential for aphasia.

Thus far, this chapter has presented the theory, applied it's principles to analysis of aphasic language and interpreted findings in the contexts of two well-known sentence production models. Results have supported the following conclusions: (1) sonority appears to operate on high level linguistic representations, but may be coded redundantly throughout some parts of the linguistic system, (2) the sonority patterns observed in a case of jargonaphasia (H.V.) are those that would be expected in the normal case, suggesting that sonority is a "hard-wired" aspect of language operations and (3) sonority can explain regularities in random generator and checkoff monitor mechanisms incorporated into Garrett's serial model and, (4) sonority can explain regularities in neologism construction within a parallel processing model of sentence production.

It appears that sonority is a promising concept for explanation in aphasia as well as in normal language production. Of course, much more research is needed in these areas. The case study reported above represented an initial attempt to determine whether sonority principles might prove useful in the analysis of the phonological errors of a fluent aphasic. However, H.V. was only one individual and was rather impaired; at two years post-onset, she remained unintelligible with the majority of her lexical targets rendered unrecoverable. Replication and expansion of sonority analyses with a larger and less severe population of fluent aphasics would allow examination neologistic phenomena. Interpretation of findings within both serial and parallel models of sentence production might suggest the most likely mechanisms governing the operation of sonority principles in neologism formation.

CHAPTER TWO: THE PROPOSAL

The following dissertation investigation proposed here will address these six questions: (1) What demisyllable shape preferences (in each of four contexts) are present in the utterances of three fluent aphasics (addresses the markedness issue), (2) What segment sequence preferences in four demisyllable contexts are present in the neologistic productions of fluent aphasics (addresses the SSP), (3) Are these patterns similar to those observed in the well-formed utterances of normal speakers, (4) How might the sonority principle provide descriptive, explanatory or predictive power for phonological error analysis, (5) Can sonority be incorporated further into current models of sentence production and, (6) What implications for the theory are suggested by the results of this study.

METHOD

Subjects

Three fluent adult aphasics (50-84 years of age), who meet the selection criteria described below, located via search of area hospitals, nursing homes, home health agencies, private speech and hearing practices and university speech and hearing clinics, will be randomly selected for inclusion in this study.

All subjects will be right-handed individuals who have incurred damage to left posterior language cortex. Etiology may include any that produces a focal neurological lesion and a moderate or severe fluent aphasia characterized by neologisms. Medical records will be examined to rule out etiology of language deficit due to dementia, closed head injury or emotional disturbance. Subjects will also be free of associated communication disorders (ex. dysarthria, verbal apraxia) that might influence speech or language production. All subjects will speak English as their native language.

Procedure

A language sample will be obtained from each of the three subjects selected for inclusion in the study. Structured and unstructured language tasks will be employed to elicit data. Following is a description of the structured tasks.

Five (5) high, five mid (5), and five (5) low frequency words will be selected for each activity described below. Thus,15 different stimuli per task will be administered to each subject. Single and multi-syllabic words will be randomly selected from Dahl's Word Frequencies of English (1979), and will be randomized in order of presentation.

Each subject will be asked to do the following with stimuli representing selected words:

A. Name pictures

B. Read single words

C. Repeat verbal model of words

D. Tell the function of objects

E. Point to the same pictures on verbal request

F. Point to the same written words on verbal request

G. Point to the same object whose function is named verbally

The pointing tasks are included to provide a means of comparing accessibility of underlying lexical representations, both receptively and expressively. On occasion, it may be necessary to compare performances in order to determine whether a subject was able to access the lexicon at all for a particular stimulus item.

Picture stimuli will consist of large, clear photographs and written material will include single words written legibly on large (5 x 8 inch) index cards, one word per card. All verbal stimuli will be presented in a normal conversational speech mode. Stimuli repetitions will be given as needed.

With respect to the unstructured language tasks, spontaneous language will be elicited from each subject via (1) picture description/interpretation activities and (2) conversation with the examiner. Prior to language sampling, each subject will be instructed as to the purpose of the study and the nature of ensuing tasks. See Exhibit 1, Appendix B, for these instructions.

Instrumentation

All data collection will be conducted in a quiet, non-distracting location convenient to each subject. A high quality audio recording will be made of every session (Sony Tapecorder, Model TC 110b, with Sony Dynamic Microphone, Model F-V2M). Each tape will be phonemically transcribed by the examiner, as well as by another independent individual who is skilled in phonological transcription and who is unaware of the purpose of this study. Interjudge agreement on transcriptions must be 80% or better as averaged

across all samples before analysis will begin. The criterion of 80% is selected in recognition of the difficulty of neologism transcription, and in recognition that more unintelligible subjects will have lower interjudge agreement ratings.

Methods of Data Analysis

I. Language Sample Transcription

Each language transcription will be prepared to present the following information: Orthographic representation of text, phonemic transcription of target utterances (subject to recoverability), and phonemic transcription of actual utterances. The protocol sheet for the transcription will be organized so that a reader can see at any given time the relationship of the three strands of text, as follows:

Orthographic:____

Target Phonemic:______________________________________

Actual Phonemic:______________________________________

Conventional IPA diacritical markings will be used to indicate pauses, tonic stress, ends of utterances, etc. Transcription will preserve syllable segmentation patterns.

II. Analyses of demisyllable types

The type of each demisyllable will be determined (CV, VC, etc.) for every demisyllable produced in every word studied from examination of the transcriptions. All demisyllables will then be placed into one of the following four context categories: utterance-initial demisyllable, embedded-initial demisyllable, utterance-final demisyllable, and embedded-final demisyllable. Tabulations of numbers of demisyllables per type and per context will yield percentage of occurrence scores that will indicate subject preferences for demisyllable type by context.

This analysis will determine which demisyllable shapes are most frequently used in each type of word studied (ie. neologism, English). Analyses will be conducted for: (1) all neologisms vs. English words, and (2) abstruse vs. target-related neologisms. Results will determine whether each subject produces demisyllables and syllables that are more or less marked (per context and by word type) taccording to the theory. This procedure will determine whether there are different demisyllable preferences for construction of correctly accessed words vs. neologisms. It will also reveal differences in demisyllable preference between the two types of neologisms. Statistical analyses will involve application of

non-parametric statistics to determine the probability that frequencies occurred by chance.

III. Sonority Sequencing Patterns

A. For every demisyllable context across all utterances in the sample, the frequency with which each sonority slope profile occurs will be computed. This will be done to determine the nature of slope preferences per demisylllable shape, context, and word type, and will indicate whether subjects use the same slope patterns predicted by the theory. Slope profiles will be computed by counting the frequency with which each type of consonant (ONLG) precedes or follows the vowel, per demisyllable type and context. Ranking sequence preferences will also provide an indication of complexity (re: Clement's tables).

Non-parametric statistics will be applied to determine the probability that results occurred by chance.

B. The frequency of occurrence scores for embedded-final demisyllables and embedded-initial demisyllables in both types of neologisms (as well as in English words) will be analyzed to determine whether predictions made by the Syllable Contact Law hold for neologism and real word construction in these aphasic subjects. Analysis will answer the question of whether minimal slope patterns in embedded demisyllables are typically followed by steeply sloping patterns in embedded initial demisyllables. Non-parametric statistics will be applied to determine the probability that results occurred by chance.

C. The slopes of utterance-final demisyllables will be compared to the slopes of utterance-initial demisyllables in neologisms to determine whether steeply sloping utterance-final demisyllables are followed by steeply rising sonority profiles in utterance-initial demisyllables, as is predicted by the theory. Slope determination will involve the same procedures as for "II.A" above. Frequency of occurrence scores will be computed, bar graphs developed and non-parametric statistics applied to determine the probability that results occurred by chance.

RESULTS

All significant findings will be reported and interpreted. Bar graphs and tables will be developed to illustrate summary data and will be displayed in the Appendices.

DISCUSSION

All major findings will be explored with respect to the questions addressed by this study. The first portion of the discussion will be devoted to summation and analysis of major sonority patterns apparent in neologisms. In the second section, results will be interpreted as to implications for mechanisms of neology with respect to serial and parallel models of sentence production. Discussion will also address the adequacy of the sonority theory in view of this type of data.

CHAPTER THREE: METHOD

Subjects

Three individuals meeting the subject selection criteria described above gave informed consent for participation in the study. A brief case history for each is given below.

Subject M.S. is a 50 year old, right-handed, white male who entered Charity Hospital in New Orleans, Louisiana, on 8-30-89 after suffering a hypertensive stroke. Medical testing revealed the presence of a hemmorhage in the parieto-temporal area of left hemisphere cortex, with some extension into the left lateral ventricle. No other complications were noted. M.S. had received a college education and had worked locally as an ordained minister prior to his illness.

Speech/language testing was partially administered on 10-16-89 through the services of the LSU Medical Center Department of Communication Disorders. Although portions of the Boston Diagnostic Aphasia Examination were presented to M.S., he was unable to complete them. Since no further testing was conducted by LSU-MC, no formal test results were available on 10-31-89 , the date of speech/language sampling for this study. Nevertheless, analysis of spontaneous and elicited language clearly revealed the presence of fluent speech characterized by numerous paraphasias and neologisms. Two certified Speech Pathologists were present during data collection (at Charity Hospital) and agreed as to the nature of the language deficit. Auditory comprehension was poor, but audiological assessment revealed hearing to be adequate for conversational purposes.

Subject H.V. is the (now) 55 year old, right-handed female who had participated in the pilot study described in Chapter One. The details of her medical and speech/language history have been presented in detail above. Interviews with her son revealed that there have been no remarkable medical events or changes in speech/language status since those in 1987 documented above. Nevertheless, the reader will recall that H.V. incurred infarcts in the inferior aspects of the left frontal lobe, in a large portion of the left temporal lobe and in the left parietal lobe. She did not display articulation deficits and was not found to be apraxic, despite damage to the left frontal area. Her speech was rapid and fluent. Although she was in good health when tested for this study, her speech remained unintelligible and was characterized almost completely by paraphasias and jargon. Auditory comprehension was good and audiological assessment revealed hearing to be adequate for conversational purposes. Data collection from H.V. took place in a quiet

room in her home on 2-16-90.

Subject E.P. is an 84 year old white female who suffered a stroke on 1-16-90 and was subsequently admitted to Seventh Ward General Hospital in Hammond, Louisiana. Physical examination upon admission revealed that E.P. was alert, but had some blocking of speech and some difficulty comprehending questions. Neurological examination indicated that cranial nerves two through twelve (C. N. II-XII) were intact. Gross sensory and motor examinations were normal. Results of Computerized Tomographic scanning of the head conducted on 1-17-90, revealed an , "acute ischemic infarction of the left posterior temporal parietal region" of the cortex. Radiology findings also stated that, "no other focal brain abnormalities were identified". Medical reports indicated that E.P. has had a history of very few medical problems other than hypertension. Before retirement, she taught music at the local university in Hammond.

When E.P. returned home, she began receiving speech/language therapy services from a local private practitioner. Speech/language sampling conducted by two certified Speech Pathologists on 3-28-90 revealed that she produced fluent speech characterized by frequent paraphasias and neologisms. Auditory comprehension of spoken language was poor but audiological assessment conducted on 3-7-90 indicated that her hearing was adequate for conversational purposes. Data collection from E.P. took place in a quiet room in her home on 4-3-90.

In summary, all subjects met the basic criteria for inclusion in the study: production of fluent aphasia characterized by paraphasias and neologisms subsequent to a focal neurological lesion to left posterior cortex in right-handed individuals. Hearing was adequate in these individuals and no other complications were present. Since the purpose of this study was to describe the syllabic structure of neologistic productions, rather than to correlate speech/language behaviors with "type" of aphasia, and since speech/language analysis was conducted on spontaneous samples, the absence of formal test results on these individuals was not deemed a significant factor. Although neologisms have been produced variously by "Global", "Wernicke's", and "Conduction" aphasics (see, for example, Mitchum, Ritgert, Sandson, and Berndt, 1990), there is no evidence in the neurolinguistic literature that neologism formation or structure differs as a function of aphasia classification. Differences among subjects were found with regard to numbers of neologisms produced and, to a small degree, performance on receptive tasks (see Chapter Four, Results). However, as the data will show, these differences were not significant for

the purposes of this study.

Method of Data Collection

The author of this study conducted all subject interviews in the following manner. Test stimuli and audio-recorder were brought to each test location. Subjects were informed as to the nature of the test activities and informed consent papers were signed (Exhibit 1, Appendix B). The LSU Human Subjects committee approved the procedures for use of subjects for this study (License # 72-3 and Multiple Assurance # Ml128) (Exhibit 2, Appendix B).

The procedures for selecting tasks and stimuli were identical to those described in Chapter Two above. The resulting corpus of test items therefore included stimuli drawn with regard to frequency of occurrence in the English language across a variety of expressive and receptive tasks. See Exhibit 3, Appendix B, for test protocol. The author engaged each subject in the expressive tasks first, while subjects were most alert, and concluded with the receptive tasks.

Due to equipment malfunction, two different audio-recorders were employed during taping sessions. For Subject M.S., a Sony Tapecorder (Model TC 110B) with Sony Dynamic Microphone (Model F-V2M) was used. For Subjects H.V. and E.P., an Audiotronics Classette (model # 147A) was used. High quality audio casette tapes were used during recording. This equipment change did not reduce the quality of the audio-recordings.

Transcription of Speech/Language Samples

Each speech/language sample collected was transcribed by two experienced listeners trained in techniques of broad transcription with the International Phonetic Alphabet. Although one listener was the author, the second listener was unaware of the purpose of the study. The author compared both transcriptions for each subject syllable by syllable and marked each discrepancy between listeners. The author then went through the transcriptions again with the audiotaped recording to resolve differences in favor of either transcriber and to arrive at one final version of transcription for each subject. When this activity was completed, the following interrater agreement scores were achieved for the three sets of transcriptions: 92% agreement for Subject M. S., 66% agreement for Subject H. V., and 89.4% agreement for Subject E. P. The average interrater agreement across all

three subjects was 82.5%, slightly above the criterion designated for inclusion of data in this study.

These percentages, however, were based on transcriptions of utterances from the first three expressive language tasks, rather than on utterances from all tasks. In fact, data from the first three expressive tasks were selected as the total data core from which to perform all subsequent analyses. This change in procedure became necessary after listening to the tapes; responses to the stimuli in these tasks provided the only data base where there was reasonable certainty as to the nature of the intended word forms during production of neologisms. Even when spontaneous conversation occurred during these tasks, it was fairly recoverable, since it usually related to a patient's explanation of why he or she couldn't say a word or name a picture.

The low agreement score attained for Subject H.V. was a function of the preponderance of neologisms and unintelligible gibberish (ie. extremely fast speech) produced by this individual. However, the most unintelligible strings were generally discarded unless both transcribers could eventually decipher them. These overall agreement percentages were based on the ratio of "agreed-upon" syllables to total syllables in each sample as follows: Subject M.S., 2040/2220 syllables, Subject H.V., 710/1074 syllables, and Subject E.P., 1659/1856 syllables.

Compilation of Neologism Data Bases

Once a final transcription was attained for each subject, it was then examined as to its contents. Every word in every sample was classified as one of the following: legitimate, contextually appropriate English word, semantic paraphasia, target-related neologism, and abstruse neologism. This activity underscored the importance of recoverability of intended word forms, since the following rule was applied to separate neologisms by type: a neologism was labeled "target-related" if it contained 50% or more of the phoneme segments contained in the intended word form. However, if the neologism differed by more than 50% from the intended form, it was labeled "abstruse". This procedure was adapted from one described by Mitchum, et. al. (1990) . Occasional exceptions to this rule were made for each subject when the examiner felt that application of the rule would erroneously categorize a subject's production. Semantic paraphasias were discarded for purposes of sonority analysis.

The corpus of combined target-related and abstruse neologisms for each subject was reassessed as to interrater agreement on transcription for these forms as a group, with the following results: Subject M.S., 76% agreement (225/296 syllables), Subject H.V., 50% agreement (265/532 syllables), and Subject E.P., 65% agreement (153/237 syllables). Since the overall average of interrater agreement across subjects was only 64%, the neologism data for each subject was submitted to a third, expert listener for decisions on neologism transcription discrepancies. After this step, some syllables were revised or eliminated, yielding the final interrater agreement scores for neologisms as follows: Subject M.S., 94% agreement (262/279 syllables), Subject H.V., 83% agreement (402/483 syllables), and Subject E.P., 87% agreement (205/236 syllables). The average agreement rate across all three subjects at this point was 88%, a level well above the minimum established criterion level.

It should be noted that the activity of the third, expert listener not only provided a reliability check for listener transcriptions, but also provided a reliability check for categorization of neologisms as "target-related" or "abstruse". This listener has written extensively on the problems of neologism analysis and the problems of target-related vs. abstruse forms. He was able to examine neologistic forms <u>in their contexts</u> within the original transcriptions and did not recommend changes in categorization of neologism forms.

<u>Compilation of English Word Data Bases</u>

The corpus of legitimate English words selected for each subject was drawn randomly from the total transcription for each subject. The number of English words selected was of an amount such as to yield an approximately equal number of syllables as was contained in the neologism core for a subject. Thus, for example, 279 syllables from legitimate English words were drawn for Subject M.S. to match the total 279 neologism syllables from his sample. Subject H.V. produced fewer English words than she did neologisms, so her English syllable total was 464 as compared to 483 for neologisms. A total of 234 syllables from English words were selected from Subject E.P. to closely match the 236 syllables in her neologism core. Interrater agreement scores were calculated for two listeners on English words as a group and yielded the following: Subject M.S., 94.5% agreement (263/279 syllables), Subject H.V., 87% agreement (404/464 syllables), and Subject E.P., 94% agreement (220/234 syllables). Since the average agreement rating across all subjects

was 92%, a third listener was not necessary.

Compilation of Demisyllable Data Bases

At this point, cores of neologisms and English words had been drawn from total samples, transcribed to satisfactory interjudge agreement levels and reliably categorized as to type (ie. abstruse and target-related neologisms). All remaining procedures operated on these data and pertained to one of two general aspects of analysis: (1) cataloging demisyllable frequencies by shape (CV, VC, etc.), by context (utterance-initial, embedded-final, etc.), by word type (target-related neologisms, abstruse neologisms, English words), by subject (M.S., H.V., E. P.) and (2) cataloging sonority profiles by sonority sequence pattern, by demisyllable shape, by context, by word type and by subject.

A separate demisyllable core was made for target-related neologisms, abstruse neologisms and English words for each subject, a total of 9 bodies of data. Each demisyllable core was formed by taking all syllables in the target-related, abstruse and English word cores and breaking them into their composite demisyllables. By the time this activity was completed, a total of 3988 demisyllables had been compiled: 992 demisyllables from the target-related neologism core, 1036 demisyllables from the abstruse core, and 1960 demisyllables from the English word core. Thus, 51% of total demisyllables were from aphasic errors (2028/3988), and 49% of total demisyllables were from normal English targets (1960/3988).

This roughly equal division was designed as an internal control device for the study, such that demisyllable frequencies and sonority patterns of neologisms produced by the subjects could be compared not only to the normal patterns described by Clements, but also to the patterns found in their own "normal" word forms. Additionally, the patterns found in the "normal" word forms could be compared to those described by Clements to determine whether aphasic individuals produce even their "normal" forms in some unexpected way.

Demisyllable tally grids were created so that every demisyllable in every data core could be categorized along the four parameters described above (subject, context, word type, demisyllable shape). Summary data are contained in Tables 2-6, Appendix A, and results are presented in Chapter Four.

Once cores had been analyzed for demisyllable information, they were re-anlayzed for sonority sequence patterns. These patterns were determined for every demisyllable in every data core. Tally grids allowed categorization of each demisyllable by sonority pattern (OV, NV, OGV, OOLV etc), shape (CV, VC, etc.), context (utterance-initial, utterance-final, etc.), word type (target-related neologism, abstruse neologism, English) and subject (M.S., H.V., E.P.). Summary data are contained in Tables 7-17, Appendix A, and results are presented in Chapter Four.

Statistical Analyses

A non-parametric statistical procedure (Chi-Square Goodness of Fit Test, two-tail) was applied to specific data in cases where a claim would be made as to the significance of the data. This procedure was selected since frequency distributions required comparison to distributions that could have occurred by chance. Therefore, Chi-Square testing was performed on summary frequency distributions for demisyllable shapes and sonority patterns to determine whether results differed significantly from those that could have occurred by chance. One-tail Chi-square follow-up tests were performed on the two most frequently occurring items in each distribution to determine whether their specific positions in the distribution could have occurred by chance. An alpha level of .05 was selected for each test. Results are presented in Chapter Four.

CHAPTER FOUR: RESULTS

Demisyllable shapes: Findings by word type

Demisyllable analyses described above yielded frequency distributions for shapes of initial and final demisyllables per and across subjects, by word type (target-related neologisms, abstruse neologisms, and English words). Data were most illustrative when summarized across subjects and across contexts. Findings are presented below.

Results from analyses of target-related neologisms (Table 2, Figure 7a, 7b, and 7c, Appendix A), indicated that initial demisyllables were most frequently of the form CV for each subject (72%, 87%, 87%) and, therefore, across all subjects (83%). With regard to context, utterance-initial demisyllables were most often of the form CV (70%), as were embedded-initial demisyllables (85%) (Table 3, Figure 8a, Appendix A).

Final demisyllables were most frequently of the form VC for each subject (48%, 55%) except H.V., who preferred final demisyllables of the shape V (60%). Summary figures for final demisyllables reflected this fact and yielded equal preference for final demisyllables of the type VC and V across subjects (45% each). With regard to context, 61% of utterance-final demisyllables were of the form VC. However, the majority of embedded-final demisyllables (54%) were of the form V (Table 3, Figure 8a, Appendix A).

Chi-Square testing of summary distributions (Table 2, Appendix A) revealed that results were generally significantly different from those that could have occurred by chance: initial demisyllables ($X^2 = 773.64$, df = 3, $p < .001$ for two-tailed test; $X^2 = 271.96$, df = 1, $p < .0005$ for one-tailed test) and final demisyllables ($X^2 = 329.70$, df = 3, $p < .001$ for two tailed test; $X^2 = .008$, df = 1, $p > .95$ and $< .98$ for one-tailed test). The exception to the rule was the finding for the one-tailed test, where results were not significantly different from chance. This is not surprising, since the statistic was testing the difference between VC and V demisyllables, across all final demisyllables, including utterance-final demisyllables (VC pattern) and embedded-final demisyllables, (V pattern).

Since the most frequent demisyllables were of the type CV, VC and V, then the most frequent syllable shapes of target-related neologisms were CVC and CV forms (ie. CV+VC demisyllables and CV+V demisyllables resulted in CVC and CV syllables, respectively). Both types of syllable are among the most frequent and least marked of

those that comprise legitimate English words, suggesting that the syllable shapes most often characterizing target-related neologisms were similar to those that most often characterize "normal" words of the English language.

With regard to abstruse neologisms (Table 3 & 4, Figures 9a, 9b, and 9c, Appendix A), results indicated that the most frequently occurring initial demisyllable type was CV, for each subject (83%, 79%, and 86%) and across all subjects (81%) (Table 4, Appendix A). With regard to context, 73% of utterance-initial demisyllables were CV, and 83% of embedded-initial demisyllables were CV (Table 3, Figure 8b, Appendix A).

Final demisyllables were most frequently of the form V for each subject (48%, 67%, 59%) and across subjects (60%). With respect to context, 54% of utterance-final demisyllables were VC, and 67% of embedded-final demisyllables were V (Table 3, Figure 8b, Appendix A).

Chi-Square testing of summary data (Table 4, Appendix A) revealed that overall results were significantly different from those that could have occurred by chance: initial demisyllables ($X^2 = 757.56$, df =3, $p < .001$ for two-tailed test; $X^2 = 290.04$, df = 1, $p < .0005$ for one-tailed test) and final demisyllables ($X^2 = 369.94$, df = 3, $p < .001$ for two-tailed test; $X^2 = 31.42$, df = 1, $p < .0005$ for one-tailed test).

These results resemble those found for target-related neologisms in that initial demisyllables were most frequently of the type CV. However, final demisyllables for abstruse neologisms were most often of the form V, rather than the V and VC forms predominant in target-related neologisms.. Since the most common demisyllable shapes for abstruse words were of the forms CV and V, then the most preferred syllable pattern for these words was CV (CV + V demisyllables = CV syllables). The CVC syllable shape frequent in target-related neologisms was not as common in abstruse neologisms, suggesting that abstruse forms were generally simpler in syllable shape construction than were the target-related forms.

Demisyllable shape preferences of legitimate English words (Table 3 & 5, Figure 10a, 10b, and 10c, Appendix A), revealed that initial demisyllables were most often of the form CV for each subject (61%, 69%, 68%) and across subjects (67%). With regard to context, the majority of utterance-initial demisyllables were CV (55%), and the majority of embedded-initial demisyllables were also CV (71%) (Table 3, Figure 8c, Appendix A).

Final demisyllables were most frequently of the form VC (50%, 45%, 47%) for three subjects and also equally of the form V for two subjects as well (45%, 47%). Summary

figures revealed that the VC shape was the most preferred overall form for final demisyllables (46%). With respect to context, 55% of utterance-final demisyllables were VC, whereas embedded-final demisyllables were equally often of the forms VC and V (44% (Table 3, Figure 8c, Appendix A).

Chi-Square testing for summary data (Table 5, Appendix A) indicated that results generally differed significantly from those that could have been expected from chance: initial demisyllables ($X^2 = 876.24$, df = 3, $p < .001$ for two-tailed test; $X^2 = 131.90$, df = 1, $p < .0005$ for one-tailed test) and final demisyllables ($X^2 = 618.42$, df = 3, $p < .001$ for two-tailed test; $X^2 = 1.48$, df = 1, $p > .10$ and $< .15$ for one-tailed test). The exception to the rule was the one-tailed test for final demisyllables, where results were not significant. This is not surprising, when considering that the statistic was testing the difference between VC and V demisyllables, across all final demisyllables, which include equally the utterance-final (VC pattern) and the embedded-final (V pattern).

The pattern of these results for initial demisyllables is the same as that described above for both types of neologisms (ie. CV preference). However, final demisyllables differed from previous findings in that they were most frequently of the VC shape, rather than VC/V and V patterns found for target-related neologisms and abstruse neologisms, respectively. Therefore, since the most frequent demisyllable shapes were CV, V, and VC, then the most frequent syllable shapes were CV and CVC for English words. Results suggest that the syllable shape most frequently found in legitimate English words was slightly more complex than the shape for either abstruse neologisms (CV syllables) or target-related neologisms (preference for simpler CV syllables equally as often as for CVC syllables).

Demisyllable Shapes: Findings by collapsed word types

When neologisms were considered as a group across all subjects, summary data (Table 6, Figure 11, Appendix A), revealed that initial demisyllables were most often of the form CV (82%). When context is examined in more detail, utterance-initial and embedded-initial demisyllables were most frequently of the form CV, 72% and 85%, respectively (Table 7, Figure 12a, Appendix A).

English initial demisyllables (across all subjects) are most also most often of the form CV (67%) (Table 6, Figure 11, Appendix A). With respect to detailed context analysis, both utterance-initial and embedded-initial demisyllables were most often of the form CV,

55% and 71%, respectively (Table 7, Figure 12a, Appendix A).

English utterance-initial demisyllables, however, were produced with V demisyllables (43%) much more often than they were for neologisms (10%), suggesting more frequent production of marked initial demisyllables for English words than for neologisms (CV is a less marked syllable shape than is V).

Chi-Square testing of summary data (Tables 6 &7) indicates that these results differed significantly from those that could have occurred by chance: neologism initial demisyllables ($X^2 = 1612.71$, df = 3, $p < .001$ for two-tailed test; $X^2 = 572.72$, df = 1, $p < .0005$ for one-tailed test) and English initial demisyllables ($X^2 = 876.24$, df = 3, $p < .001$ for two-tailed test; $X^2 = 255.74$, df = 1, $p < .0005$ for one-tailed test).

The CV shape is the least marked of all initial demisyllable patterns, regardless of utterance context (utterance-initial, embedded-initial). It is desirable from a sonority perspective because it implies that there will be some rise in sonority from the syllable onset to the peak, accomplished with a minimum of segments (ie. vs. CCV demisyllable). Neologisms and English words preferred the CV pattern, but English words were also produced frequently with vowel onsets (not to be confused with the onset slot for consonants in typical syllable constituent structure), a more marked production in this context.

When the final demisyllable patterns of the same data were examined (Table 6, Figure 11, Appendix A), it appeared that V demisyllables were most frequent in neologisms (V=53%, VC=40%), whereas VC demisyllables are most frequent for English words (VC=46%, V=43%). The interpretation of this information depends on context; V demisyllables are more marked in utterance-final contexts than they are in embedded-final contexts. When each context was examined separately (Table 7, Figure 12b, Appendix A), 61% of embedded-final demisyllables were terminated by the vowel, and 57% of utterance-final demisyllables were of the form VC. These patterns were appropriate for each context.

For English final demisyllables, when each context was examined separately (Table 7, Appendix A), 44% of embedded-final forms terminated with V or VC. However, 55% of utterance-final forms were VC. These patterns were appropriate for each context (Figure 12b, Appendix A).

Chi-Square testing of summary data (Table 7, Appendix A), indicates that these results generally differed significantly from those that could have occurred by chance: neologism

final demisyllables ($X^2 = 796.41$, df = 3, $p < .001$ for two-tailed test; $X^2 = 17.06$, df = 1, $p < .0005$ for one-tailed test) and English final demisyllables ($X^2 = 621.04$, df = 3, $p < .001$ for two-tailed test; $X^2 = 1.74$, df = 1, $p > .05$ and $< .10$ for one-tailed test). The exception to the findings of significance was seen for the one-tailed test for English final demisyllables. However, this finding was not surprising, since this statistic tested all final demisyllables, including utterance-final demisyllables (VC pattern) and embedded-final demisyllables (V pattern).

Therefore, neologisms ending most frequently with a vowel were those in the embedded-final demisyllables, the least marked pattern for that context. Embedded-final demisyllables of English words were often terminated by vowels. However, they ended with equal frequency as VC in that context as well, a more marked pattern and indicative of the greater complexity shown by English forms.

When neologisms as a group are considered, they demonstrate a CV syllable shape preference (highest initial demisyllable preference of CV, highest final demisyllable preference of V). English words, however, demonstrate a CVC syllable shape preference (highest initial demisyllable shape preference of CV, highest final demisyllable preference of VC). Results suggest that English words as a group were constructed with a more complex syllabic structure than were the group of neologisms.

Sonority Sequence Patterns: Findings Across Subjects

The sonority sequence patterns of every demisyllable were analyzed by word type, demisyllable shape, and utterance context across subjects with results presented below. Table 8, Figures 13-16, Appendix A, contain summary (collapsed) frequency rankings of sonority sequence patterns for target-related neologisms, abstruse neologisms and English words per context across subjects. These were the data that best permitted calculation of sonority trends (large data base = 3988 demisyllables across three subjects) and these were the data that underwent statistical testing. The expanded summary distributions from which these came (Table 9), and the individual subject distributions, from which all summary data was compiled (Tables 10-15), are contained in Appendix A as well, for the reader's review. Individual subject scores are referenced as needed in each section below.

Complexity ratings for each summary distribution discussed are also given below. Clements assigns specific complexity rankings for various segment sequence patterns according to demisyllable context (initial vs. final), and length (one, two, three and

four-member demisyllables). However, he does not give complexity ratings for summary data that represent combined demiyllable types (ie. syllables in the category "obstruent onset" may include two-member units (ex. OV), and three-member units (ex. OLV, OGV). Further, complexity ratings (calculated from the above-mentioned dispersion formula) vary with segment seguences in the demisyllables. As an example, OV (.06) is least complex for CV demisyllables, and OLV (.56) is less complex than OGV (1.17) for CCV demisyllables. Nevertheless, relative complexity of summary data can be extrapolated from the individual ratings that are available.

Regardless of the number of demisyllable members contained in a phoneme class category, an overall ascending order of complexity may be assumed for initial demisyllable classes of summary data: Obstruent onsets (Rank 1), Nasal onsets (Rank 2), Liquid onsets (Rank 3), Glide onsets (Rank 4), and Vowel-only demisyllables (Rank 5). Final demisyllable summary data ratings may be assigned using the following ascending complexity scale: Vowel-only demisyllables (Rank 0), Glide codas (Rank 1), Liquid codas (Rank 2), Nasal codas (Rank 3), and Obstruent codas (Rank 4). Note that initial demisyllable ratings range from 1-5, whereas final demisyllable rankings range from 0-4. When demisyllables with multiple segments (ex. VCC or CCV, VCCC or CCCV) are individually mentioned (as opposed to being discussed within a phoneme class group), the rankings used are those given by Clements in his 1990 article.

Target-Related Neologisms

Results indicated that, across subjects, Obstruents were the most frequent onsets for utterance-initial demisyllables (71%, Rank 1), followed by Nasals (10%, Rank 2), Vowels (9%, Rank 5), Liquids (5%, Rank 3) and Glides (5%, Rank 4) in descending frequency of occurrence (Table 8, Figure 13, Appendix A). Obstruent onset percentages for each subject were the following: E.P., 70%, H.V., 45%, and M.S., 88% (Table 10, Appendix A. Table 11 gives the expanded frequency rankings for the reader's information).

Chi-Square testing of the summary utterance-initial distribution revealed that results differed significantly from those that could have been expected by chance: $X^2 = 140.59$, $df = 4$, $p < .001$ for two-tailed test; $X^2 = 38.62$, $df = 1$, $p < .0005$ for one-tailed test.

This result was the same as that predicted by the theory for normal word forms in this context; frequent obstruent onsets created the preferred steep rise in sonority from

demisyllable periphery toward the peak. However, demisyllables formed with no consonant onset were more frequent than those formed with liquid or glide onsets, yet represented a higher complexity ranking than for liquids or glides. It appeared that while the general preference for obstruent onset held, the prediction that syllables would be formed in decreasing frequency from O > N > L > G > V did not.

The only utterance-initial demisyllables produced with multiple consonant onsets were of the CCV type. Of these, 78% were OLV (.56 = Rank 1), 17% were OGV (1.17 = Rank 2) and 5% were NGV (1.36 = Rank 3). Results show that the least complex segment sequence was the most frequent, as would be predicted by sonority theory, (also see Harris, 1983).

Embedded-initial demisyllables (across subjects) were also formed most frequently with Obstruent onsets (67%, Rank 1), followed by Nasals (12%, Rank 2), Liquids (10%, Rank 3), Glides (6%, Rank 4), and Vowels (5%, Rank 5) in descending frequency of occurrence (Table 8, Figure 14, Appendix A). Obstruent onset scores for individual subjects were as follows: E.P. 60%, H.V. 64%, and M.S. 82% (Table 10, Appendix A; Table 11 gives expanded figures for the reader's review).

Chi-Square testing of the summary embedded-initial distribution revealed that results differed significantly from those that could have occurred by chance: $X^2 = 562.66$, $df = 4$, $p < .001$ for two-tailed test; $X^2 = 152.10$, $df = 1$, $p < .0005$ for one-tailed test.

This result was the same as that predicted by the theory for normal word forms in this context; obstruent onsets provided a steep rise in sonority from demisyllable periphery toward the peak. In this case, however, the prediction of demisyllable formation along the scale of O > N > L > G > V held. Demisyllables with multiple onsets were of the type CCV. Of these, 75% were OLV (Rank 1), 22% were OGV (Rank 2) and 3% were OOV (Rank undefined). Results showed that the least complex form produced was the most frequent, a finding that would be supported by sonority theory.

Utterance-final demisyllables were produced most frequently (across subjects) with Obstruent codas (49%, Rank 5), followed in descending order of occurrence by Nasals (22%, Rank 4), Vowel-only demisyllables (19%, Rank 1) and Liquids (10%, Rank 3) in descending frequency of occurrence (Table 8, Figure 15, Appendix A). Glide codas did not occur. Obstruent coda percentages for individual subjects were as follows: E.P. 41%, H.V. 37% and M.S., 63% (Table 10, Appendix A; Table 11 gives expanded figures for the reader's review). Subject H.V. produced Vowels (41%) more frequently as final

demisyllables in this context (ie. with no consonant coda).

Chi-Square testing of summary data revealed that results differed significantly from those that could have been expected by chance: $X^2 = 40.23$, df = 3, $p < .001$ for two-tailed test; $X^2 = 12.20$, df = 1, $p < .0005$ for one-tailed test.

Clements notes that a demisyllable with an obstruent (or other) coda is more likely than a vowel-only demisyllable in utterance-final context than it is in embedded-final context. This was the overall trend for target-related neologisms. However, the prediction of V > G > L > N (once obstruent preference was removed) did not obtain.

Although vowel-only final demisyllables (with no sonority decline) are not unusual in this context, they do represent a more complex production fron a sonority perspective. H.V.'s preference for this pattern may reflect a greater preference for the least marked CV syllable shape than other subjects. Utterance-final demisyllables with multiple coda segments were of the forms VCC and VCCC. Of the VCC forms, 59% were VLO (Rank 4), 31% were VNO (Rank 3), 5% were VOO (Rank undefined), and 5% were VLN (Rank 2). Of the VCCC forms, 100% were of the type VLNO (Rank 2). With regard to the VCC forms, the majority reflected more, rather than less, complexity in construction. However, the VLO pattern may have been preferred for it's even distribution of sonority decline, regardless of complexity (by extrapolation, from Harris, 1983).

Embedded-final demisyllables were produced most frequently (across subjects) with no consonant coda (ie., vowel-only final demisyllables) (54%, Rank 1), followed by Obstruents (25%, Rank 5), Nasals (11%, Rank 2) and Liquids (10%, Rank 3) in descending frequency of occurrence (Table 8, Figure 16, Appendix A). Glide codas did not occur. Vowel coda percentages for individual subjects were as follows: E.P. 50%, H.V., 63%, and M.S. 40% (Table 10, Appendix A; Table 11 gives expanded figures for the reader's review). Subject M.S. produced obstruents as codas somewhat more often than vowels in this context (41%).

Chi-Square testing of summary data revealed that results differed significantly from those that could have been expected by chance: $X^2 = 189.85$, df = 3, $p < .001$ for two-tailed test; $X^2 = 142.32$, df = 1, $p < .0005$ for one-tailed test.

The overall result was the same as that predicted by the theory for legitimate English words in this context: there is frequently no decline in sonority after the syllable peak. However, it appeared that while the general preference for vowels was supported by these results, the prediction of V > G > L > N > O in descending frequency of occurrence was

not.

Demisyllables with multiple segment codas were of the types VCC and VCCC. Of the VCC demisyllables, 43% were VLO (Rank 4), 26% were VOO (Rank undefined), 17% were VNO (Rank 3), 9% were VLN (Rank 2), and 5% were VLL (Rank 1). The most complex (defined) demisyllable type was produced most frequently; a finding that was curious, but possibly explained by the more even sonority decline of VLO (ie. V, G, L, N, O) as opposed to the others. The VCCC demisyllables were both of the form VLNO.

Abstruse Neologisms

Results indicate that, across subjects, Obstruents were the most frequent onsets in utterance-initial demisyllables (70%, Rank 1), followed by Vowels (10%, Rank 5), Nasals (9%, Rank 2), Glides (7%, Rank 4) and Liquids (4%, Rank 3) in descending frequency of occurrence (Table 8, Figure 13, Appendix A). Obstruent onset percentages in individual subjects were the following: E.P., 84%, H.V., 51%, and M.S., 91% (Table 12, Appendix A; Table 13 gives expanded figures for the reader's review).

Chi-Square testing of summary data revealed that results differed significantly from those that could have been expected by chance: $X^2 = 166.32$, df = 4, $p < .001$ for two-tailed test; $X^2 = 47.62$, df = 1, $p < .0005$ for one-tailed test.

Results were congruent with those predicted by the sonority theory; obstruent onsets in utterance-initial position create a steep rise in sonority from syllable periphery toward the peak. Again, however, the prediction that descending frequency of occurrence would pattern as $O > N > L > G > V$ did not hold.

Demisyllables composed of multiple onsets were of the form CCV. Of these, 61% were OLV (Rank 1), 17% were OGV (Rank 2), 11% were OOV (Rank undefined), and 11% were NGV (Rank undefined). The evenly distributed pattern of OLV was again the most preferred.

Embedded-initial demisyllables were most frequently formed (across subjects) with Obstruent onsets (68%, Rank 1), followed by Nasals (11%, Rank 2), Vowels (10%, Rank 5), Glides (7%, Rank 4), and Liquids (4%, Rank 3) in descending frequency of occurrence (Table 8, Figure 14, Appendix A). Obstruent onset percentages for individual subjects were as follows: E.P., 50%, H.V., 65%, and M.S. 89% (Table 12, Appendix A; Table 13 gives expanded figures for the reader's review).

Chi-Square testing revealed that results differed significantly from those that could have been expected by chance: $X^2 = 614.91$, df = 4, $p < .001$ for two-tailed test; $X^2 = 177.76$, df = 1, $p < .0005$ for one-tailed test.

The preference for obstruent onsets (with steep sonority rise) was predicted by the theory in this context. However, the prediction of O > N > L > G > V in descending frequency of occurrence did not obtain.

Embedded-initial demisyllables with multiple onsets were of the form CCV. Of these, 64% were OLV (Rank 1), 17% were OGV (Rank 2), 7% were NGV (Rank 3), 4% were OOV (Rank undefined), 4% were ONV (Rank 2) and 4% were GGV (Rank undefined). Note that the GGV sequence is possible when /h/ is considered to be a glide (Ladefoged, 1982). Preference for the OLV pattern (least complexity) as predicted by the theory is, again, supported with this data.

Utterance-final demisyllables were most frequently terminated with Vowels (38%, Rank 1), Obstruents (26%, Rank 5), Nasals (23%, Rank 4), and Liquids (Rank 3) in descending frequency of occurrence (Table 8, Figure 15, Appendix A). Glides did not occur. Vowel percentage scores for individual subjects were as follows: E.P., 54%, H.V., 44%, and M.S., 14% (Table 12, Appendix A; Table 13 gives expanded figures for the reader's review). Subject M.S. preferred obstruents as most frequent demisyllable codas.

Chi-Square testing revealed that results for two-tailed test generally differed significantly from those that could be expected by chance: $X^2 = 19.79$, df = 3, $p < .001$. However, results were not significant for the one-tailed test: $X^2 = 2.44$, df = 1, $p > .05$ and $< .10$. Apparrently the difference in frequency of occurrence between vowels and obstruents in this context was somewhat random.

Sonority theory predicts termination of final demisyllables with vowels. However, this pattern is more typical in embedded-final context than in utterance-final context. Obstruents were, in fact, second in frequency to vowels and created a steep sonority decline from vowel peak to demisyllable periphery on 26% of occasions. The prediction of V > G > L > N > O did not hold, but rather appeared to move somewhat backward along the scale.

Utterance-final demisyllables with multiple codas were of the form VCC. Of these, 46% were VLO (Rank 4), 36% were VNO (Rank 3), 9% were VLN (Rank 2), and 9% were VOO (Rank undefined). Although the most complex pattern was preferred, it again

may be explained by the appeal of even distribution of sonority decline from syllable peak toward the periphery.

Embedded-final demisyllables were most frequently terminated with Vowels (67%, Rank 1), followed by Obstruents (15%, Rank 4), Nasals (9%, Rank 3), and Liquids (9%, Rank 2) in descending frequency of occurrence (Table 8, Figure 16, Appendix A). Vowel preference scores for individual subjects were as follows: E.P. 61%, H.V., 73%, and M.S., 59% (Table 12, Appendix A; Table 13 gives expanded figures for the reader's review).

Chi-Square testing of summary data revealed that results differ significantly from those that could have been expected by chance: $X^2 = 433.11$, df = 3, $p < .001$ for the two-tailed test; $X^2 = 130.10$, df = 1, $p < .0005$ for the one-tailed test.

These results were congruent with those predicted by the theory for legitimate English words. Embedded-final demisyllables ending with vowels prevented any sonority decline after demisyllable peak. However, the predicted pattern of $V > G > L > N > O$ did not obtain; in fact, frequency of segment production moved backwards along the scale (after exclusion of vowels).

Embedded-final demisyllables with multiple codas were of the form VCC. Of these, 50% were VLO (Rank 4), 20% were VNO (Rank 3), 20% were VOO (Rank undefined), and 10% were VLN (Rank 2). Again, although the more complex final demisyllable pattern was preferred in these VCC forms, the most prevalent was the VLO pattern with an evenly distributed sonority decline.

English Words

Utterance-initial demisyllables were most frequently initiated by Vowels (43%, Rank 5), followed by Glides (24%, Rank 4), Obstruents (18%, Rank 1), Nasals (13%, Rank 2), and Liquids (2%, Rank 3) in descending frequency of occurrence (Table 8, Figure 13, Appendix A). Individual subject vowel preference scores were as follows: E.P., 42%, H.V., 39%, and M.S., 64% (Table 14, Appendix A; Table 15 gives expanded figures for the reader's review).

Chi-Square testing of summary data revealed that results differed significantly from those that could have been expected by chance: $X^2 = 124.69$, df = 4, $p < .001$ for the two-tailed test; $X^2 = 28.18$, df = 1, $p < .0005$ for the one-tailed test.

This result was unexpected. Sonority theory suggests that obstruent onsets are preferred in utterance-initial contexts, for creation of the steep sonority rise toward syllable peak. However, the English words produced by these subjects most frequently lacked any sort of consonant onset and did not follow the descending frequency of occurrence pattern predicted by the scale: O > N > L > G > V. Clements doesn't suggest that vowels never initiate initial demisyllables, but simply notes that this situation represents a more marked sonority pattern. Perhaps, for these subjects, complexity is better tolerated in well-formed English words than it is in either their target-related or abstruse neologisms.

The utterance-initial demisyllables with multiple onsets were of the type CCV. Of these, the only pattern produced was OLV (100%, Rank 1). This is, again, the least complex pattern for VCC utterance-initial demisyllables (.56).

Embedded-initial demisyllables were most frequently formed with Obstruent onsets (46%, Rank 1), followed by Vowels (25%, Rank 5), Glides (15%, Rank 4), Nasals (10%, Rank 2), and Liquids (4%, Rank 3) in descending frequency of occurrence (Table 8, Figure 14, Appendix A). Individual subject obstruent percentages were as follows: E.P., 46%, H.V., 48%, and M.S., 44% (Table 14, Appendix A; Table 15 gives expanded figures for the reader's review).

Chi-Square testing of summary data revealed that results were significantly different from those that could have occurred by chance: $X^2 = 390.07$, df = 4, $p < .001$ for the two-tailed test; $X^2 = 162.96$, df = 1, $p < .0005$ for the one-tailed test.

These results were consistent with those predicted by the theory; obstruent onsets created a steep sonority slope from demisyllable periphery toward vowel peak. However, the predicted descending frequency of occurrence along the scale O > N > L > G > V did not obtain.

Embedded-initial demisyllables with multiple onsets were of the type CCV. Of these, 69% were OLV (Rank 1), 19% were OGV (Rank 2), and 12% were OOV (Rank undefined). The most frequently produced pattern was the least complex and again of the type representing the most evenly distributed sonority rise, OLV.

Utterance-final demisyllables were most frequently terminated by Obstruent codas (48%, Rank 4), followed by Vowels (38%, Rank 0), Liquids (7%, Rank 2), and Nasals (7%, Rank 3) (Table 8, Figure 15, Appendix A).. Glide codas did not occur. Individual subject obstruent percentages were as follows: E.P., 35%, H.V., 51%, and M.S., 51% (Table 14, Appendix A; Table 15 contains expanded figures for the reader's review).

Subject E.P. preferred utterance-final demisyllables that terminated with vowels (46%).

Chi-Square testing revealed that results differed significantly from those that could have been expected by chance for the two-tailed test: $X^2 = 124.92$, df = 3, $p < .001$. However, results for the one-tailed test were not significant: $X^2 = 2.26$, df = 1, $p > .05$ and $< .10$. Apparently, the difference in frequency of occurrence between obstruents and vowels was somewhat random.

This finding was not unexpected according to predictions that sonority theory holds for legitimate English words. Although obstruent codas hold a higher complexity rating than other segments, they are not atypical in utterance-final context. The prediction of V > G > L > N > O did not hold in any pattern of descending frequency of occurrence.

Utterance-final demisyllables with multiple codas were of the forms VCC and VCCC. Of the VCC forms, 50% were VLO (Rank, 4), 43% were VNO (Rank 3), and 7% were VOO (Rank undefined). The evenly distributed (but more complex) VLO pattern was again the most preferred among VCC forms. Of the two VCCC demisyllables, 100% were VLLO (Rank undefined).

Embedded-final demisyllables were most frequently terminated by Vowels (44%, Rank 0), followed by Obstruents (43%, Rank 4), Nasals (7%, Rank 3), and Liquids (6%, Rank 2) (Table 8, Figure 16, Appendix A). Individual subject percentages for vowels were as follows: E.P., 47%, H.V., 48%, and M.S., 36% (Table 14, Appendix A; Table 15 gives expanded figures for the reader's review). Subject M.S. preferred obstruent codas (50%).

Chi-Square testing of summary data revealed that results generally differed significantly from those that could have been expected by chance for the two-tailed test: $X^2 = 395.02$, df = 3, $p < .001$. However, results for the one-tailed test were not significant: $X^2 = .182$, df = 1, $p > .05$ and $< .10$. Apparently, the difference in frequency of occurrence between obstruents and vowels was somewhat random..

These results were those predicted by the theory for legitimate English words; frequent demisyllable termination with vowels prevented any drop in sonority in this context in many cases. However, vowel termination was not significantly different from frequency of obstruent termination, a less preferred pattern in this context. Again, the prediction of V > G > L > N > O in descending frequency of occurrence did not obtain.

Embedded-final demisyllables with multiple codas were of the type VCC and VCCC. Of the VCC forms, 48% were VNO (Rank 3), 41% were VOO (Rank undefined), 7% were VLO (Rank 4), 4% were VLL (Rank undefined). Of the VCCC forms, 67% were VLOO

(Rank undefined), and VOOO (Rank undefined). For the VCC forms, the VLO evenly distributed pattern was not most frequent. Instead, a less complex pattern predominated. However, among the VCCC forms, the VLOO pattern was preferred.

Transsyllabic Sonority Patterns

Tables 16 and 17 (Appendix A) contain the distributions from which transsyllabic sonority patterns were determined. Results indicated that for all word types, embedded-final demisyllables were terminated most frequently by vowels, and were followed most often by obstruent onsets in adjacent embedded-initial demisyllables (Table 16). However, in the case of embedded-final demisyllables for English words, the difference in frequency of occurrence for vowels and obstruents was not statistically significant.

This result is generally that which was predicted by the theory; most often a flat sonority slope was present in embedded-final demisyllables but was followed by a steeply rising sonority slope in subsequent embedded-initial demisyllables. This pattern created a desirable sonority contrast across syllable boundaries (V $ Ob). With regard to English words, a relatively equal frequency of occurrence between obstruents and vowels in embedded-final demisyllable context is a more marked pattern than would be expected and is indicative of the greater complexity tolerated in legitimate word forms (vs. neologisms).

Table 17 contains the distributions for the transsyllabic sonority patterns for the sequence utterance-final demisyllable followed by a post-pausal utterance-initial demisyllable. Results indicated that each word type presented a different sonority pattern across syllable boundaries. Target-related neologisms revealed that obstruent codas in utterance-final context were most often followed by obstruent onsets in utterance-initial context (Ob $ (pause) Ob).

The reader should recall that, in the case of utterance-final demisyllables for abstruse neologisms and English words, the difference in frequency of occurrence for obstruents and vowels was not statistically significant. Therefore, abstruse neologisms were terminated essentially equally often by vowels and obstruents in utterance-final demisyllables, to be followed most frequently by obstruent onsets in utterance-initial demisyllables (V $ (pause) Ob). English words revealed that essentially equally frequent vowel and obstruent codas in utterance-final demisyllables were most often followed by vowels initiating utterance-initial demisyllables (Ob $ (pause) V). Nevertheless,

apparrently, the presence of a pause (by definition) between utterance-final and utterance-initial demisyllables creates enough contrast between syllable boundaries that the need for a particular sonority pattern to achieve this end is eliminated.

Note that all of the distributions in Tables 16 and 17 have already been tested by Chi-Square procedures, with results presented in earlier sections of this chapter.

Receptive Language Testing

The purpose for receptive testing of task stimuli (Exhibit 3, Appendix B) was to determine the ease with which subjects could generally access underlying word forms for comprehension purposes. Subject M.S. (2 months post-stroke) demonstrated 60% accurracy when pointing to pictures, 65% accuracy when pointing to written words and 50% accuracy when pointing to objects associated with functions. Errors were present for the following stimuli: father, mother, house, bed, car, cat, day, people, face, children, baseball, couch, book, pencil, soap, chair, towel, shoes, and clock.

M.S. produced neologisms (83%) in response to all items (during expressive tasks) except the following, which were characterized by semantic paraphasias: money, phone, books, dream, week, person, one, and ten. He did not demonstrate comprehension difficulty on the correctly produced items. However, he did produce neologisms for all words he had difficulty comprehending, as well as for some that he didn't have difficulty comprehending. It appears that his ability to access underlying forms for comprehension may be somewhat independent of his ability to access those forms for production (or, upon correct access, his ability to prevent subsequent phonological distortion may be impaired).

Subject H.V. (> 5 years post-stroke) demonstrated 100% accuracy when pointing to pictures, 89% accuracy when pointing to written words, and 100% accuracy when pointing to objects associated with functions. Items incorrectly identified were: mother and couch.

Subject H.V. produced neologisms (92%) in response to all items (during expressive tasks) except the following: girl, ten, six, and feet. Semantic paraphasias occurred in response to all of these items, except girl, which was correctly produced. Thus, neologisms were produced frequently, regardless of success on comprehension tasks. It appears that H.V.'s ability to correctly access the lexicon for comprehension is somewhat independent of her ability to access it for production, (or with correct access, her ability to prevent subsequent phonological distortion may be impaired).

Subject E.P. (2 1/2 months post-stroke) demonstrated 100% accuracy when pointing to pictures, 84% accuracy when pointing to words and 100% accuracy when pointing to objects associated with functions. Errors were produced on the following items: morning, people, and face.

E.P. produced neologisms (65%) for all items (during expressive tasks) except: house, money, boy, cat, people, mother, day, man, face, train, couch, home, week, ten, six, and feet. All were correctly produced except for "people, Friday and ten", which were characterized by semantic paraphasias. The words "people and Friday" were eventually correctly produced.

E.P., as the other subjects, produced neologisms for many of the items that she had correctly identified on receptive tasks. She demonstrated the highest correspondence between successful lexical access for comprehension and production. Nevertheless, like the other two subjects, her ability to access the lexicon for comprehension is somewhat independent of her ability to access it for production (or, with access, her ability to prevent subsequent phonological distortion may be impaired).

CHAPTER FIVE: DISCUSSION

The following discusion will address each of the questions that this study was designed to answer (see the introduction to Chapter Two). The first part of this chapter will answer the first three questions (regarding the nature of demisyllable and sonority patterns found in neologisms and English words) by summarizing findings from Chapter Four. The second part of this chapter will answer the last three questions by exploring implications of these findings for the sonority theory and for models of neology. The third part of this chapter will explore an alternate theory (ie. other than sonority) that may also be able to explain the results of this study. Finally, the chapter will conclude with suggestions for future research.

Patterns of Findings: Demisyllable and Syllable Shapes

The first question posed at the start of this study was, "What demisyllable shape preferences (in each of four contexts) were present in the utterances of three fluent aphasics?" Specific results have been presented in Chapter Four. However, they can be summarized with the following statements:

(1). Initial demisyllables were most frequently of the form CV, for each type of neologism, for neologisms as a group, and for English words. With regard to initial demisyllable shape by context, both utterance-initial and embedded-initial demisyllables were most frequently of the form CV for all word types.

(2). Final demisyllable patterns varied for each type of word. English word demisyllables occurred (statistically) equally often as V and VC forms, as did target-related neologisms. Abstruse neologisms were most often of the form V. Final demisyllables in neologisms as a group were most often of the form V, whereas they were most often of the form VC for English words. With regard to final demisyllable contexts, utterance-final demisyllables were most often of the form VC for all words. Embedded-final demisyllables were most often of the form V, for neologisms as a group and for many English words. However, an equal number of English words were of the form VC in that context.

(3). The syllable shapes preferred most often for target-related neologisms were CV and CVC, although the shape preferred most often for abstruse neologisms was CV. Neologisms as a group were most often of the shape CV. English words were most frequently of the syllable shapes CV and CVC.

These findings as a whole pattern in similar ways to those described by sonority theory for legitimate English words produced by normal native speakers of the language. In this study, aphasic speakers produced neologisms and English words most often with CV initial demisyllables (utterance-initial and embedded-initial) just as normals do. This pattern is preferred for initial demisyllables because of the rise in sonority created from consonant to vowel. Likewise, final demisyllables were produced primarily with the VC pattern (all word types) in utterance-final context and the V pattern (all word types) in embedded-final context. The only exception was the VC pattern also found with English words in embedded-final demisyllables. These results were those expected by extrapolation from the theory; the VC pattern in utterance-final demisyllables created a preferred drop in sonority, whereas the V pattern observed in embedded-final demisyllables resulted in a sonority plateau that is desirable in that context.

Results are also those predicted by the theory for syllable shapes; neologism syllables were most often of the form CV, while English words were most often of the form CVC. Neologisms as a group were formed by using the most universal and least marked syllable shape available, whereas English words were of a form that was slightly more marked. Clements has noted that English words produced by normal speakers are most frequently of the forms CV and CVC; results of this study pattern similarly. However, the English words produced by these subjects appear to reveal somewhat more complexity, whereas the neologism syllable forms in general represent the simplest of available options.

Among word types, however, it appeared that some words produced by the subjects were slightly more complex than others, in descending order: English words, target-related neologisms, abstruse neologisms. English words were most frequently of a more marked syllable shape (CVC) than either type of neologism and their final demisyllable patterns also revealed more complexity (ex. embedded-final demisyllables equally often as VC and V) than found in neologisms. Target-related neologisms showed equal frequency for CVC and CV syllable shapes (more complexity than abstruse but less overall than English words) but final demisyllables were of predicted forms per context. Abstruse neologisms displayed the least marked syllable pattern among all word types, (CV shape) but final demisyllables were of the predicted forms per context.

In sum, with regard to demisyllable and syllable patterns, these findings suggest that neologism patterns do not differ wildly from either the patterns of English words produced by the same aphasic speaker, or from the patterns described by the theory for words

produced by normal speakers. In fact, they conform quite well to sonority theory predictions, but differ in small ways from each other and from English words with regard to syllable shape, choosing simplicity over complexity the majority of the time.

Nevertheless, these findings may suggest that target-related and abstruse neologisms are formed by different mechanisms. If target-related neologisms pattern somewhat more like English words (ex. re: syllable shape) than do abstruse neologisms, then perhaps they represent distortions of real words. That is, the phonological error processes that created them could have operated on English words correctly accessed from the lexicon, but subsequently altered by processes that create phoneme paraphasias.

Abstruse neologisms, however, formed most frequently by series' of the simplest syllable unit available, may arise from some sort of random syllable generating device stocked with the prototype syllable forms available in the language. When lexical access is blocked, this device may produce the simplest syllable form it can (less stress on an already taxed system). As this form gains increased activation within the random generator (discussed later), the likelihood of subsequent CV forms is increased (a process which can explain the overall high frequency of CV forms as well as some phoneme perseveration phenomena). A model explaining these processes in more detail will be described in a later section of this chapter.

Patterns of Findings: Sonority Profiles

The second question addressed by this study was the following: "What segment sequence preferences in four demisyllable contexts are present in the neologistic productions of fluent aphasics?" Specific results have been presented in Chapter Four. However, results can be summarized as follows:

(1). Utterance-initial demisyllables were characterized by obstruent onsets for target-related and abstruse neologisms. English words were the exception, with vowels most frequently initiating the demisyllables. Embedded-initial demisyllables were most frequently initiated by obstruents within all word types.

(2). Utterance-final demisyllables were characterized by obstruent codas for target-related neologisms. English words were terminated equally (statistically) often by obstruents and vowels. Abstruse neologisms, however, were characterized most frequently by vowel-only or obstruent productions. Embedded-final demisyllables were terminated by vowel-only demisyllables within all word types.

(3). In all cases, CCV demisyllables were most frequently of the type OLV. In all cases but one, VCC demisyllables were of the type VLO (VNO was the exception). Four segment demisyllables did not occur in initial contexts and did not occur enough in final demisyllables to reveal a pattern of production.
(4). In only one case did a prediction of frequency preference along the sonority scale (O>N>L>G>V or V>G>L>N>O, etc.) hold (target-related neologism, embedded-initial demisyllables). Otherwise, either no discernable pattern was evident or else the pattern moved somewhat backward along the sonority scale.
(5). With regard to transsyllabic patterns, vowels were followed by obstruents most frequently in the embedded-final/embedded-initial demisyllable sequence. No discernable pattern was evident for the sequence of utterance-final/utterance-initial demisyllables.
(6). Receptive language probing indicated that subjects generally produced neologisms even for words that they could identify correctly on comprehension tasks. Results suggest some dissociation between ability to access the lexicon for comprehension vs. production. Alternately, given correct access, subjects demonstrated some inability to prohibit subsequent phonological distortion.

Results revealed a remarkable tendency to follow the patterns described by sonority theory for English words produced by normal native speakers of the language. Apparrently, the neologisms and English words produced by aphasic individuals are not substantially different along sonority parameters from words produced by individuals whose neurological systems are intact. These results support the notion of sonority as (1) hard-wired component of the language system, since it's operation is not significantly impaired in phonological systems that have undergone serious impairment and, (2) mediator of phonological construction in all word forms, neologistic or otherwise. Neologisms resemble their legitimate English word counterparts with regard to sonority parameters and, as a result, appear to be driven by a common phonological guide at some stage of processing. The next section of this chapter will explore the role of sonority in models of language production and in mechanisms of neologism formation.

Models and Mechanisms

Chapter One described in some detail a serial and an interactive model of language production, and described how sonority could be incorporated into those models.

However, the next set of questions addressed by this study asked if this exercise could be taken further, given the results and findings from this study of jargonaphasia. Question Four asked if sonority provided any descriptive, explanatory or predictive power for phonological error analysis in this study.

It appears evident from information contained in Chapter Four that sonority can provide a metric for describing the segmental composition of neologism syllables. It was useful as one means of organizing a discrete set of seemingly disorganized word forms, and at the very least revealed that neologisms as a class of utterance were not without some across-group regularities (recognizing, however, that there are inherent differences between types of neologisms). Certainly it illustrated the similarities and differences between neologism types and revealed how similar both types are to normal word forms.

Whether or not the resulting descriptions are theoretically or clinically useful, however, will depend on the purposes of investigators and on the degree to which they believe that sonority actively governs construction of neologisms. If they had some basis on which to found such a belief, their consideration of sonority might have even greater utility; they could explain why forms were of a given type. Explanation would, in turn, facilitate further predictions about formation of future neologisms and, by extrapolation, perhaps suggest methods for rehabilitation of language processing. These issues will be addressed later in the next section of this paper (An Alternate Perspective on Sonority).

While the descriptive power of a theory may not be as critical as it's ability to facilitate the explanation or predictability of phenomena, it is certainly important.. Description provides the foundation upon which to build theories of explanation and prediction. From the conclusions based on description in this study, discussion of the role that sonority might play in the formation of neologisms can proceed with more confidence than would have otherwise been possible (Clements has already done this for legitimate words of languages).

The regularity with which sonority patterns occurred argues against chance as explanation and statistical testing supports this conclusion. Regularities also suggest that sonority is a consistent and significant aspect of word formation, neologistic and otherwise. If this is the case, then sonority principles must apply during some stage of neologism formation; the interesting questions, of course, being "when" and "how" and "why". The following discussion attempts to answer these questions (and Question Five of this study: Can sonority be further incorporated into models?) by integrating the

(modified) mechanisms of serial and parallel models that construct phonological forms (described in Chapter One of this dissertation).

The integration of serial and parallel models is not unfeasable if one assumes that language processing generally must involve both levels of linguistic representation and active computations that map between the levels. Both the serial and parallel models described in Chapter One include these features. Parallel models claim that activities at any given stage of processing can almost simultaneously affect activities at higher and lower stages of processing. However, if serial processing is fast enough , would not mapping between and among levels appear almost a simultaneous process? With regard to the question of feedback, an important difference between these two types of models, recall that Garrett did not rule-out feedback from level to level in his model.

As the reader will recall, the Garrett model of sentence production is a serial one, composed of a series of representational levels mapped one onto the other by sets of computational processes. One mechanism added to this model provided for a default system of syllable production (in the form of a random syllable generator), in the case of blockage to lexical access (form-based lexicon). Additional mechanisms include devices that could derail as they copied and checked off segments from a holding buffer into a phrasal frame during production . These device errors have been used to (1) illustrate how phoneme addition, deletion and movement errors occur, regardless of method of neologism genesis, and (2) to explain neologism formation as a process of phonological distortion of otherwise correctly accessed words. In this case, infrequent derailments would result in identifiably target-related neologisms, whereas copious derailments would result in abstruse neologisms.

The additions to Garrett's model provide useful ways of conceptualizing the mechanisms that could create neologisms and, facilitate visualization of the locus of phonological breakdown in the course of language processing. However, to date, few have described the inner workings of the random generator or copier/monitor devices. (but see Dell, 1988, discussed later). It is at this level that interactive activation is useful; ie. as a means of describing the operation of normal computational processes, as well as derailing devices and default mechanisms.

Operation of the random generator appears to be constrained by sonority; the abstruse neologisms in this study (ie. those most likely to be produced by the generator) were formed in accordance with sonority sequencing principles in the majority of cases. It

appeared to construct the simplest types of syllables most frequently when generating neologisms; CV syllables were most frequent among abstruse forms. However, these observations do not explain the process by which these results were realized, nor do they explain the perseverative nature of abstruse neologisms on repeated attempts to name. Every subject in this study produced strings of neologisms when attempting to name pictures, read words, or imitate words. One example of this was a series produced by subject M.S. when attempting to label "couch". Utterances included, "[kɔ̀rɾər], [kɔrt], [kɔnt] and [kɔ́rɾəd] for /kaUtʃ/. For purposes of discussion, the segment /d/ will be assigned as the phoneme underlying the phonetic element "flap". Later, the possibility of /t/ as underlying phoneme will be examined. If a random syllable generator throws out a new set of random syllables every time lexical access is blocked, then how is the perseverative similarity among neologisms explained?

One possibility is that phonological activation metrics work within encapsulated devices as well as between devices (Figure 17, Appendix A). Suppose that the first set of syllables produced by the generator are either truly random, or minimally resemble the target. A speaker might have attempted to access Lexical Lookup #1 (meaning-based), and have been successful or not. A subsequent unsuccessful attempt to access Lexical Lookup #2 (form-based) would activate phonological processing in the default mechanism (random generator). Suppose partial access in Lookup #2 resulted in activation of only one segment, /k/ (which is possible, given data from the so-called tip-of-the-tongue phenomenon) and this information were available to the random generator as part of it's input instructions for operation. If it is not entirely encapsulated, perhaps it can accept some small amount of phonological input.

The phoneme /k/, however, is not a syllable. The generator could randomly select appropriate consonantal and vocalic segments to form a series of syllables. Vowel elements would be selected first, and consonants attached to each vowel in the manner described in Chapter One : each segment may be attached to a previous one, moving leftward first from syllable peak toward onset periphery, as long as each segment subsequently attached has less sonority than the preceding segment. Thus, segments would be positioned first in onset slots simultaneously for both vowel units. Remaining segments would be attached to coda positions for each vowel, again ideally in such a way as to create preferred patterns of sonority rise, plateau or decline.

Thus, if the sequence of segments in the random generator were CVCCVC, the medial sequence of consonants would be assigned to the onset position of the second syllable as much as possible. Remaining consonants, if any, would be assigned to the coda position of the first syllable. The resulting novel word form would be placed into the holding buffer for subsequent scan-copier placement into the phrasal frame. The scan-copier would place the vowel into the peak slot of the syllable template, and place segments of decreasing sonority to onset and coda slots on either side of the peak. Checkoff monitor activity would eliminate segments from the holding buffer as soon as they have been positioned. The assumption at this point is that, at the time of mechanism triggering, phoneme segments in the random generator were of equal activation levels. Therefore, selection of segments for production from among those of equal activation would represent the random component of mechanism operation.

The important assumption at this level of processing is that, at the time of neologism construction, sonority constraints guide attachment of selected segments to syllable onset and coda positions as they are organized in the random generator and as they are being placed into the syllable templates of the phrasal frame by the scan-copier. This redundancy in the system accounts, in part, for the claim that sonority must be a widely-distributed phenomenon.

As an example, segments /k, ɔ, r, d, ə , and r/ could have been activated in the random generator for output in the following manner. Following the syllabification procedure described above, the vowels /ɔ/ and /ə/ would be activated first among the segments that were originally in the generator. Segments of less sonority than the vowel would be tentatively attached to onset and then coda positions, reiteratively, as long as each segment added to an already attached segment was of less sonority value than the one to which it was being attached. Thus, for the sequence CVCCVC, (/kɔ́r dər/), the vowels would be selected first, /k/ assigned to onset position of the first syllable, and /d/ assigned to the onset of the second syllable. One /r/ segment would be assigned to the coda of the second syllable. However, phonotactics prevent an /rd/ onset for the second syllable, so the second /r/ segment would be assigned as coda to the first syllable. This pattern is also necessitated since a series of liquid-obstruent (/rd/) in an initial demisyllable is a violation of sonority constraints.

Given a random string of segments, /r, r, k, ɔ , ə , d/, (the same as those in the form /k r d r/ but without knowing that it was an actual form uttered by a speaker), the prediction

would have been that the segment at the beginning of the utterance would be an obstruent (ex. /k/ or /d/), the internal (embedded-final) consonant would be of high sonority (ex. /r/) and an utterance-final consonant would exist to provide some degree of sonority decline. The choice of /k/ vs. /d/ as utterance onset would either be random, or perhaps biased by the position of /k/ as the initial segment of the target word /kaUtʃ/. Nevertheless, the resulting word form would most preferably be that which was actually produced, /kɔ́r dər/, because this order of randomly selected segments would create: steep sonority rise in the initial demisyllable /kɔ/, minimal sonority decline in the embedded-final demisyllable /ɔr/, steep sonority rise in the embedded-initial demisyllable /də/ and some sonority decline in the utterance-final demisyllable /ər/. Thus, sonority could be seen as imposing ordering constraints (in combination with phonotactic restraints) on an otherwise random process. Sonority is therefore viewed not as a <u>mechanism</u> of neologism formation, but rather as a <u>constraint</u>, or guiding principle, on a mechanism. Once segments were placed into the holding buffer, the scan-copier would place them into the phrasal frame in the correct sonority sequence dictated by the activation links between onset/peak and peak/coda. The buffer would "clear out" (reduce activation levels) after all segments had been appropriately scan-copied and checked-off.

A speaker's subsequent attempts at word production, stymied in the same way as described above, might again trigger operation of the random generator. However, after production of the form /k r d r/, those particular segments might have <u>maintained</u> previous levels of activation (compared to all other segments in the generator), as a result of difficulty "disengaging" the system; a not unlikely proposition in a language processing system that has sustained damage as a result of neurological insult. Thus, a second attempt at /kaUtʃ/ might be of the form /kɔrt/, the /k, ɔ , r/ segments re-selected because of high levels of resting activation. Such a process would explain perseveration phenomena from the generator.

The origin of /t/, however, is of interest. Perhaps a system that is weakened is not only unable to disengage appropriately, but is also unable to maintain steady activation levels for all phonological segments over time. Phoneme features must ultimately be neurally coded <u>somehow</u>, perhaps that coding fluctuates in an unsteady system such that there is faulty regulation and maintenance of neurological coding of phoneme information over time. Thus, perhaps the activation level for the /d/ in the original abstruse neologism "weakened" to the point that another segment was randomly activated in it's place. The final output of

the generator on the second attempt would therefore be /k rt/ and it would be dumped into the holding buffer to await scan-copier/checkoff-monitor manipulation.

On the other hand, the phonetic flap of the onset segment in the second syllable suggests that the underlying phoneme could have been a /d/, as in /kɔ́ r də r/, or a /t/ as in /kɔ́ r tə r/. If /t/ is the underlying form, then it is possible to explain the /t/ of /kɔ rt/ by the same re-activation process described above for perseveration phenomena.

Again, the underlying assumption in the formation of this second word is that sonority constraints guide the syllabification procedures for the utterance. Once the vowel was selected (the driving force of initially selected metrical peaks in phonetic/syllabic production is a crucial aspect in Levelt's (1989, Chapt. 9) model) and assigned to a peak node in the phrasal frame, segments of less sonority value could be attached to either side, with the high probability that an utterance-initial demisyllable would begin with either /k/ or /t/, and the final demisyllable would terminate with a sequence of /r/ plus whatever consonant had not been chosen for the onset. In the example given here, the initial demisyllable was of the form OV and the final demisyllable of the form VLO, with very desirable sonority patterns in each.

These processes could be employed in the same way to explain the phonological forms of the other two neologistic forms mentioned above (/kɔnt/, /kɔ́ r dərd/). In fact, they could be employed to explain perseverative neologistic strings in general. It should be noted that the only truly (random generator produced) abstruse neologism of the four in the string described above was the first one; the rest resulted from paraphasic distortion of the first. Therefore, it is possible that the random generator can account for one kind of "target-related neologism", that which is still abstruse with reference to the target word (ex. /kaUtʃ), but which is related perseveratively to a previous abstruse form.

There are certainly other, and perhaps better, ways to account for abstruse neologisms and subsequent perseverative strings. Perhaps the random generator produces only the majority of the first abstruse neologism, as described above for /kɔ́r dər/, with sonority guiding segment ordering and syllabification processes. After all, it is possible that an individual could have had partial access to Lexical Lookup #2 and could have correctly selected initial onset /k/, placing it into the buffer via normal processes. In that case, the random generator would need only to produce an acceptable syllable core for attachment to /k/, (though multiple syllables could follow).

After being sent to the holding buffer, the scan-copier device could function appropriately to place segments in intended syllabic slots for production. However, it is possible that it is the activation levels in the buffer, rather than in the random generator, that do not diminish. In the normal case, reduction in activation levels for segments once they have been placed in the phrasal frame is what the checkoff monitor accomplishes. However, when the system does not disengage and activation levels remain inappropriately high in the buffer, then that is "checkoff monitor" derailment.

Dell (1988) makes a distinction between devices that actively function to do things such as delete segments from a buffer, and devices that are the result of passive processes, such as the one described immediately above. Dell has invoked the notion of postselection feedback to account for various "checking off" processes in phonological production models. In postselection feedback, activation levels of phonemes are (actively) set back to zero (ie. resting level) to prevent unwanted reselection of segments. A passive version of this process would involve decay of activation levels to resting status. The passive process would not be as desirable as the active one, since it would, by definition require a certain amount of time for decay to be completed. Perhaps in a neurologically damaged system, the active mechanism is disrupted, and a decay process is invoked as a default device. However, in an unstable system, decay might take an inordinate amount of time and result in inappropriately high levels of reactivation of prior segments, even as processing continues. Alternately, perhaps the device that "sets" activation levels malfunctions so that segment activation levels are reassigned to some inappropriately high (rather than zero) level. Either scenario could account for perseveration effects.

Thus, on a second attempt at the utterance (Figure 18, Appendix A), the random generator might not operate because there is already information activated in the holding buffer, ready for a new copying and editing process. The scan-copier selects the most highly activated of the segments in the buffer, but may not select those whose activation levels have weakened (decayed) significantly (ex. the /dər/ in /kɔ́r dər/ above). Note that it is the tonic syllable which does not get set back to its resting level. One would presume, in general, that tonic syllables are more highly activated than other syllables. If so, there would have to be more postselection feedback to get those syllables back to their resting states. This might be why we observe more perseveration of tonically accented syllables (Buckingham & Kertesz, 1976, p. 42). In fact, units with high activation generally inhibit selection of all other units. The scan-copier selects /kɔr/ but then selects /t/ as well, a new

segment that possibly arose as a result of unstable activation levels in a damaged system (or, as above, might already be there if /t/ is the underlying segment for the flap). If segments can be changed as a result of an unsteady system, then it is logical that <u>additional</u> segments could suddenly become activated as well, accounting for the new /n/ phoneme in /kɔnt/ and for the new /d/ segment in /kɔ́r dərd/. Alternately, the new /d/ could be a doublet created from the original /d/. If so, that would imply that the phonetic [ɾ] came from underlying /d/, not /t/. Once enough time passed between attempts to produce words, the activation levels of the holding buffer might diminish enough so that the buffer would appear "empty" during subsequent phonological processing. At that point, the random generator might again be called into action and create a new abstruse neologism.

The processes described here with respect to the copying and check-off activities could also easily account for formation of "target-related neologisms" from words that were otherwise correctly accessed. Complete or partial information from Lexical Lookup #2 could be placed into the buffer, where it is scan-copied (because of high level of activation) but not checked-off because activation levels fail to decline. If activation levels were high enough, the scan-copier might perseveratively re-copy the segment until activation levels dropped beyond some critical point. This would account for perseverative paraphasia errors in target-related neologisms. If activation levels were unsteady, segments might disappear from the buffer or be added to the buffer at random (though they generally differ from intended targets by only a feature or two), explaining addition and deletion paraphasias. Segments might also switch syllabic positions (coda to onset, for example, in the same syllable) or segments might switch places across syllables (onset to onset, coda to coda) with scan-copier derailment. However, if sonority is redundantly coded in the scan-copier, and if it is tied to syllabification processes, then it would follow that appropriate sonority patterns would be maintained for sequential ordering errors.

Of importance, however, is the notion that sonority constrains these phoneme movement, addition and deletion processes. Although this project was not designed to examine the role of sonority in patterns of paraphasic errors, future studies will. Some investigators are already exploring this phenomenon, as described in Chapter One. However, the prediction at this point, is that studies will find that phoneme error patterns in paraphasic productions are of a nature that repeatedly (1) prevent formation of phoneme sequences in neologisms that would yield undesirable sonority profiles, and (2) create

words formed persistently from the least complex of sonority profile possibilities.

From the discussion so far, it appears that sonority constraints are redundantly coded in the random generator, scan-copier and checkoff-monitor devices. But exactly "where" are these devices in the language processing system of a speaker? Obviously they do not really exist in any tangible form; they are simply metaphors for opaque language processing activities. The questions are therefore raised: if these devices aren't concretized, then where is sonority information "located", and how is it that individuals with differing neurological lesion sites demonstrate remarkably similar sonority patterns? The answer must be that sonority is a well-distributed form of knowledge coded throughout the language system. It must also be "hard-wired" into the system, since it remains so resistent to disruption following neurological impairment.

The above discussion attempted to incorporate sonority constraints into a model of language processing that integrates serial and parallel models. Sonority was invoked to explain regularities in neologism formation for two significantly different theories of neology. There are those, however, who propose an alternate account for what has been described as "sonority", and who suggest that there might be other phenomoma that can account for some of the regularities in segmental sequences within and across syllables (normal and otherwise) attributed to sonority. In fact, there are some who say that, "...sonority has never satisfactorily defined..." and that, "...there are no prospects that anyone is even getting close to solving this problem - except, perhaps, by abandoning it and invoking an entirely new notion to explain segment sequences." (Ohala, 1990b, p. 160). This alternate perspective will be described in the final section of this chapter.

An Alternate Perspective on Sonority

One of the main criticisms of sonority theory has been that investigators have been unable to empirically define it (ie. to isolate phonetic correlates of it). Ohala (1984, 1990a) is one critic who notes that, in the absence of this information, sonority theory does no more than simply re-state patterns of syllabification that have been observed for years. In other words, he proposes that sonority offers no principled account for why phonemes pattern the way they do in syllables and suggests that, when invoked as explanation, sonority must be taken entirely "on faith". Ohala asserts that if sonority could explain segment sequence patterns from a phonetic perspective, it would have greater power, since an investigator could point to something concrete (ie. evidence from the speech signal) as

evidence that sonority were indeed the phenomenon that was constraining segment patterning. Without this evidence, however, he claims that the nature of sonority is rather vague.

Ohala proposes that segment sequences are motivated by patterns of signal modulations (changes in amplitude, periodicity, fundamental frequency, spectral composition) across sounds. He notes that languages will use most frequently those sequences of phonemes that yield maximal modulations (ex. obstruent/vowel) but will use less frequently those sequences resulting in minimal modulations (ex. glide/vowel).

As a case in point, the reader should reflect on the size of the class, Obstruent. This term refers to segments that are stops, fricatives or affricates and thus includes roughly 419 different segment types, compared to the 47 Nasals, and 53 approximants found within various languages (Lindblom & Maddison, 1988). Certainly the frequency of obstruent onsets and codas in initial and final demisyllables was significant in this study, just as predicted by the sonority theory. However, were obstruents more frequently selected as onsets and codas simply because they are more numerous as a class (as opposed to selection because of sonority principles)? Or are they more numerous as a class because, over the ages, human speakers have found that they provide a desirable constrast in signal modulation to vowels and have thus developed them as a class of sound? Ohala's conclusions above render the latter scenario quite likely.

Most discussions of sonority examine the patterning of segments in reference to their phoneme class, rather than examining the patterning of specific phonemes within classes. Ohala, however, looks at this level of phonological activity and finds patterns of phonological activity that sonority cannot explain. As an example, for the sequence Glide/Vowel, he notes that combinations of /ji/ are much less frequent than /ju/. Likewise, combinations of /wi/ are much more common than /wu/. Nothing in the discussion of sonority thus far would account for these patterns, since sonority principles fully permit Glide/Vowel sequences and since sonority does not speak to within-class patterns. The only sonority account that has come close to specification of segments below the level of phoneme class, was that which distinguished between the sonority values of voiced vs. voiceless segments and incorporated those differences into a sonority scale (e.g. Jesperson, 1904, cited in Clements 1988, 1990).

Ohala, however, speculates that /wi/ and /ju/ are more common sequences than /wu/ and /ji/ because the shift from first to second phoneme creates more change in signal

periodicity, amplitude, and spectrum (as can be seen in second and third formant changes) for /wi/ and /ju/ than is present for shifts in /wu/ and /ji/. Ohala does not say that minimally modulated sequences do not occur, but rather suggests that languages exploit more extensively sequences where modulations are maximal. He notes that this method of accounting for variations in segment patterning is more empirical and sound than an explanation relying on the nebulous sonority factor.

Ohala makes the further point that modulation-based activities are "blind" to syllable context; he asserts that this account is therefore more useful for describing acceptable sound sequences in a language than it is for motivating syllabification phenomena. He notes that other processes (ex. those in prosodic phonology) could subsequently manage syllabification activities after segment sequences have been determined. With regard to syllabification, he does make the claim for the perceptual strength of CV syllables (as opposed to VC syllables), stating that maximal modulations occur at CV boundaries as opposed to VC boundaries. Languages should therefore preserve more modulatory contrasts in pre-vocalic contexts than in post-vocalic contexts. This principle would account for the overwhelming occurrence of steeply rising sonority slopes in initial demisyllables (both utterance-initial and embedded-initial) and flatter sonority slopes in final demisyllables (especially embedded-final demisyllables) in the present study.

The following questions arise from this discussion: Does sonority have "psychological reality"? Must it be localizable in the acoustic speech signal in order to matter? Are signal modulation variables actually explaining patterns of rise and fall in acoustic enery that have been heretofore been attributed to "sonority"? Could sonority principles constrain the high level sequencing rules of phoneme classes and the syllabification patterns of a language, while individual phoneme combination preferences are conditioned by modulatory concerns? Could the two theories provide explanatory power at different levels of language production? It is conceivable that the relationship between abstract sonority principles and concrete phonetic features is not so disparate; perhaps it is a case of the one giving rise to the other.

Perhaps sonority is a product of centuries of peripheral vocal tract activity and physiology. Information about peripheral tract differences among sounds (ex. relative amplitudes and spectra, relative degrees of vocal tract opening) could have been coded into higher cortical representational knowledge over the course of evolution, and could now be well-distributed throughout the entire language system. Perhaps sonority principles

represent the high level mental constructs formed after eons of experimentation with sound production; such that the segment sequence and syllabification patterns we now call sonority constraints were formed because they were those that repeatedly produced the most significant modulations in the speech signal and thus provided the most salient perceptual contrasts for human auditory systems. This approach renders the continued search for the phonetic reality of sonority somewhat unnecessary; we may have already found it.

Conclusion

This study has provided a descriptive account of sonority patterns in the neologistic utterances of three jargonaphasic individuals. Until now, no study has provided an in-depth, statistically supported examination of the segment sequence and syllable production patterns of neologisms, either as as group or by type (target-related, abstruse). However, with the results of this investigation, such a data base exists as a springboard from which future studies of jargon can emerge.

Results of this study have shown that, while neologism types differed in some ways from each other and from English words, they were still overwhelmingly well-formed with respect to the syllable preference patterns of English, and with respect to sonority profiles predicted by the theory. Clearly, neologisms are significantly different from the "real" words of a language; an observation that approaches understatement when abstruse neologisms are encountered. Nevertheless, in accounting for the uniqueness of neologisms (as a group) vs. the legitimate words of a language, one cannot look too much to syllable shapes or segment class patterns for answers. Rather, one might now begin to investigate patterns of individual phoneme selection and combination errors instead.

A starting point for future studies would be to continue examination of phoneme addition, deletion and movement patterns in target-related neologisms to determine how errors alter or maintain the sonority patterns of neologisms, as compared to the patterns observed in intended targets. Study of target-related neologisms (vs. abstruse) would facilitate recording procedures for noting (1) direction of change in sonority profiles from intended targets to neologisms, and (2) nature of change in syllable shapes from intended targets to neologisms, because intended targets would be readily recoverable. Many of the procedures (and much of the data) described and examined in the present investigation could be used in such a study.

From a series of studies such as this, trends might become evident that would account for the majority of the apparent variability of neologisms. Perhaps these trends would provide greater insight into the mechanisms creating neologisms, and eventually suggest clinically useful techniques for inhibiting their production. One suggestion might be to test whether synthesized sonority "cues", presented under controlled conditions to jargonaphasic subjects, would facilitate lexical access (under conditions of partial anomia) any better than a place cue (for example) by strengthening activation links between phoneme members of the same sonority class. A sonority cue would contain enough information in the signal to trigger the percept of a class of sound, but not so much as to specify a particular phoneme in that class. If one accepts an activation metric for lexical access, then a sonority cue (ex. nasal) might facilitate lexical search (ex. of a target beginning with a nasal) by increasing the activation of members in that sonority class (ie. all words with a nasal onset), while simultaneously inhibiting members of inappropriate classes (ie. all words beginning with any other consonant than nasal). Certainly giving an individual a specific phoneme model would best facilitate lexical search, however, results would at least indicate the strength of sonority cues in the search process.

It is clear that sonority deserves more study, whether it involves a continued search for sonority in the phonetic signal, an exploration of micro-level (specific phoneme sequence) phenomena, or an investigation of clinical applications for the concept. Regardless of the findings of future research, this study concludes that sonority must play a role in the core phonological operations of syllabification and segment (class) sequencing in the formation of neologisms in jargonaphasia.

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APPENDIX A

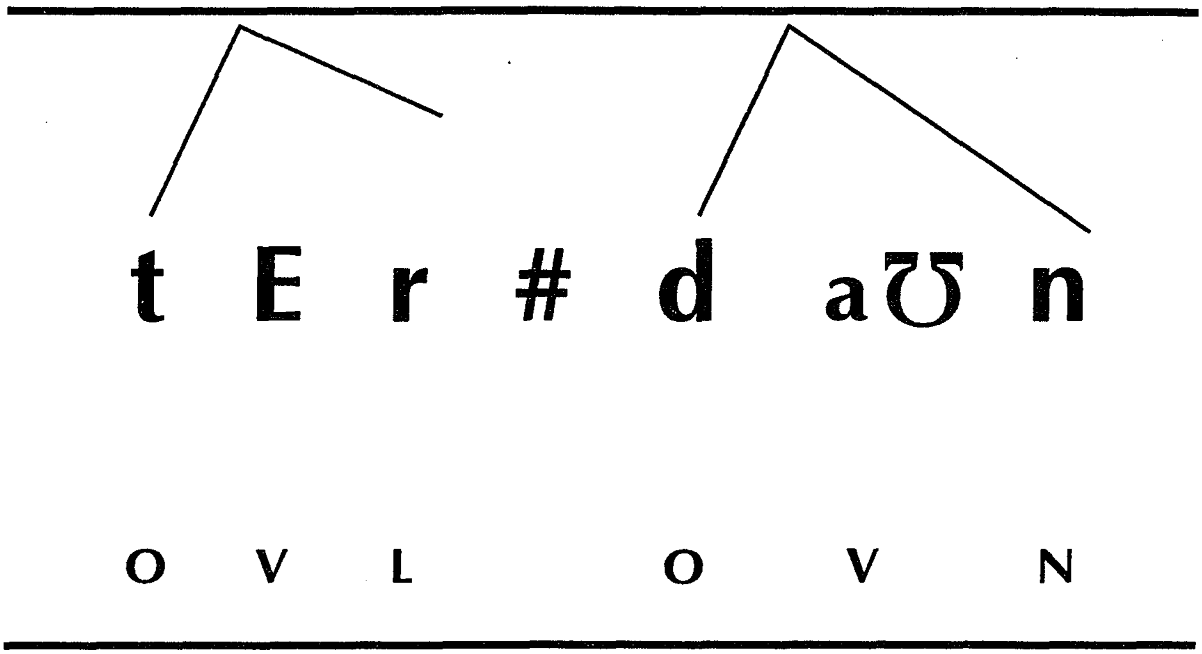


Figure 1. Sonority Slopes for the phrase "tear down". In the CVC#CVC syllable series /t E r # d aU n/, the utterance-initial demisyllable /t E/has a steeply rising sonority slope while the embedded-final demisyllable /E r/ has a more gradual sonority decline. The embedded-initial demisyllable /d aU/ has a steeply rising slope and the utterance-final demisyllable /aU n/ has a somewhat steeply falling slope. These alternating patterns of sonority rise and fall across adjacent demisyllables are predictable for well-formed words in normal speakers.

Table 1. Frequency of occurrence scores for syllable shapes (Subject H.V., pilot study)

RANK	SHAPE	NUMBER OF OCCURRENCES	FREQUENCY OF OCCURRENCE
1	CV	158	34%
2	CVC	131	28%
3	V	72	16%
4	VC	54	12%
5	CVCC	14	3%
6	CCV	12	3%
7	VCC	8	2%
8	CCVC	6	1%
9	C̩C	3	<1%
10	C̩	1	<1%
11	CCVCC	1	<1%

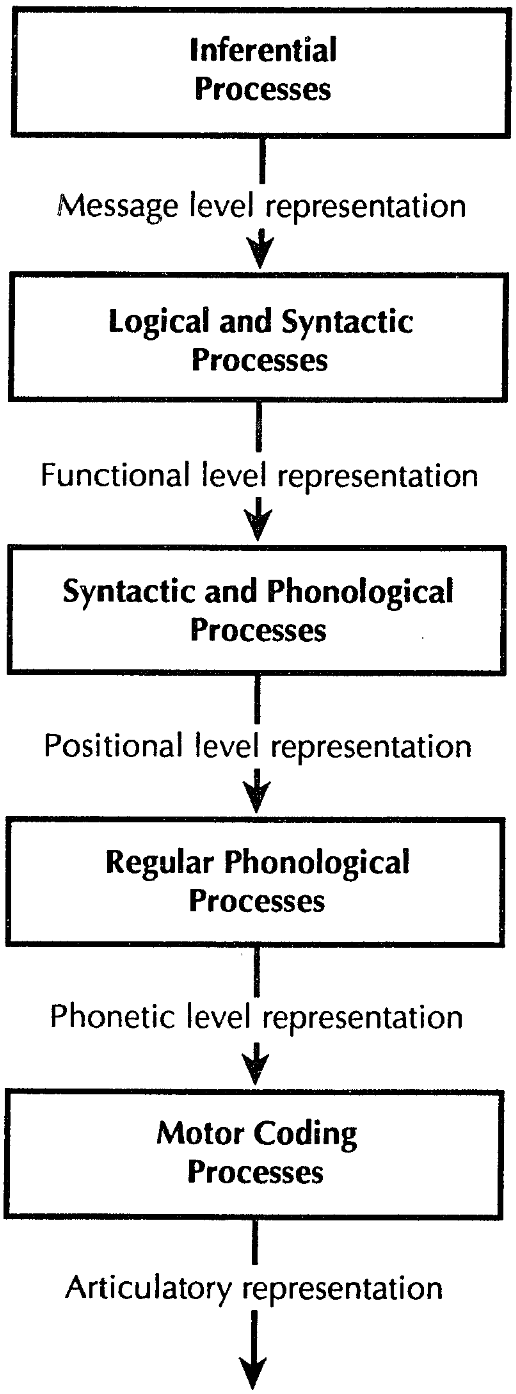


Figure 2. The Garrett model of sentence production, illustrating the computational processes mapping levels of language representation to each other during sentence production. (From Schwartz, 1987, redrawn from Garrett, 1984.)

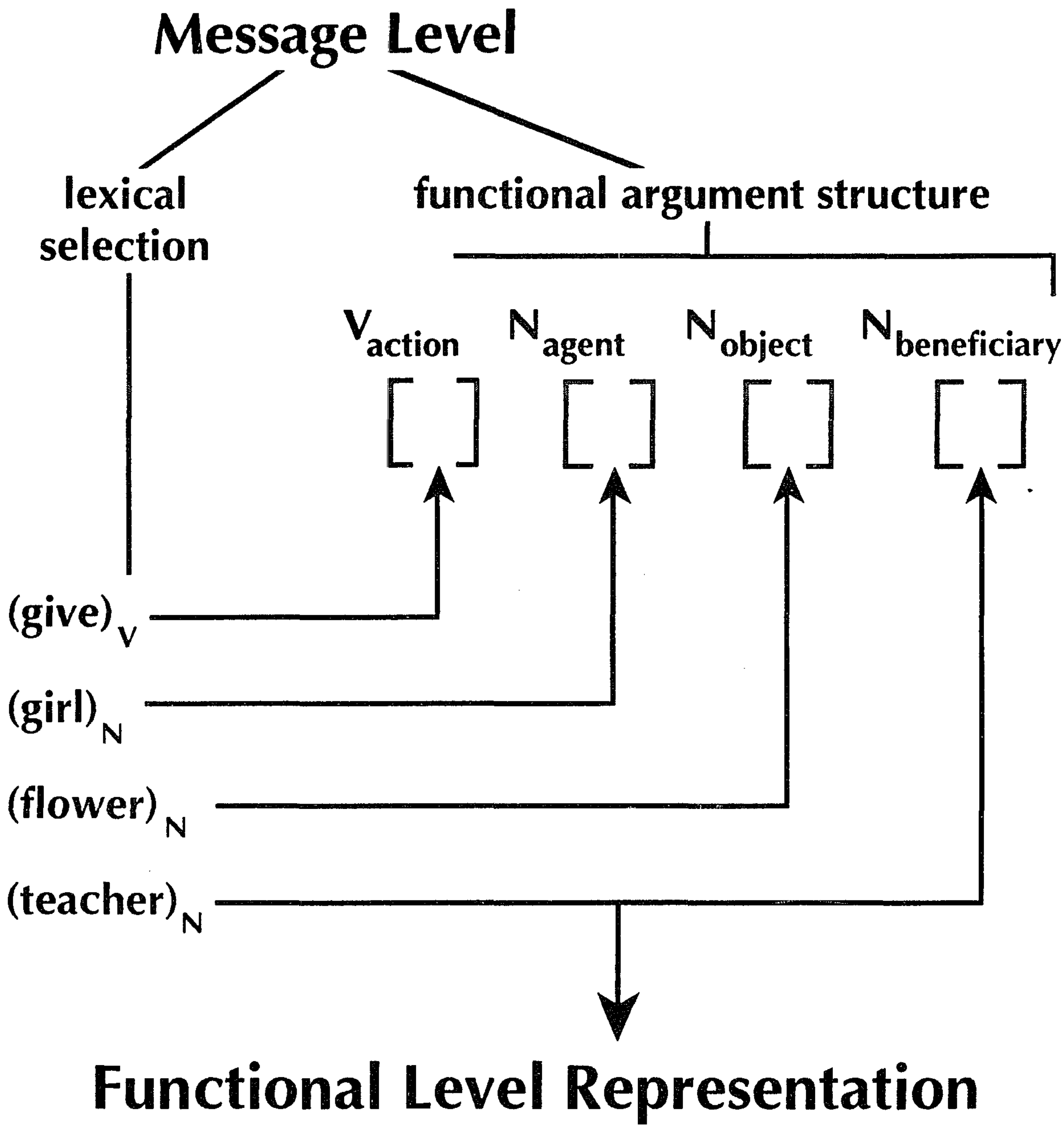


Figure 3. Computations mapping the Message Level of representation to the Functional Level of representation during sentence production. (From Schwartz, 1987, redrawn with modification from Garrett, 1984.)

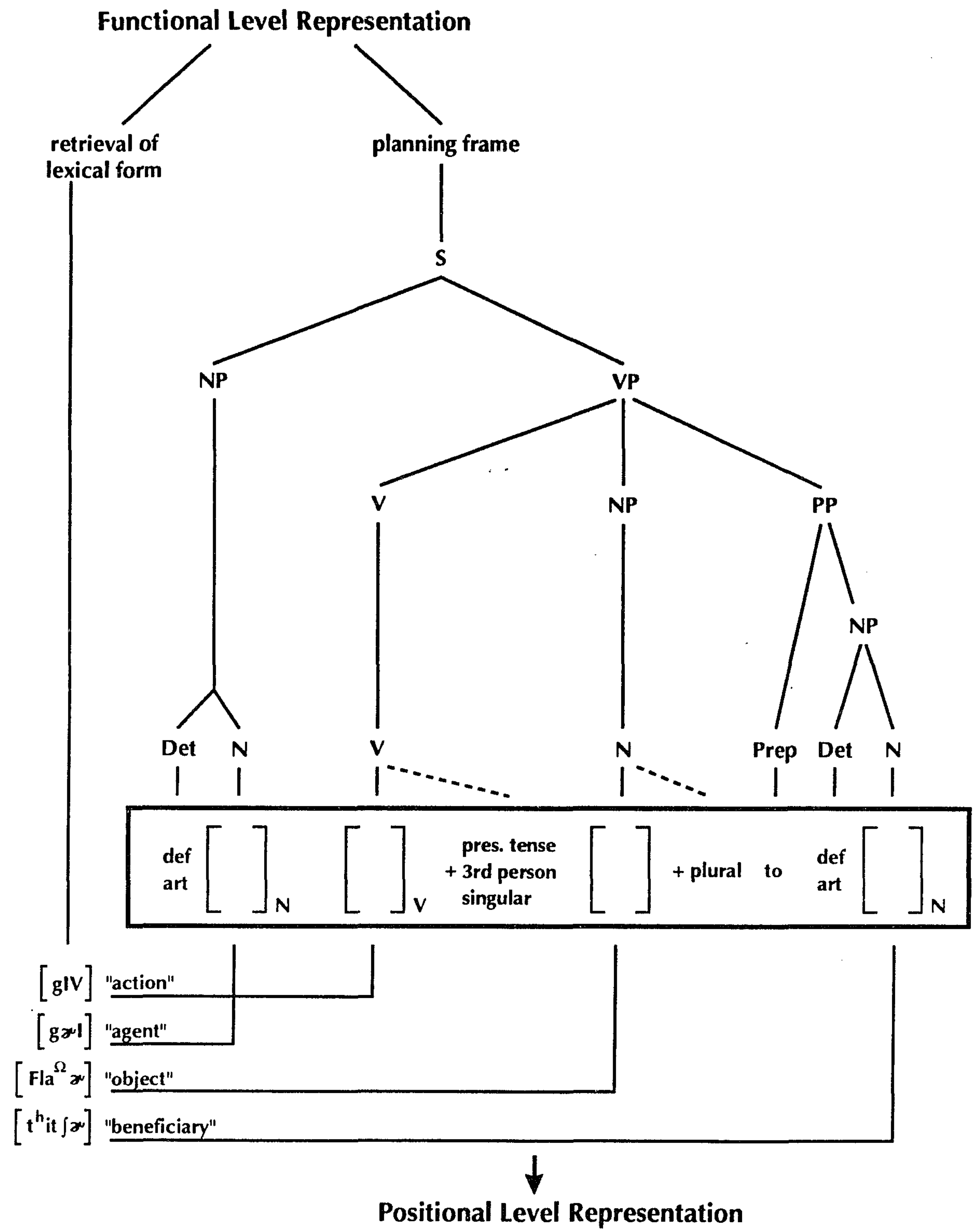


Figure 4. Computations mapping the Functional Level of representation to the Positional Level of representation. (From Schwartz, 1987, redrawn with modification from Garrett, 1984.)

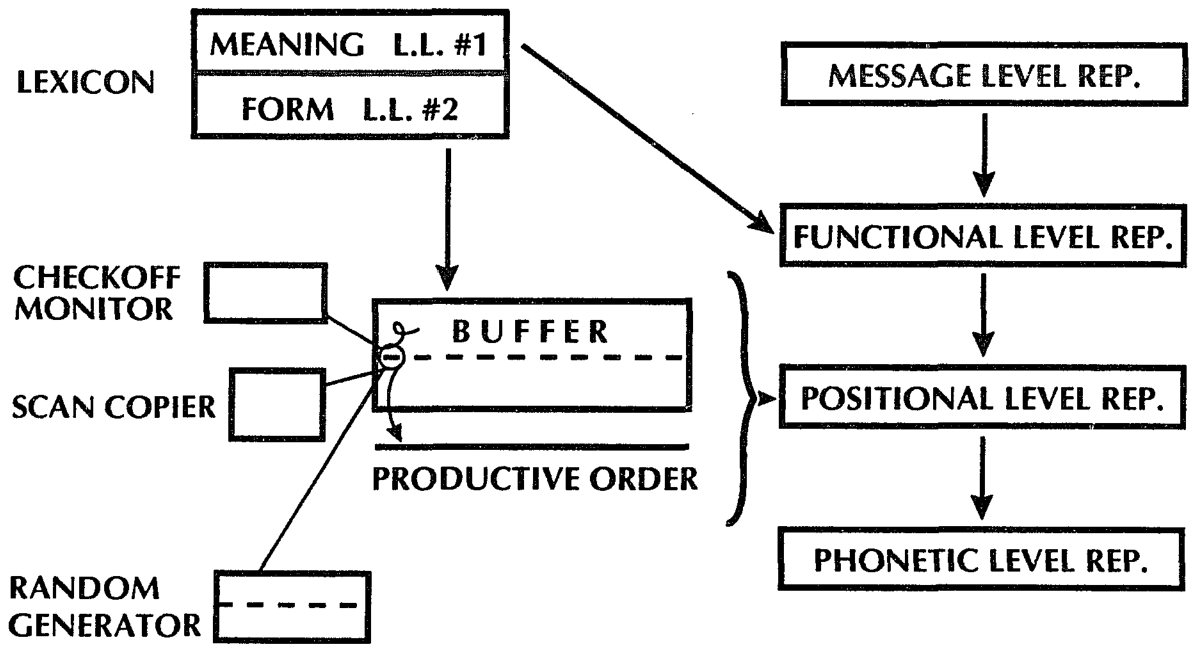


Figure 5. Augmented schematic of computations mapping the Functional Level of representation to the Positional Level of representation in Garrett's model. Modifications illustrate Lexical Lookup #1 and #2, Checkoff Monitor, Scan Copier, Buffer and Phrasal Frame (productive order). (Redrawn from Buckingham, 1986.) The random generator is a default syllable producing mechanism that provides alternate buffer input whenever normal input processes are impaired.

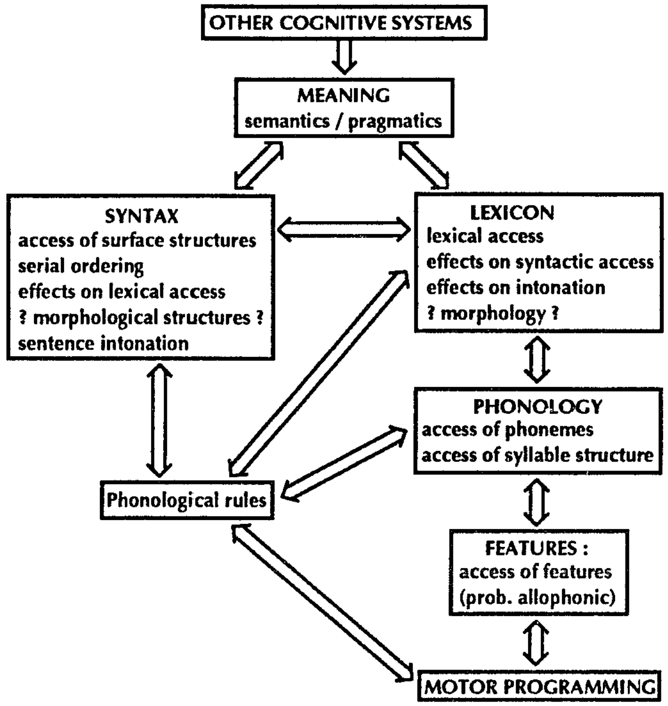


Figure 6a. General structure of the interactive activation model of language production. (From Stemberger, 1985.)

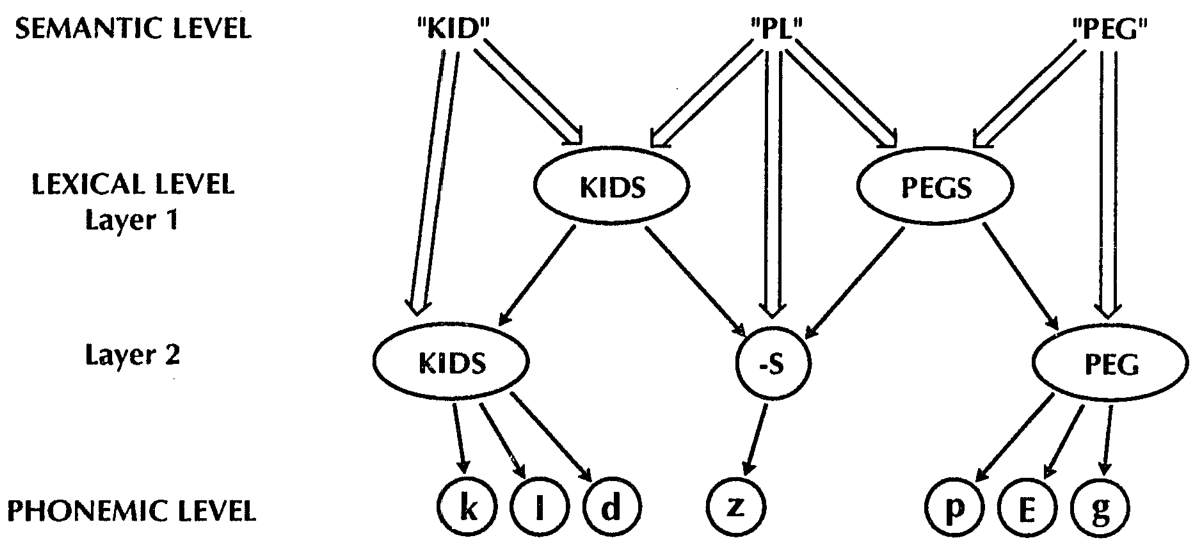


Figure 6b. Schematic of lexical and phonological selection processes in the interactive activation model. (Redrawn from Stemberger, 1985.)

Table 2. Demisyllable Shapes. Frequency distribution for target-related neologisms, per and across subjects, by general context.

Context	SUBJECTS							
	M.S.		H.V.		E.P.		Summary	
Initial Demi.	CV	72% ✧	CV	87% ✧	CV	87% ✧	CV	83% ✧
	CCV	24%	CCV	4%	CCV	9%	CCV	11%
	V	4%	V	9%	V	4%	V	6%
	CCCV	0%	CCCV	0%	CCCV	0%	CCCV	0%
		100%		100%		100%		100%
	(n=137)		(n=205)		(n=154)		(n=496)	
Final Demi.	VC	48% ✧	VC	35%	VC	55% ✧	VC	45% ✧
	VCC	20%	VCC	5%	VCC	5%	VCC	9%
	V	30%	V	60% ✧	V	40%	V	45% ✧
	VCCC	2%	VCCC	0%	VCCC	0%	VCCC	1%
		100%		100%		100%		100%
	(n=137)		(n=205)		(n=154)		(n=496)	

✧ Denotes most frequently occurring category.

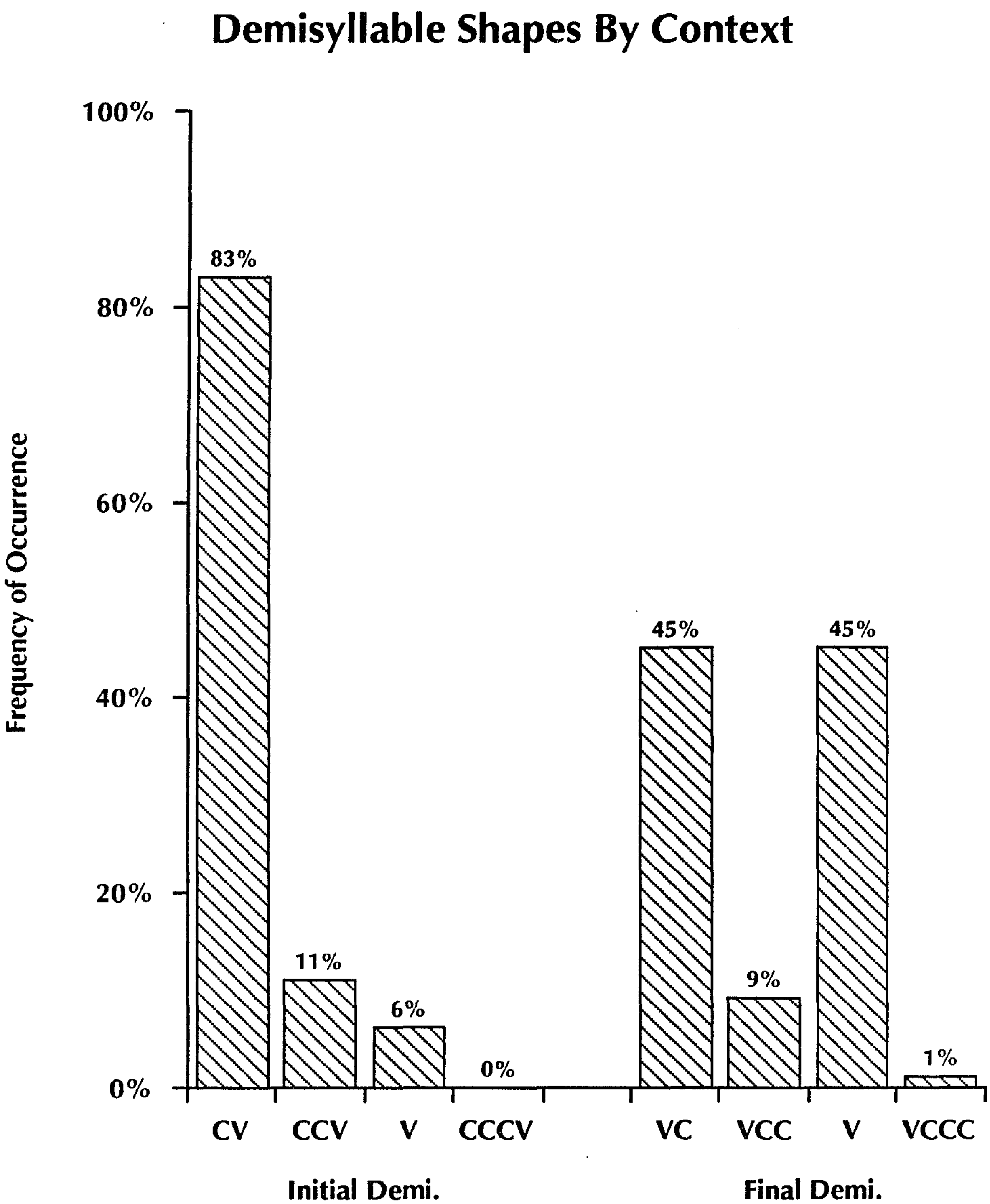


Figure 7a. Graphic illustration of the summarized frequency distributions for target-related neologisms, across subjects, by general context.

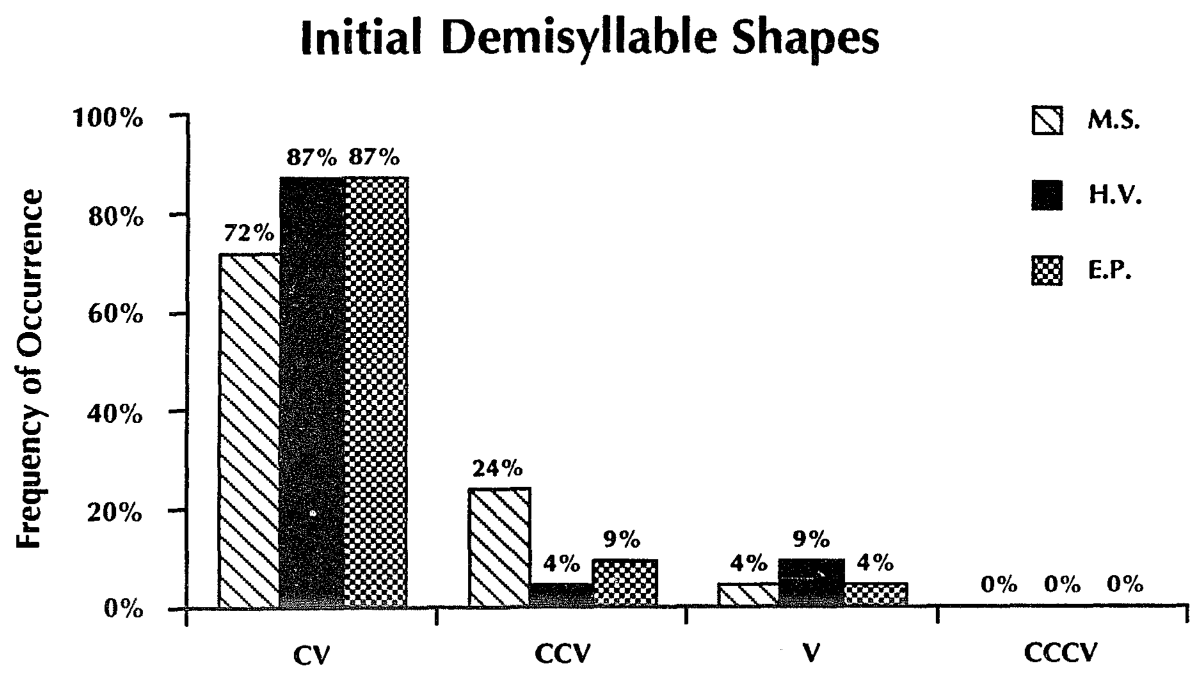


Figure 7b. Graphic illustration of the frequency distributions for general initial demisyllables, by subject, in target-related neologisms.

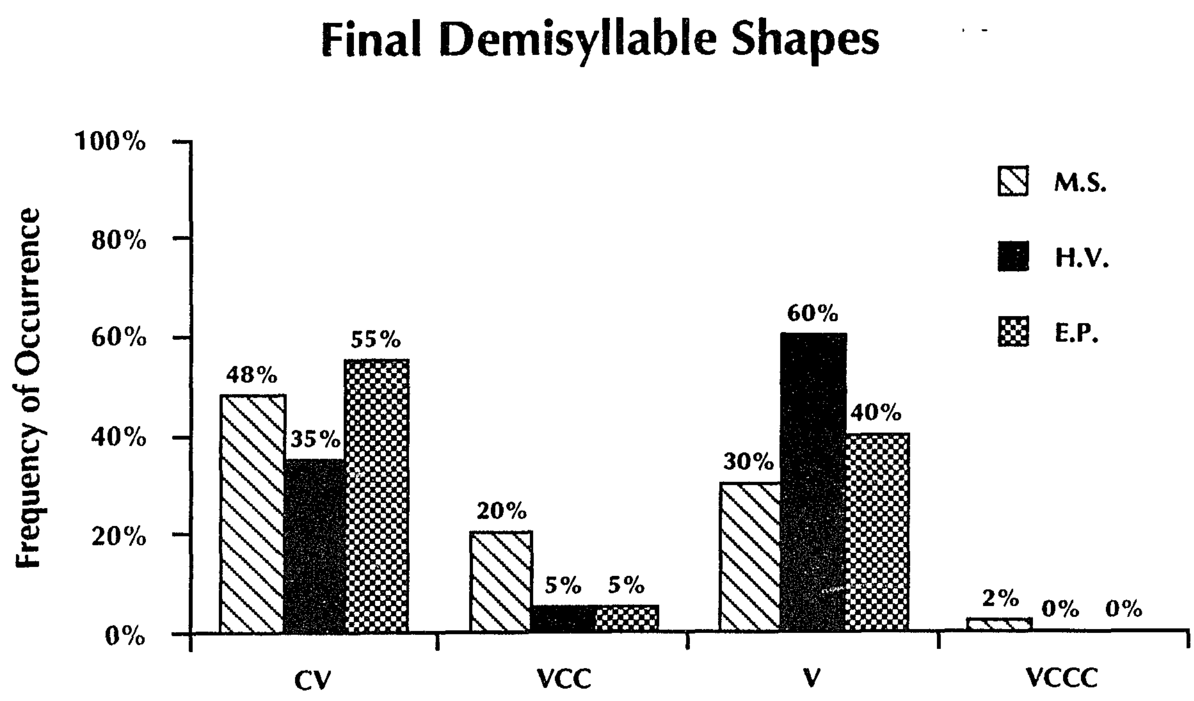


Figure 7c. Graphic illustration of the frequency distributions for general final demisyllables, by subject, in target-related neologisms.

Table 3. Demisyllable shapes for each word type, across subjects, by context.

Target-Related Neologisms

Utterance-Initial		Embedded-Initial		Utterance-Final		Embedded-Final	
CV	70% ✧	CV	85% ✧	VC	61% ✧	VC	40%
CCV	21%	CCV	10%	VCC	18.5%	VCC	6%
V	9%	V	5%	V	18.5%	V	54% ✧
CCCV	0%	CCCV	0%	VCCC	2%	VCCC	0%
	100%		100%		100%		100%
(n=86)		(n=410)		(n=118)		(n=378)	

Abstruse Neologisms

Utterance-Initial		Embedded-Initial		Utterance-Final		Embedded-Final	
CV	73% ✧	CV	83% ✧	VC	54% ✧	VC	30%
CCV	17%	CCV	7%	VCC	8%	VCC	3%
V	10%	V	10%	V	38%	V	67% ✧
CCCV	0%	CCCV	0%	VCCC	0%	VCCC	0%
	100%		100%		100%		100%
(n=108)		(n=410)		(n=125)		(n=293)	

English Words

Utterance-Initial		Embedded-Initial		Utterance-Final		Embedded-Final	
CV	55% ✧	CV	71% ✧	VC	55% ✧	VC	44% ✧
CCV	2%	CCV	4%	VCC	6%	VCC	12%
V	43%	V	25%	V	38%	V	44% ✧
CCCV	0%	CCCV	0%	VCCC	1%	VCCC	0%
	100%		100%		100%		100%
(n=268)		(n=712)		(n=227)		(n=753)	

✧ Denotes most frequently occurring category.

Figure 8a. Target-related neologisms

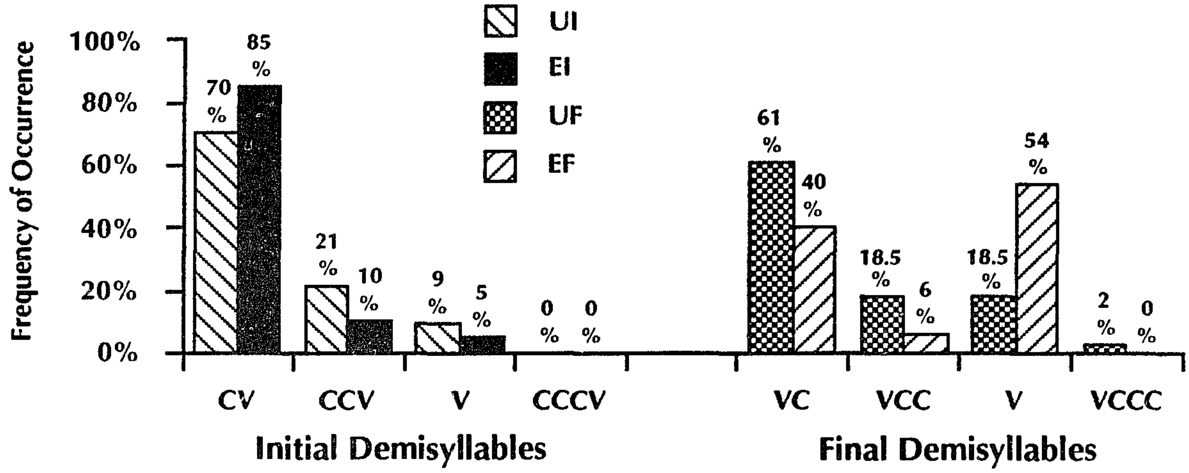


Figure 8a. Abstruse neologisms

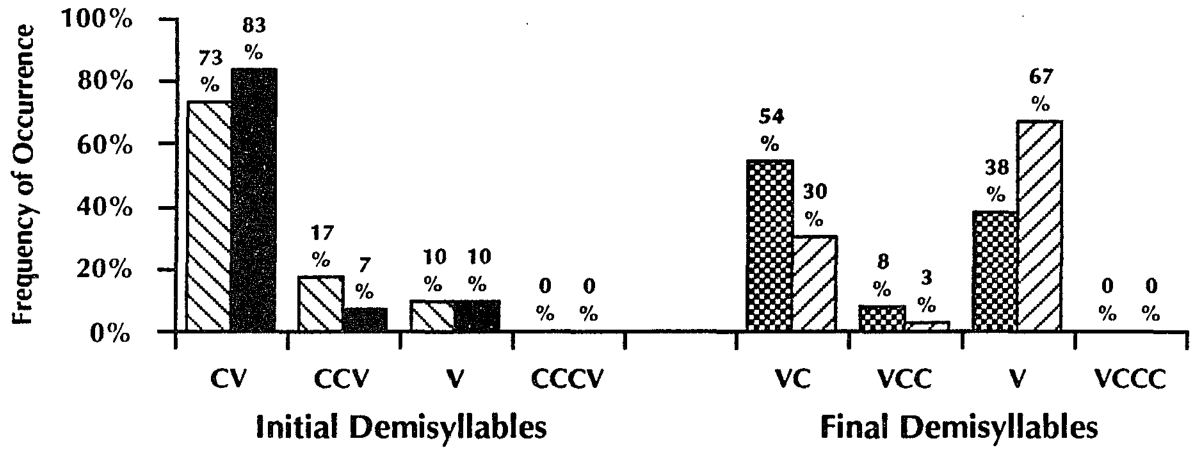
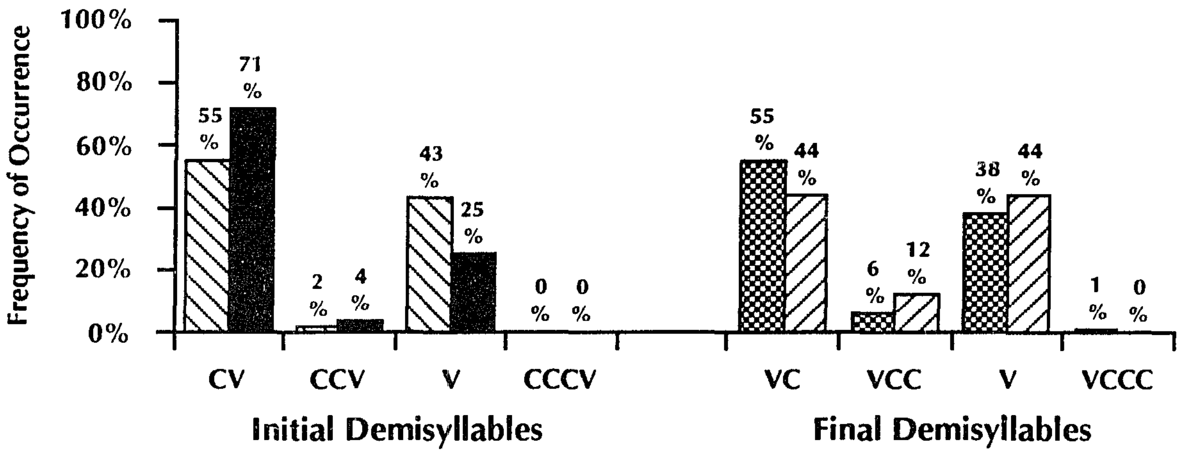


Figure 8a. English words



Figures 8a, 8b, 8c. Graphic illustrations of demisyllable shapes for each word type, across subjects, by context.

Table 4. Demisyllable Shapes. Frequency Distribution for abstruse neologisms, per and across subjects, by general context.

Context	SUBJECTS							
	M.S.		H.V.		E.P.		Summary	
Initial Demi.	CV	83%✧	CV	79%✧	CV	86%✧	CV	81%✧
	CCV	14%	CCV	6%	CCV	9%	CCV	9%
	V	3%	V	15%	V	5%	V	10%
	CCCV	0%	CCCV	0%	CCCV	0%	CCCV	0%
		100%		100%		100%		100%
	(n=151)		(n=280)		(n=87)		(n=518)	
Final Demi.	VC	43%	VC	31%	VC	39%	VC	36%
	VCC	9%	VCC	2%	VCC	2%	VCC	4%
	V	48%✧	V	67%✧	V	59%✧	V	60%✧
	VCCC	0%	VCCC	0%	VCCC	0%	VCCC	0%
		100%		100%		100%		100%
	(n=151)		(n=280)		(n=87)		(n=518)	

100% ✧ Denotes most frequently occurring category.

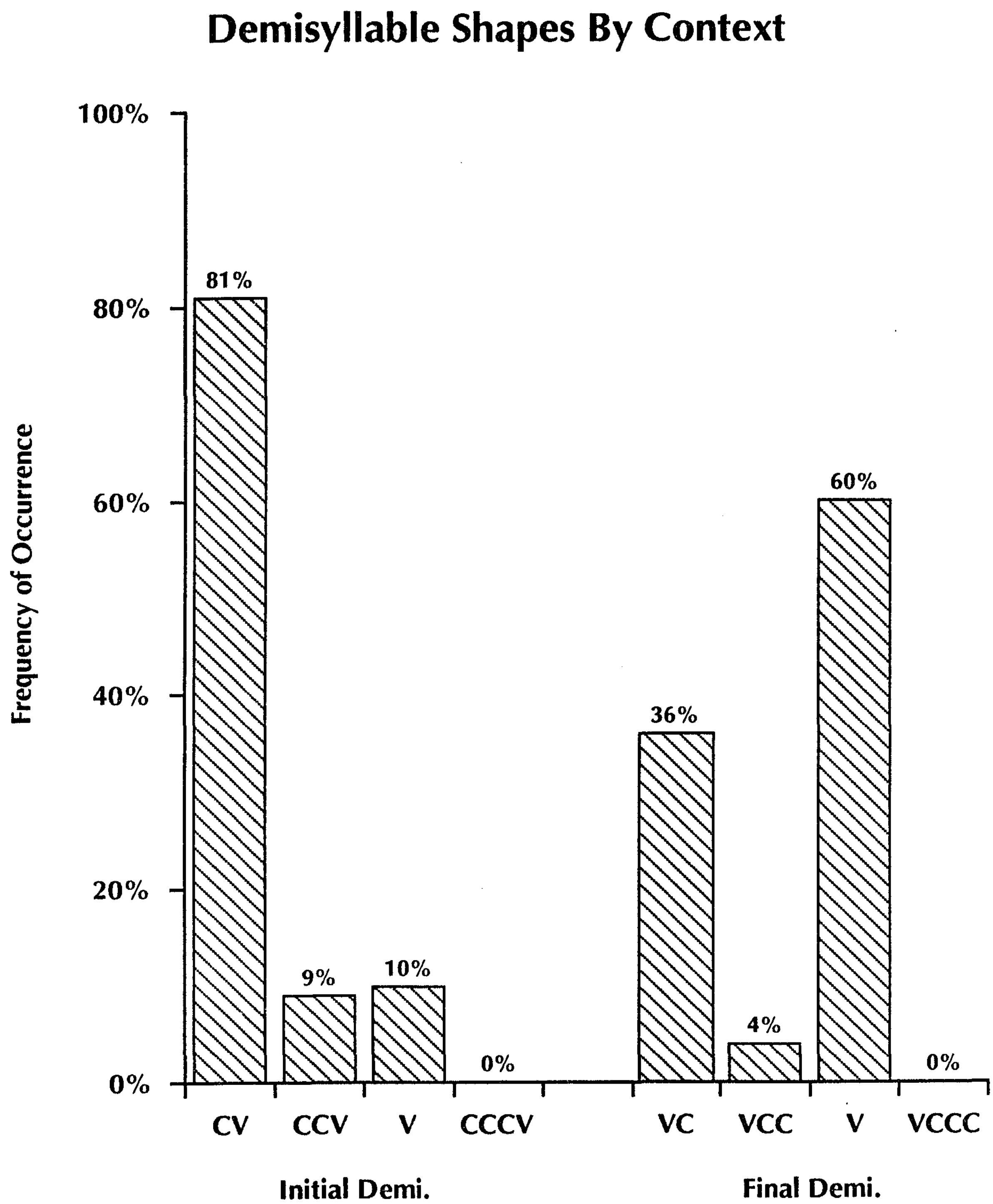


Figure 9a. Graphic illustration of the summarized frequency distributions for abstruse neologisms, across subjects, by general context.

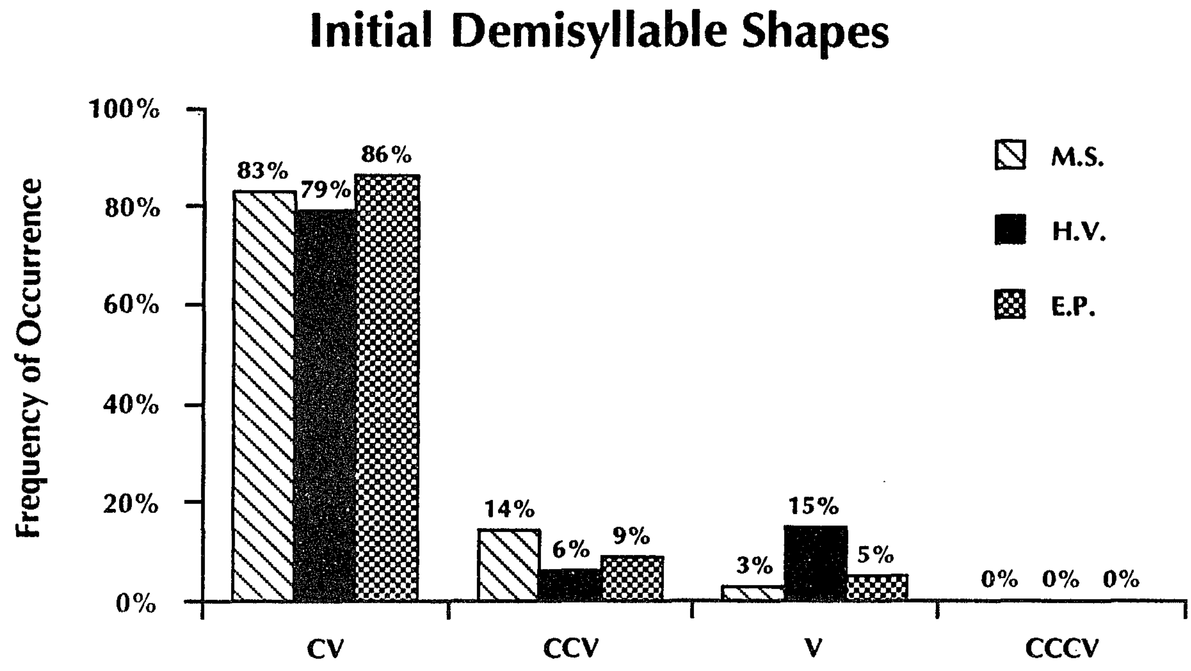


Figure 9b. Graphic illustration of the frequency distributions for general initial demisyllables, by subject, in abstruse neologisms.

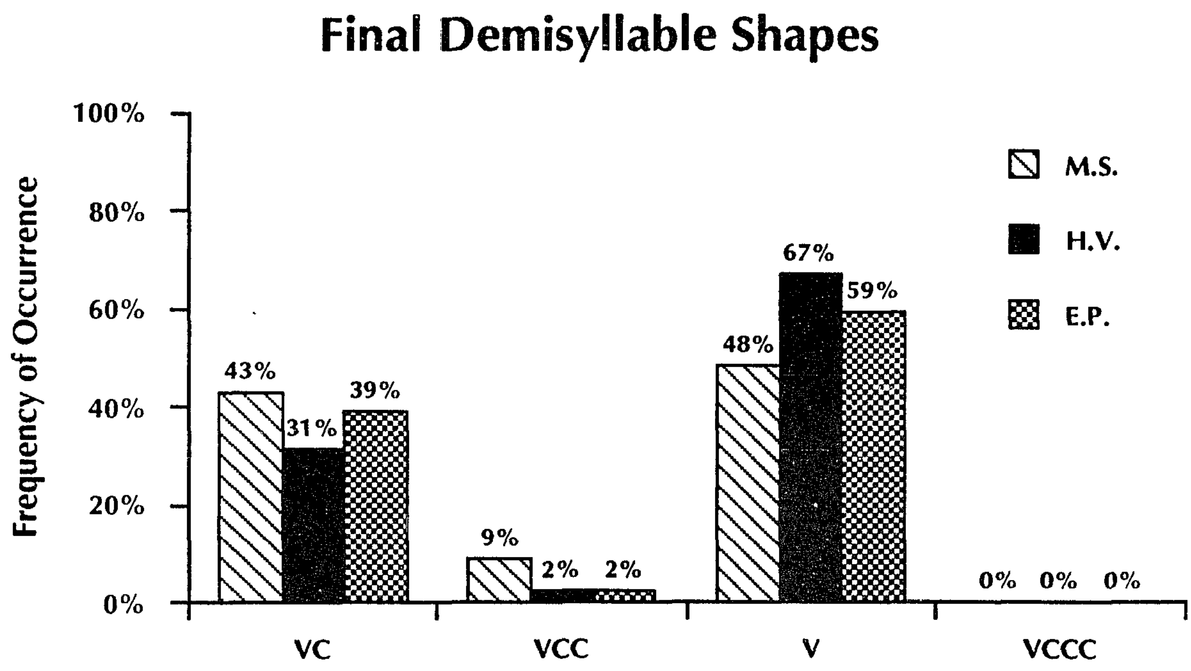


Figure 9c. Graphic illustration of the frequency distributions for general final demisyllables, by subject, in abstruse neologisms.

Table 5. Demisyllable Shapes. Frequency distributions of English words, per and across subjects, by general context.

Context	SUBJECTS			
	M.S.	H.V.	E.P.	Summary
Initial Demi.	CV 61%✧	CV 69%✧	CV 68%✧	CV 67%✧
	CCV 3%	CCV 3%	CCV 2%	CCV 3%
	V 36%	V 28%	V 30%	V 30%
	CCCV 0%	CCCV 0%	CCCV 0%	CCCV 0%
	100%	100%	100%	100%
	(n=282)	(n=467)	(n=231)	(n=980)
Final Demi.	VC 50%✧	VC 45%✧	VC 47%✧	VC 46%✧
	VCC 14%	VCC 10%	VCC 6%	VCC 10%
	V 35%	V 45%✧	V 47%✧	V 43%
	VCCC 1%	VCCC 0%	VCCC 0%	VCCC 1%
	100%	100%	100%	100%
	(n=282)	(n=467)	(n=231)	(n=980)

✧ Denotes most frequently occurring category.

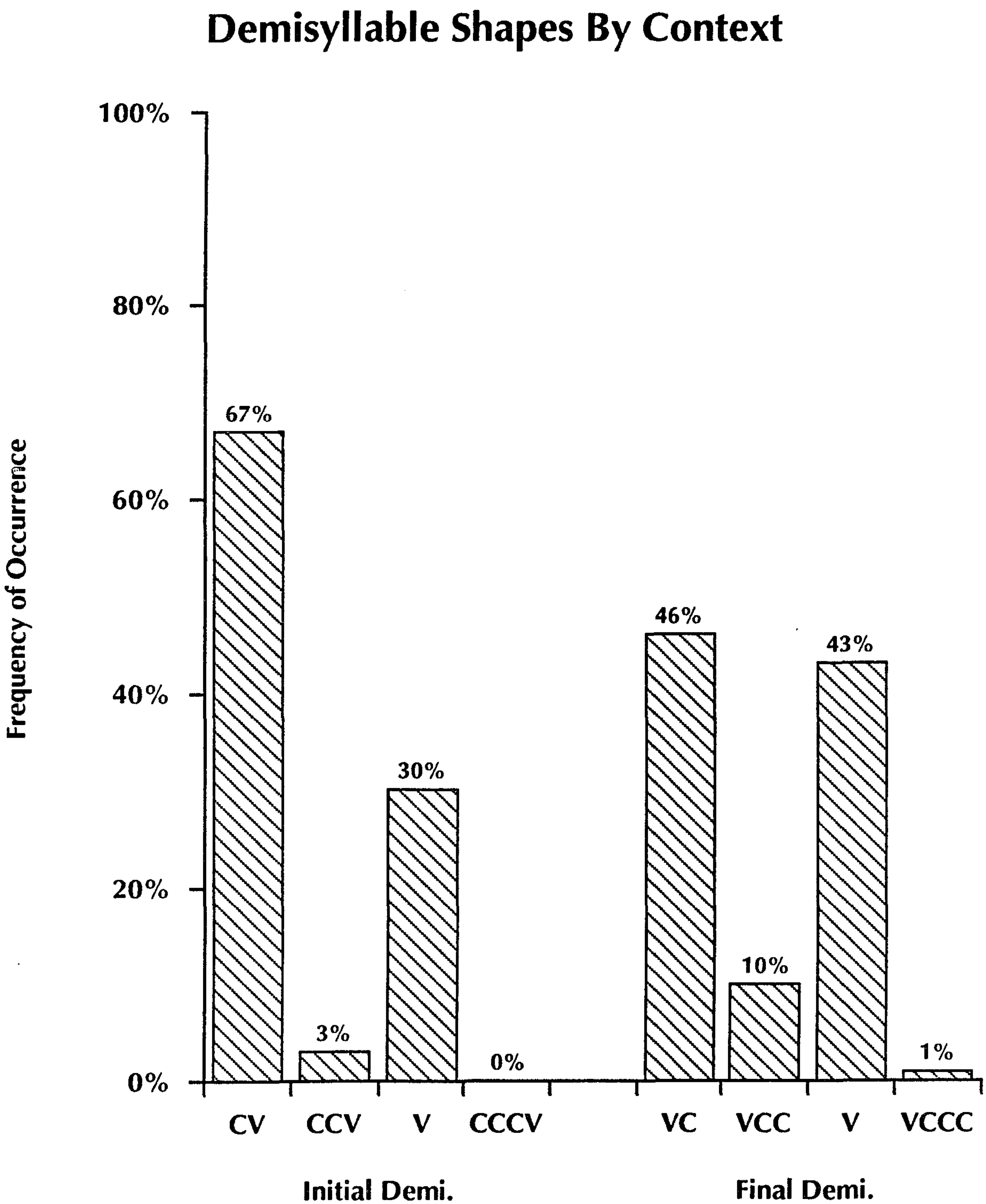


Figure 10a. Graphic illustration of the summarized frequency distributions for abstruse neologisms, across subjects, by general context.

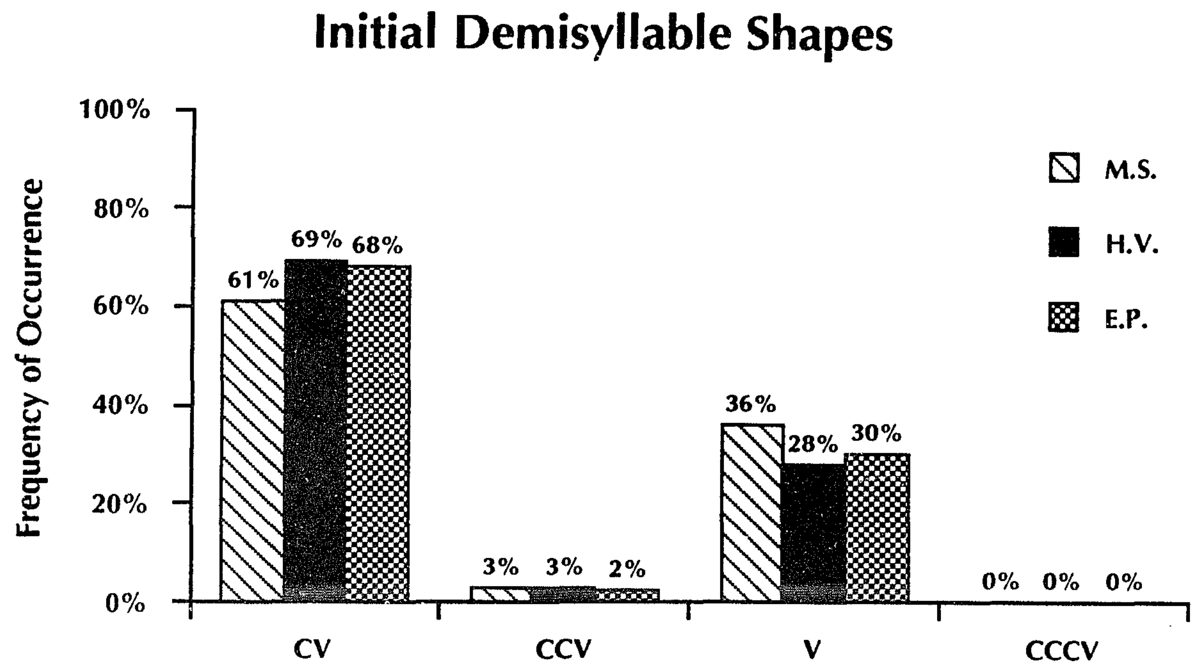


Figure 10b. Graphic illustration of the frequency distributions for general initial demisyllables, by subject, in English words.

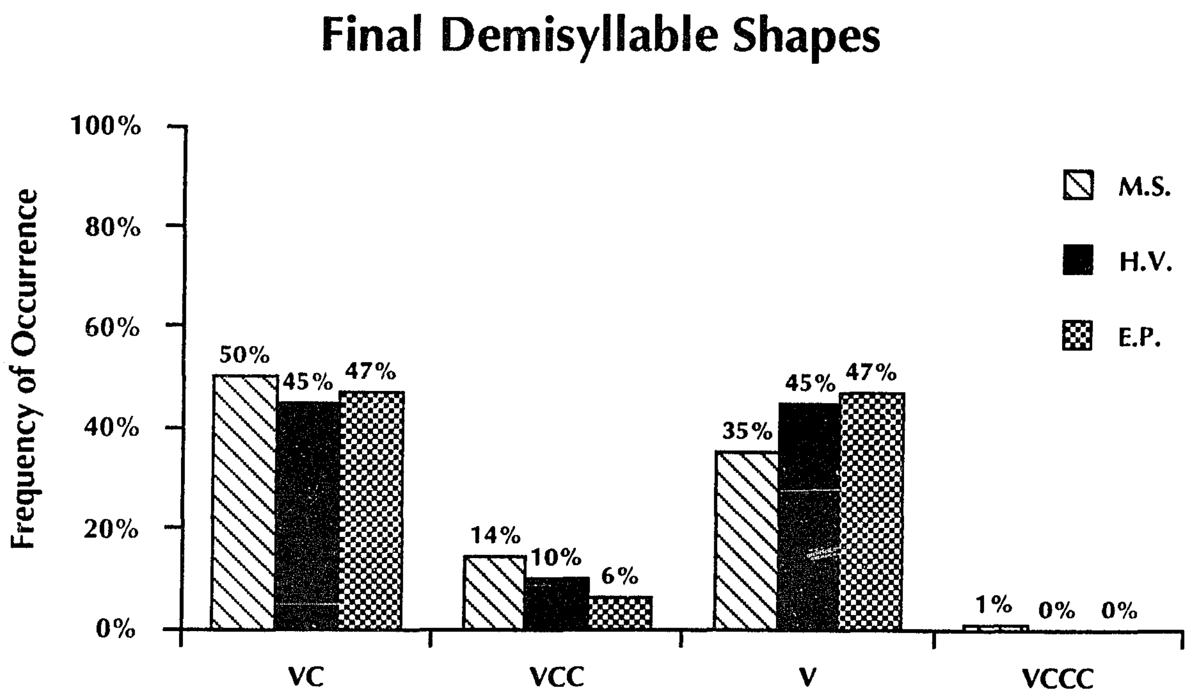


Figure 10c. Graphic illustration of the frequency distributions for general final demisyllables, by subject, in English words.

Table 6. Demisyllable Shapes. Frequency distributions for all neologisms (target-related and abstruse) vs. English words, across subjects, by general context.

Context	WORD TYPE			
	Neologisms		English Words	
Initial Demisyllables	CV	82% ✧	CV	67% ✧
	CCV	10%	CCV	3%
	V	8%	V	30%
	CCCV	0%	CCCV	0%
		100%		100%
	(n=1014)		(n=980)	
Final Demisyllables	VC	40%	VC	46% ✧
	VCC	7%	VCC	10%
	V	53% ✧	V	43%
	VCCC	0%	VCCC	1%
		100%		100%
	(n=1014)		(n=980)	

✧ Denotes most frequently occurring category.

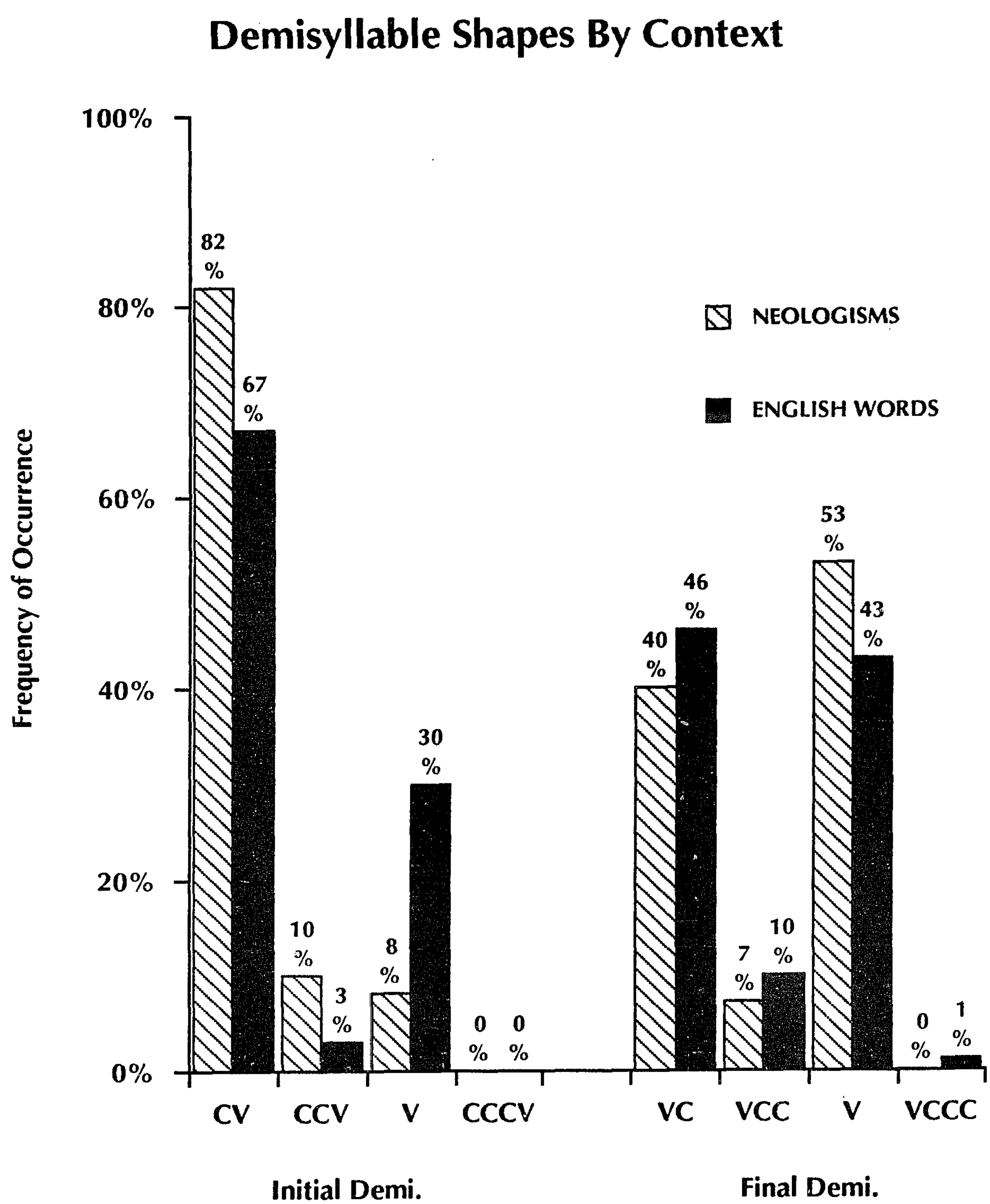


Figure 11. Frequency distribution of demisyllable shapes for all neologisms (target-related and abstruse), and all English words, across subjects, by general context.

Table 7. Demisyllable Shapes. Frequency distributions for all neologisms vs. English words, across subjects, by specific context.

Context	Utterance–Initial	Embedded–Initial	Summary–All Initial
Neologisms	CU 72% ✧ CCU 18% U 10% CCCU 0% 100% (n=194)	CU 85% ✧ CCU 8% U 7% CCCU 0% 100% (n=820)	CV 82% ✧ CCV 10% V 8% CCCV 0% 100% (n=1014)
English	CU 55% ✧ CCU 2% U 43% CCCU 0% 100% (n=268)	CU 71% ✧ CCU 4% U 25% CCCV 0% 100% (n=712)	CV 67% ✧ CCV 3% V 30% CCCV 0% 100% (n=980)

Context	Utterance–Final	Embedded–Final	Summary–All Final
Neologisms	VC 57% ✧ VCC 14% V 28% VCCC 1% 100% (n=243)	VC 35% VCC 4% V 61% ✧ VCCC 0% 100% (n=771)	VC 40% VCC 7% V 53% ✧ VCCC 0% 100% (n=1014)
English	VC 55% ✧ VCC 6% V 38% VCCC 1% 100% (n=227)	VC 44% ✧ VCC 12% V 44% ✧ VCCC 0% 100% (n=753)	VC 46% ✧ VCC 10% V 43% VCCC 1% 100% (n=980)

✧ Denotes most frequently occurring category.

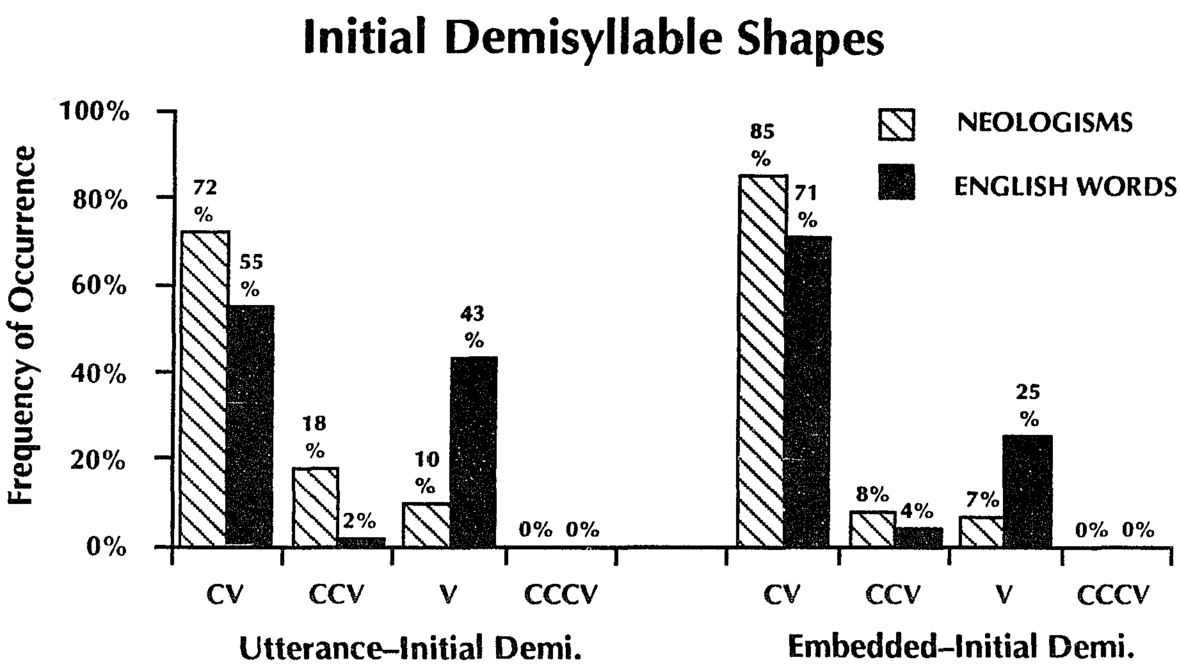


Figure 12a. Frequency distributions for initial demisyllable shapes of all neologisms and English words, across subjects by specific context.

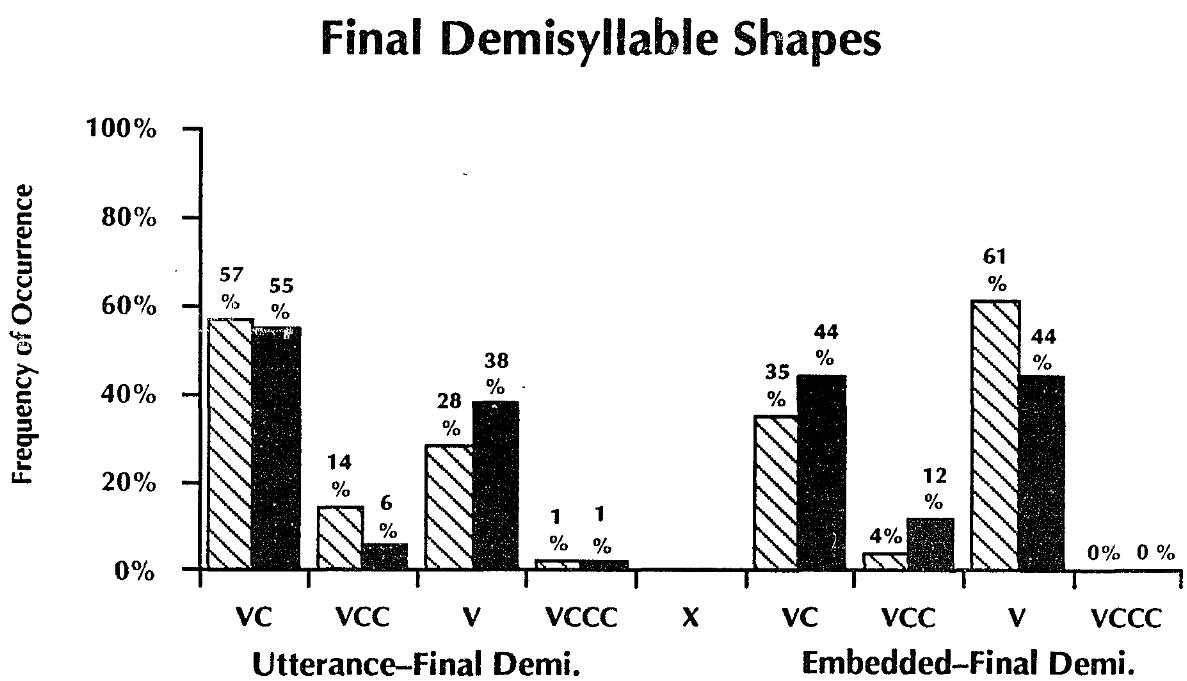


Figure 12b. Frequency distributions for final demisyllable shapes of all neologisms and English words, across subjects, by specific context.

Table 8. Collapsed grand frequency ranks for sonority sequencing patterns, across subjects, by context.

	Target-Related Neologisms		Abstruse Neologisms		English Words	
U.I. Demi.	Obst. onset	71% ✧	Obst. onset	70% ✧	Vowel onset	43% ✧
	Nasal onset	10%	Vowel onset	10%	Glide onset	24%
	Vowel onset	9%	Nasal onset	9%	Obst. onset	18%
	Liquid onset	5%	Glide onset	7%	Nasal onset	13%
	Glide onset	5%	Liquid onset	4%	Liquid onset	2%
E.I. Demi.	Obst. onset	67% ✧	Obst. onset	68% ✧	Obst. onset	46% ✧
	Nasal onset	12%	Nasal onset	11%	Vowel onset	25%
	Liquid onset	10%	Vowel onset	10%	Glide onset	15%
	Glide onset	6%	Glide onset	7%	Nasal onset	10%
	Vowel onset	5%	Liquid onset	4%	Liquid onset	4%
U.F. Demi.	Obst. coda	49% ✧	Vowel coda	38% ✧	Obst. coda	48% ✧
	Nasal coda	22%	Nasal coda	23%	Vowel coda	38%
	Vowel coda	19%	Obst. coda	26%	Liquid coda	7%
	Liquid coda	10%	Liquid coda	13%	Nasal coda	7%
E.F. Demi.	Vowel coda	54% ✧	Vowel coda	67% ✧	Vowel coda	44% ✧
	Obst. coda	25%	Obst. coda	15%	Obst. coda	43%
	Nasal coda	11%	Nasal coda	9%	Nasal coda	7%
	Liquid coda	10%	Liquid coda	9%	Liquid coda	6%

✧ Denotes most frequently occurring category.

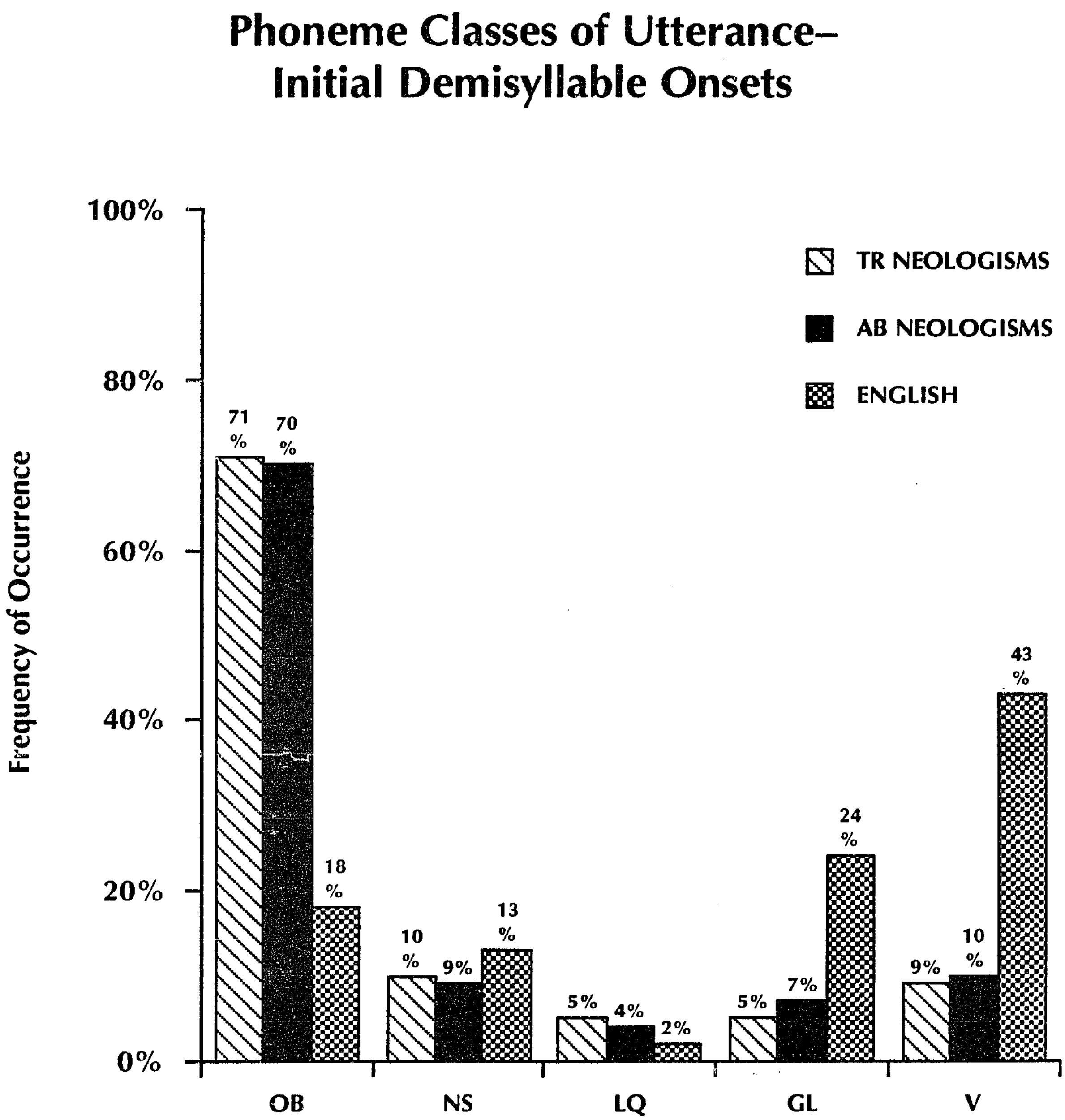


Figure 13. Graphic illustration of phoneme preference patterns across subjects and per word type for utterance– initial demisyllables. Obstruents occurred most frequently as onsets in both types of neologisms, creating a steep rise in sonority from demisyllable periphery toward vowel peak. However, English word demisyllables were most often constructed with vowel onsets, creating a more complex sonority profile of no sonorous rise toward vowel peak.

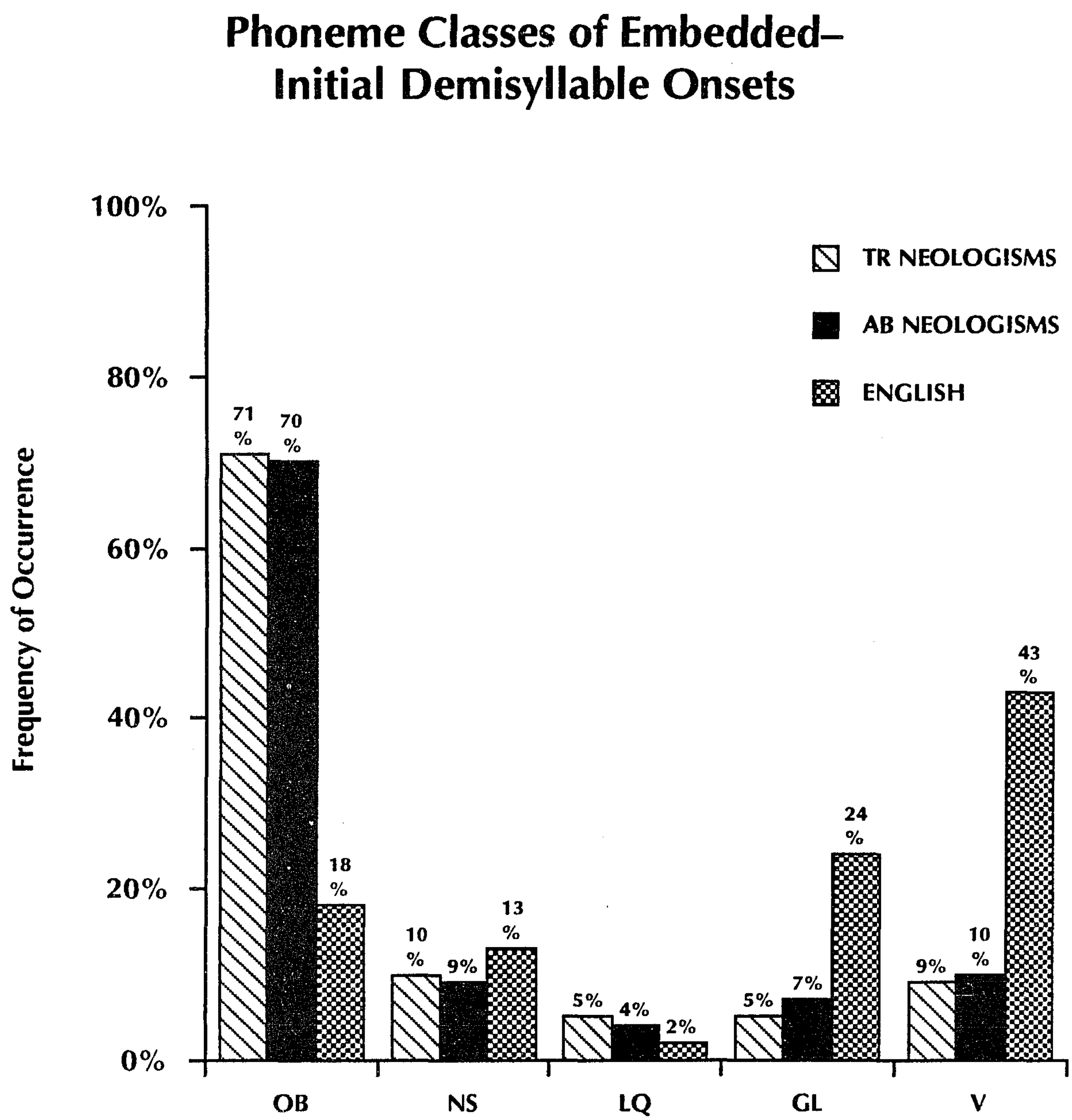


Figure 14. Graphic illustration of phoneme preference patterns across subjects and per word type for embedded-initial demisyllable onsets. Obstruents occurred most frequently across all word types, as predicted by sonority theory. The effect on the embedded-initial demisyllable will be to create a steep rise in sonority from demisyllable periphery toward the vowel peak.

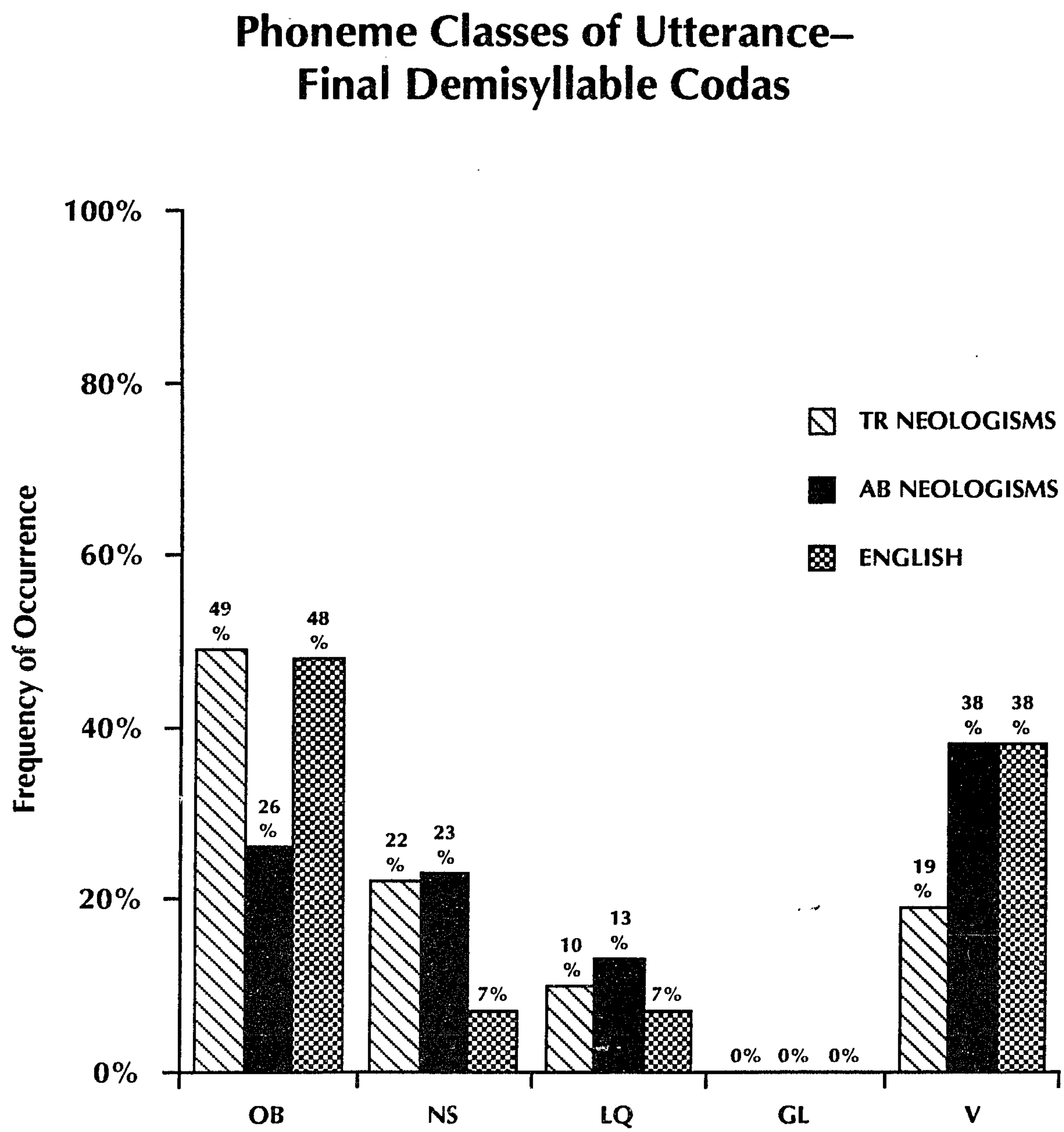


Figure 15. Graphic illustration of phoneme preference patterns across subjects and per word type for utterance-final demisyllable codas. Obstruents were most frequently produced as demisyllable codas for Target-related neologisms and English words. The sonority profile created by this pattern is a steep decline in sonorance from vowel peak to demisyllable periphery and is predicted by the theory. However, abstruse neologisms showed a preference for termination with vowels, resulting in no drop in sonority at utterance end.

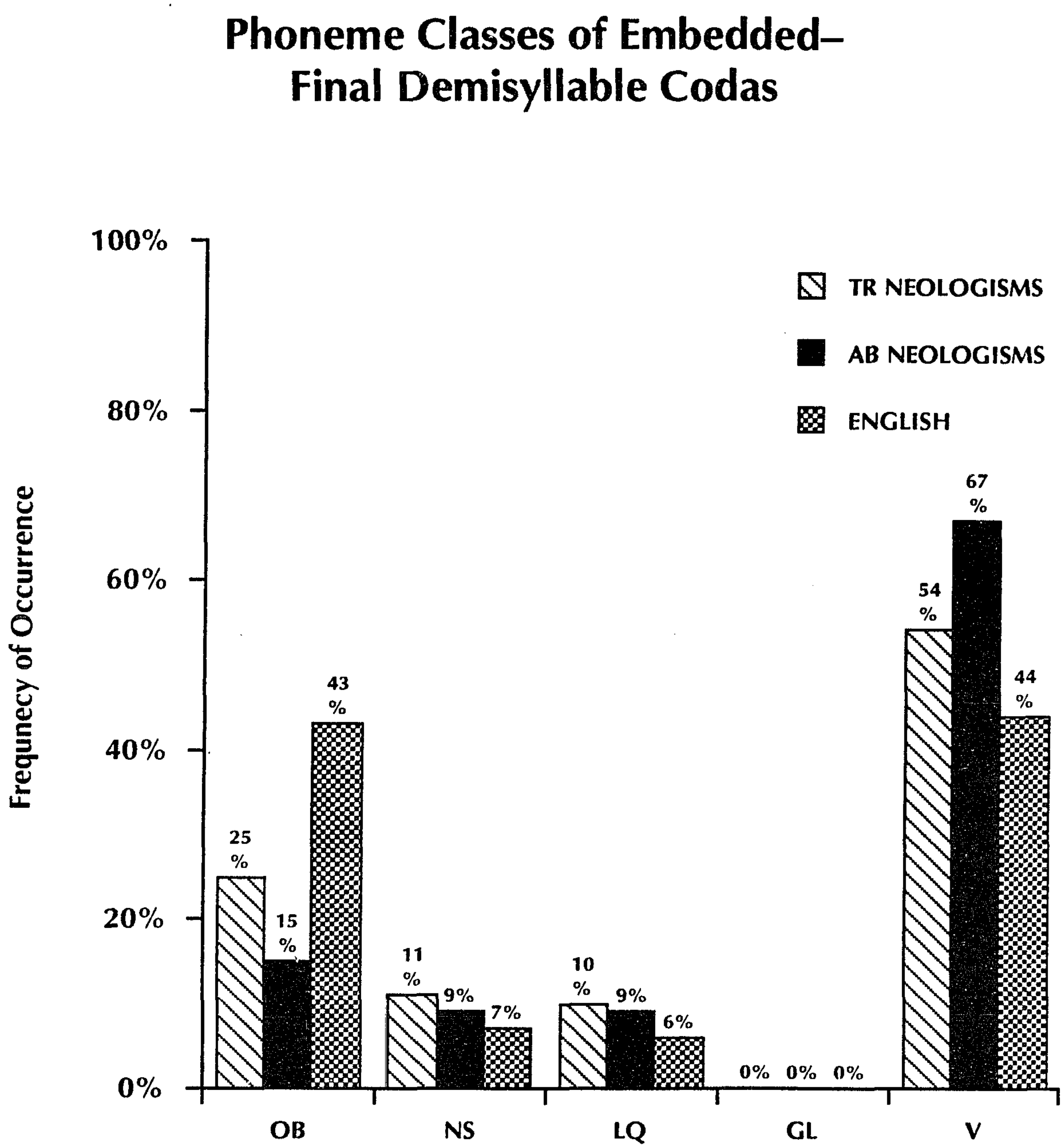


Figure 16. Graphic illustration of phoneme preference patterns across subjects and per word type for embedded-final demisyllables. All words demonstrate a strong preference for vowel codas in embedded-final demisyllables. This situation is predicted by the theory, since a flat sonority profile is desirable in this context (re: Syllable Contact Law). Ideally, a demisyllable of this type will be followed in connected speech by an embedded-initial demisyllable with a steep sonority rise, for perceptual contrast.

Table 9. Expanded grand frequency ranks for sonority sequencing, across subjects, by context.

	Target-Related Neologisms		**Abstruse Neologisms**		**English Words**	
U.I. Demi.	OV	51% ✧	OV	55% ✧	V	43% ✧
	OLV	16%	OLV	10%	GV	24%
	NV	9%	V	10%	OV	17%
	V	9%	NV	7%	NV	13%
	LV	5%	GV	7%	LV	2%
	GV	5%	LV	4%	OLV	1%
	OGV	4%	OGV	3%		
	NGV	1%	NGV	2%		
			OOV	2%		
E.I. Demi.	OV	58% ✧	OV	63% ✧	OV	42% ✧
	NV	12%	NV	10%	V	26%
	LV	10%	V	10%	GV	15%
	OLV	7%	GV	7%	NV	10%
	GV	6%	OLV	4%	LV	4%
	V	5%	LV	4%	OLV	3%
	OGV	2%	OGV	1%	OOV	0%
	OGV	0%	NGV	1%	OGV	0%
	Target-Related Neologisms		**Abstruse Neologisms**		**English Words**	
U.F. Demi.	VO	30% ✧	V	38% ✧	VO	42% ✧
	VN	21%	VN	22%	V	39%
	V	19%	VO	18%	VL	7%
	VLO	11%	VL	13%	VN	7%
	VL	10%	VLO	4%	VLO	3%
	VNO	6%	VNO	3%	VNO	2%
	VLN	1%	VLN	1%	VOO	0%
	VOO	1%	VOO	1%		
	VLNO	1%				
E.F. Demi.	V	54% ✧	V	67% ✧	V	44% ✧
	VO	20%	VO	12%	VO	31%
	VL	10%	VL	9%	VN	7%
	VN	10%	VN	9%	VL	6%
	VLO	3%	VLO	1%	VNO	6%
	VLN	1%	VNO	1%	VOO	5%
	VNO	1%	VOO	1%	VLO	1%
	VOO	1%	VLN	0%	VLN	0%
					VLOO	0%
					VOOO	0%

✧ Denotes most frequently occurring category.

Table 10. Collapsed sonority frequency ranks for target-related neologisms, by subject and context.

M.S.

U.I. Demi.	E.I. Demi.	U.F. Demi.	E.F. Demi.
Obst. onset 88% ✧	Obst. onset 82% ✧	Obst. coda 63% ✧	Obst. coda 41% ✧
Glide onset 6%	Nasal onset 9%	Nasal coda 16%	Vowel coda 40%
Vowel onset 6%	Glide onset 4%	Vowel coda 14%	Liquid coda 11%
	Vowel onset 3%	Liquid coda 7%	Nasal coda 8%
	Liquid onset 2%		

H.V.

U.I. Demi.	E.I. Demi.	U.F. Demi.	E.F. Demi.
Obst. onset 45% ✧	Obst. onset 64% ✧	Vowel coda 41% ✧	Vowel coda 63% ✧
Nasal onset 27%	Glide onset 11%	Obst. coda 37%	Obst. coda 16%
Vowel onset 23%	Nasal onset 10%	Liquid coda 11%	Liquid coda 12%
Glide onset 5%	Liquid onset 8%	Nasal coda 11%	Nasal coda 9%
	Vowel onset 7%		

E.P.

U.I. Demi.	E.I. Demi.	U.F. Demi.	E.F. Demi.
Obst. onset 70% ✧	Obst. onset 60% ✧	Obst. coda 41% ✧	Vowel coda 50% ✧
Liquid onset 13%	Nasal onset 18%	Nasal coda 37%	Obst. coda 28%
Nasal onset 7%	Liquid onset 18%	Liquid coda 12%	Nasal coda 13%
Glide onset 7%	Vowel onset 4%	Vowel coda 10%	Liquid coda 9%
Vowel onset 3%	Glide onset 0%		

✧ Denotes most frequently occurring category.

Table 11. Expanded sonority frequency rankings for target-related neologisms, by subject and context.

M.S.

U.I. Demi.		E.I. Demi.		U.F. Demi.		E.F. Demi.	
OV	53% ✧	OV	61% ✧	VO	27% ✧	V	40% ✧
OLV	32%	OLV	20%	VLO	20%	VO	29%
GV	6%	NV	9%	VN	14%	VL	11%
V	6%	GV	4%	V	14%	VN	8%
OGV	3%	V	3%	VNO	12%	VLO	7%
		LV	2%	VL	7%	VNO	2%
		OGV	1%	VLNO	4%	VOO	2%
				VLN	2%	VLNO	1%

H.V.

U.I. Demi.		E.I. Demi.		U.F. Demi.		E.F. Demi.	
OV	45% ✧	OV	60% ✧	V	41% ✧	V	63% ✧
NV	27%	GV	11%	VO	33%	VO	13%
V	23%	NV	10%	VN	11%	VL	11%
GV	5%	LV	8%	VL	11%	VN	8%
		V	7%	VNO	4%	VOO	1%
		OGV	3%			VNO	1%
		OOV	1%			VLO	1%
						VLL	1%
						VLN	1%

E.P.

U.I. Demi.		E.I. Demi.		U.F. Demi.		E.F. Demi.	
OV	53% ✧	OV	52% ✧	VN	37% ✧	V	50% ✧
LV	13%	NV	18%	VO	30%	VO	24%
OLV	10%	LV	18%	VL	12%	VN	13%
NV	7%	OLV	6%	V	10%	VL	9%
GV	7%	V	4%	VLO	8%	VLO	2%
OGV	7%	OGV	2%	VOO	3%	VOO	2%
V	3%	GV	0%				

✧ Denotes most frequently occurring category.

Table 12. Collapsed sonority frequency ranks for abstruse neologisms, by subject and context.

M.S.

U.I. Demi.	E.I. Demi.	U.F. Demi.	E.F. Demi.
Obst. onset 91% ✧	Obst. onset 89% ✧	Obst. onset 39% ✧	Vowel coda 59% ✧
Vowel onset 6%	Nasal onset 4%	Nasal onset 33%	Liquid coda 16%
Liquid onset 3%	Glide onset 4%	Liquid onset 14%	Obst. coda 16%
	Vowel onset 2%	Vowel onset 14%	Nasal coda 9%
	Liquid onset 1%		

H.V.

U.I. Demi.	E.I. Demi.	U.F. Demi.	E.F. Demi.
Obst. onset 51% ✧	Obst. onset 65% ✧	Vowel coda 44% ✧	Vowel coda 73% ✧
Nasal onset 19%	Vowel onset 15%	Obst. coda 23%	Obst. coda 14%
Vowel onset 16%	Nasal onset 9%	Nasal coda 18%	Nasal coda 9%
Glide onset 11%	Glide onset 8%	Liquid coda 15%	Liquid coda 4%
Liquid onset 8%	Liquid onset 3%		

E.P.

U.I. Demi.	E.I. Demi.	U.F. Demi.	E.F. Demi.
Obst. onset 84% ✧	Obst. onset 50% ✧	Vowel coda 54% ✧	Vowel coda 61% ✧
Glide onset 11%	Nasal onset 24%	Nasal coda 18%	Obst. coda 19%
Liquid onset 5%	Liquid onset 12%	Obst. coda 17%	Nasal coda 10%
	Glide onset 8%	Liquid coda 11%	Liquid coda 10%
	Vowel onset 6%		

✧ Denotes most frequently occurring category.

Table 13. Expanded sonority frequency rankings for abstruse neologisms, by subject and context.

M.S.

U.I. Demi.		E.I. Demi.		U.F. Demi.		E.F. Demi.	
OV	62% ✧	OV	79% ✧	VN	30% ✧	V	59% ✧
OLV	20%	OLV	7%	VO	25%	VL	16%
OGV	6%	NV	4%	VL	14%	VO	10%
V	6%	GV	4%	V	14%	VN	9%
OOV	3%	OGV	2%	VLO	11%	VLO	4%
LV	3%	V	2%	VNO	3%	VNO	1%
		OOV	1%	VLN	3%	VOO	1%
		LV	1%				

H.V.

U.I. Demi.		E.I. Demi.		U.F. Demi.		E.F. Demi.	
OV	47% ✧	OV	60% ✧	V	44% ✧	V	73% ✧
V	16%	V	15%	VN	18%	VO	13%
NV	15%	NV	8%	VO	16%	VN	8%
GV	11%	GV	8%	VL	15%	VL	4%
NGV	4%	OLV	4%	VNO	3%	VLN	1%
LV	3%	LV	3%	VLO	2%	VNO	1%
OOV	2%	ONV	1%	VOO	2%		
OLV	2%	NGV	1%				

E.P.

U.I. Demi.		E.I. Demi.		U.F. Demi.		E.F. Demi.	
OV	63% ✧	OV	46% ✧	V	54% ✧	V	61% ✧
OLV	16%	NV	24%	VN	18%	VO	17%
GV	11%	LV	12%	VO	14%	VN	10%
LV	5%	GV	7%	VL	11%	VL	10%
OGV	5%	V	6%	VNO	3%	VOO	2%
		OGV	3%				
		OLV	1%				
		GGV	1%				

✧ Denotes most frequently occurring category.

Table 14. Collapsed sonority frequency ranks for English words, by subject and context.

M.S.

U.I. Demi.	E.I. Demi.	U.F. Demi.	E.F. Demi.
Vowel onset 64% ✧	Obst. onset 44% ✧	Obst. coda 51% ✧	Obst. coda 50% ✧
Obst. onset 17%	Vowel onset 30%	Vowel coda 30%	Vowel coda 36%
Glide onset 14%	Glide onset 15%	Liquid coda 11%	Nasal coda 9%
Nasal onset 5%	Nasal onset 7%	Nasal coda 8%	Liquid coda 5%
	Liquid onset 4%		

H.V.

U.I. Demi.	E.I. Demi.	U.F. Demi.	E.F. Demi.
Vowel onset 39% ✧	Obst. onset 48% ✧	Obst. coda 51% ✧	Vowel coda 48% ✧
Glide onset 28%	Vowel onset 20%	Vowel coda 39%	Obst. coda 37%
Obst. onsett 16%	Nasal onset 14%	Liquid coda 5%	Liquid coda 8%
Nasal onset 16%	Glide onset 14%	Nasal coda 5%	Nasal coda 7%
Liquid onset 1%	Liquid onset 4%		

E.P.

U.I. Demi.	E.I. Demi.	U.F. Demi.	E.F. Demi.
Vowel onset 42% ✧	Obst. onset 46% ✧	Vowel coda 46% ✧	Vowel coda 47% ✧
Obst. onset 26%	Vowel onset 27%	Obst. coda 35%	Obst. coda 42%
Glide onset 14%	Glide onset 16%	Nasal coda 11%	Nasal coda 6%
Nasal onset 9%	Nasal onset 8%	Liquid coda 8%	Liquid coda 5%
Liquid onset 9%	Liquid onset 3%		

✧ Denotes most frequently occurring category.

Table 15. Expanded sonority frequency rankings for English words, by subject and context.

M.S.

U.I. Demi.		E.I. Demi.		U.F. Demi.		E.F. Demi.	
V	64% ✧	OV	40% ✧	VO	32% ✧	V	36% ✧
OV	17%	V	30%	V	30%	VO	35%
GV	14%	GV	15%	VL	11%	VN	9%
NV	5%	NV	7%	VN	8%	VNO	6%
		LV	4%	VLO	8%	VOO	6%
		OLV	4%	VNO	8%	VL	5%
				VOO	3%	VLO	1%
						VLOO	1%
						VOOO	1%

H.V.

U.I. Demi.		E.I. Demi.		U.F. Demi.		E.F. Demi.	
V	39% ✧	OV	44% ✧	VO	45% ✧	V	48% ✧
GV	28%	V	20%	V	39%	VO	25%
NV	16%	NV	14% ✧	VL	5%	VL	7%
OV	14%	V	14%	VN	5%	VN	7%
OLV	2%	OLV	3%	VLO	3%	VNO	6%
LV	1%	OGV	1%	VNO	3%	VOO	5%
						VLL	1%
						VLO	1%

E.P.

U.I. Demi.		E.I. Demi.		U.F. Demi.		E.F. Demi.	
V	42% ✧	OV	43% ✧	V	46% ✧	V	47% ✧
OV	26%	V	27%	VO	35%	VO	35%
GV	14%	GV	16%	VN	11%	VN	6%
NV	9%	NV	8%	VL	8%	VL	5%
LV	9%	LV	3%			VNO	4%
		OOV	1%			VOO	3%
		OLV	1%				
		OGV	1%				

✧ Denotes most frequently occurring category.

Table 16. Transsyllabic sonority patterns across subjects for the sequence Embedded–Final / Embedded–Initial demisyllables.

Target-Related Neologisms

E.F. Demi.		E.I. Demi.	
Vowel coda	54% ✧	Obst. onset	67% ✧
Obst. coda	25%	Nasal onset	12%
Nasal coda	11%	Liquid onset	10%
Liquid coda	10%	Glide onset	6%
		Vowel onset	5%

Abstruse Neologisms

E.F. Demi.		E.I. Demi.	
Vowel coda	67% ✧	Obst. onset	68% ✧
Obst. coda	15%	Nasal onset	11%
Nasal coda	9%	Vowel onset	10%
Liquid coda	9%	Glide onset	7%
		Liquid onset	4%

English Words

E.F. Demi.		E.I. Demi.	
Vowel coda	44% ✧	Obst. onset	45% ✧
Obst. coda	43%	Vowel onset	26%
Nasal coda	7%	Glide onset	15%
Liquid coda	6%	Nasal onset	10%
		Liquid onset	4%

✧ Denotes most frequently occurring category.

Table 17. Transsyllabic sonority patterns across subjects for the sequence Utterance–Final / Utterance–Initial demisyllables.

Target-Related Neologisms

U.F. Demi.		U.I. Demi.	
Obst. coda	49% ✧	Obst. onset	71% ✧
Nasal coda	22%	Nasal onset	10%
Vowel coda	19%	Vowel onset	9%
Liquid coda	10%	Liquid onset	5%
		Glide onset	5%

Abstruse Neologisms

U.F. Demi.		U.I. Demi.	
Vowel coda	38% ✧	Obst. onset	70% ✧
Nasal coda	27%	Vowel onset	10%
Obst. coda	22%	Nasal onset	9%
Liquid coda	13%	Glide onset	7%
		Liquid onset	4%

English Words

U.F. Demi.		U.I. Demi.	
Obst. coda	48% ✧	Vowel onset	43% ✧
Vowel coda	38%	Glide onset	24%
Liquid coda	7%	Obst. onset	18%
Nasal coda	7%	Nasal onset	13%
		Liquid onset	2%

✧ Denotes most frequently occurring category.

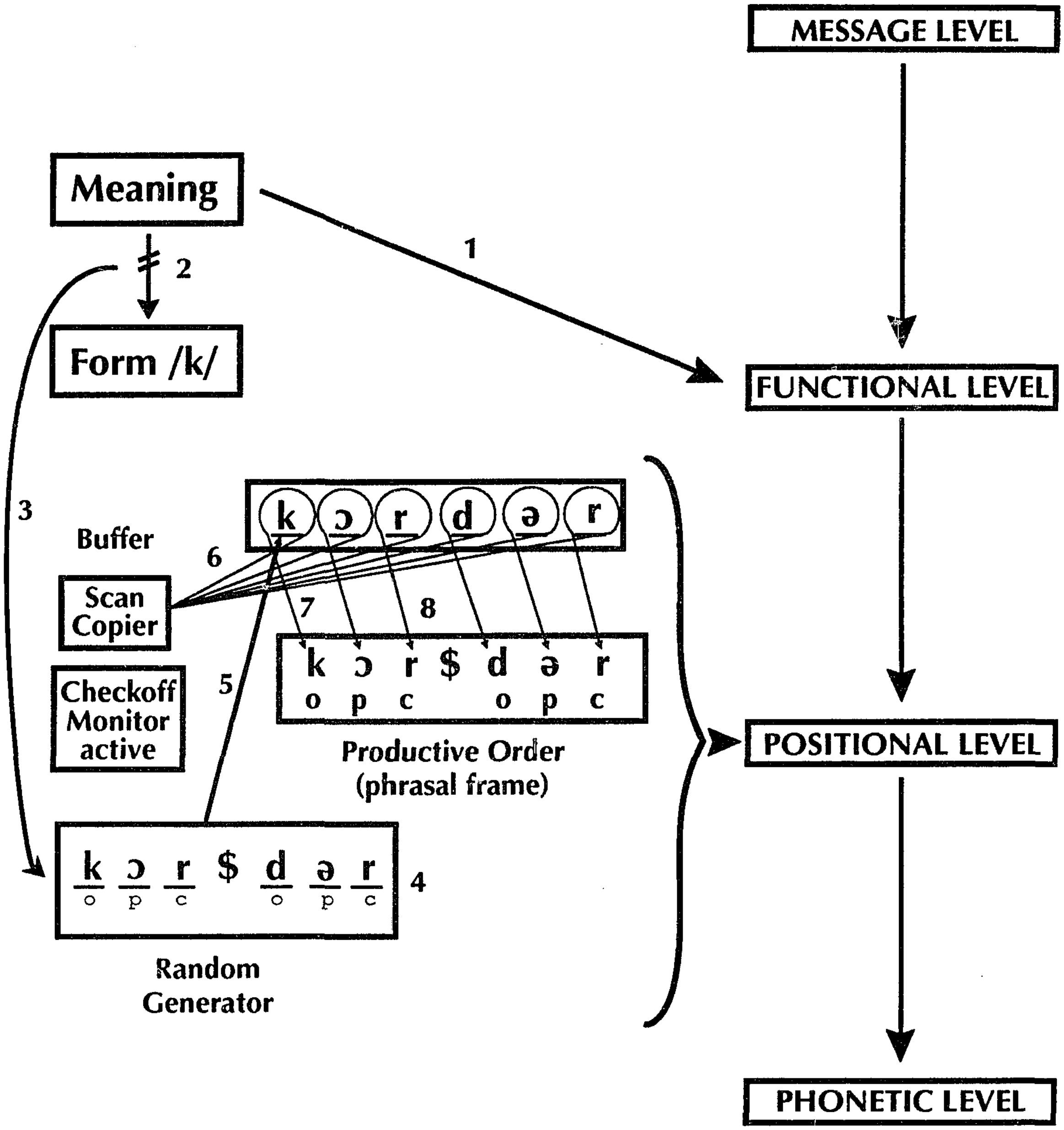


Figure 17. Schematic illustrating by-pass of form-based lexicon and activation of random generator for production of syllable strings in case of anomia. Note that the buffer clears after segments are placed into the phrasal frame by action of the checkoff monitor. (Redrawn with modification from Buckingham, 1986.)

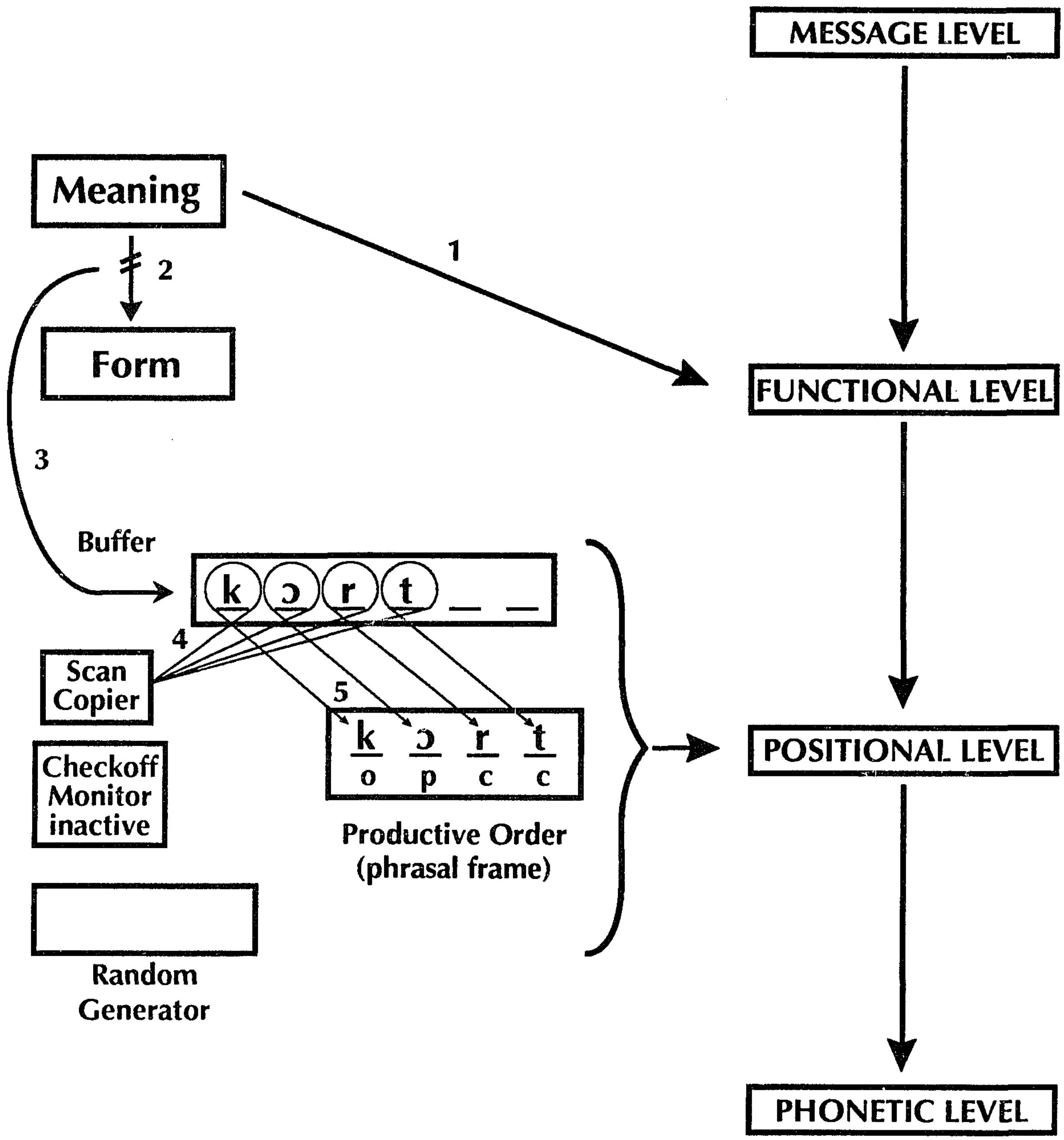


Figure 18. Schematic illustration of perseverative nature of neologisms by failure of checkoff monitor to eliminate segments from the buffer. Inordinate amounts of activation for / **kɔr** / have resulted in repeated scan-copying. Note the inactivity of the random generator following prior production of /**kɔŕdər**/ when attempting to name /**kaʊtʃ**/. Production of / **kɔrt** / is a target-related neologism (re: / **kɔ́rdər**/). (Redrawn with modification from Buckingham, 1986.)

APPENDIX B

Sarah S. Christman
Speech Communication, Theatre,
and
Communication Disorders

INFORMED CONSENT STATEMENT

I want to talk with you for a short while, and then ask you to do some things with me. First, I will ask you some questions about yourself. Then, I will ask you to name some pictures, read single words, repeat simple words, and tell the functions of common objects. I will ask you to describe the events represented in two pictures and then I will ask you to point to pictures, words and objects on command.

Nothing I will do will cause you any risk or harm. At any time during the interview you may ask me for clarification about a specific question or about my study in general. You may withdraw from the study at any time for any reason (including fatigue) without jeopardizing the quality of the medical care that you are receiving.

My work with you is not therapy, but is an adjunct to it, in that what I may discover from this study may be beneficial to therapy in the future. I want to study your language problem so that I may understand this problem better. I am not a physician; I am a Speech-Language Pathologist who is interested in your problem. Any information I collect will be held in confidence. You will not be assessed any fee for participating, nor should you expect any monetary compensation for your participation. Your assistance is completely voluntary.

Remember, any time you wish to ask me a question, you may. We can stop whenever you become tired. Do you understand? Will you consent to participate in my study? Please sign your name here and place the date next to it.

____________________________ ____________________
Patient's Signature Date

____________________________ ____________________
Guardian or Spouse's Signature Date

____________________________ ____________________
Witness's Signature Date

LOUISIANA STATE UNIVERSITY
Baton Rouge Campus
(504) 346-3145

Exhibit 2. FULL COMMITTEE RECOMMENDATION

The Committee on the Use of Humans and Animals as Research Subjects

Hugh Buckingham
Linguistics
2/1/90

Proposal # 1514 **

This is to certify that a quorum of the Committee on the Use of Humans and Animals as Research Subjects (CUHA) reviewed the proposal entitled The Role of Sonority in Jargonaphasia

The Committee evaluated the procedures of the proposal following the guidelines established for activities supported by federal funds involving humans and/or animals as research subjects.

Recommendation of Committee: xxxxx APPROVED

__________ NOT APPROVED

Comments: License #: 72-3
Multiple Assurance #: M1128
Animal Assurance # A3612-01

**YOU MUST BRING A COPY OF THIS LETTER WHEN ORDERING ANIMALS.

A review of this proposal by the Committee will be considered at least on an annual basis, and at more frequent intervals depending on the element of risk.

W. Sheldon Bivin

W. Sheldon Bivin, Chairman
Committee on the Use of Humans and Animals as Research Subjects

EXHIBIT 3. List of Stimuli.

EXPRESSIVE

	High	Mid	Low
Picture Naming	1. House	1. Boy	1. Eyes
	2. Money	2. Car	2. Cat
	3. Girl	3. Bed	3. Keys
	4. Mother	4. Phone	4. Clock
	5. Father	5. Books	5. Umbrella
Read Word Cards	1. People	1. Man	1. Nose
	2. Mother	2. Word	2. Couch
	3. Day	3. Children	3. Glasses
	4. Morning	4. Face	4. Pillow
	5. Friday	5. Train	5. Baseball
Repeat Words	1. Dream	1. Room	1. Truck
	2. Home	2. One	2. Feet
	3. School	3. Hair	3. Rabbit
	4. Week	4. Tea	4. Sweater
	5. Person	5. Six	5. Knife
Tell Function of Objects	1. Soap	1. Shoes	1. Clock
	2. Pencil	2. Towel	2. Umbrella
	3. Money	3. Chair	3. Knife
	4. Key	4. Razor	4. Glasses
	5. Book	5. Brush	5. Table

RECEPTIVE

	High	Mid	Low
Point to the Picture Named	1. Father	1. Books	1. Umbrella
	2. Mother	2. Phone	2. Clock
	3. Girl	3. Bed	3. Keys
	4. Money	4. Car	4. Cat
	5. House	5. Boy	5. Eyes
Point to the Correct Word Card	1. Friday	1. Train	1. Baseball
	2. Morning	2. Face	2. Pillow
	3. Day	3. Children	3. Glasses
	4. Mother	4. Word	4. Couch
	5. People	5. Man	5. Nose
Point to the Object That Goes with the Function	1. Book	1. Brush	1. Table
	2. Key	2. Razor	2. Glasses
	3. Money	3. Chair	3. Knife
	4. Pencil	4. Towel	4. Umbrella
	5. Soap	5. Shoes	5. Clock

VITA

Sarah Slack Christman
Southeastern Louisiana University
P.O. Box 879
Hammond, Louisiana 70402

CURRENT EMPLOYMENT

Assistant Professor, Speech-Language-Hearing Program, Department of Special Education, Southeastern Louisiana University, Hammond, Louisiana, (August, 1989-present). Conduct research in neurolinguistics / clinical aphasiology and teach graduate/undergraduate coursework in neurogenic, phonological and articulation disorders.

EDUCATIONAL HISTORY

Louisiana State University, Baton Rouge, Communication Disorders/Linguistics, Ph.D. Program (87 hours), January 1986-December 1990. Dissertation Title: The Role of Sonority in Jargonaphasia.

Louisiana State University, Baton Rouge, Speech Pathology, M.A., 1982.

Illinois State University, Normal, Deaf Education, B.S.Ed., 1980.

PUBLICATIONS

Christman, S. and Buckingham, H. (1989). Jargonaphasia. In C. Code (Ed.), The characteristics of aphasia (pp. 111-130). London: Taylor & Francis.

PRESENTATIONS

Christman, S. (1985, March). Language Deficits in Learning Disabled Children. Presentation at the Louisiana Association for Children with Learning Disabilities State Conference, Covington, Louisiana.

Christman, S. (1990, October). The Role of Sonority in Jargonaphasia. Poster presentation at the Louisiana Speech-Language-Hearing Association State Conference, Lafayette, Louisiana.

Christman, S. (1991, February). Application of Sonority Theory to Jargonaphasia: Clinical Aspects. Poster presentation accepted for the Mid-South Conference on Communicative Disorders, Memphis, Tennessee.

Christman, S. & Buckingham, H. (1990, November). The Role of Sonority in Jargonaphasia. Paper presented at the American Speech-Language-Hearing Association Annual Conference, Seattle, Washington.

CERTIFICATIONS AND AFFILIATIONS

Certifications include the ASHA Certificate of Clinical Competence, Speech-Language Pathology, Teaching Certificates in Speech-Language Pathology and Deaf Education, and Louisiana licensure in Speech-Language Pathology.

Affiliations include the American Speech-Language-Hearing Association, Louisiana Speech and Hearing Association, and Phi Kappa Phi Scholastic Honorary.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Sarah S. Christman

Major Field: Speech

Title of Dissertation: The role of sonority in jargonaphasia

Approved:

Hugh W. Buckingham

Major Professor and Chairman

[signature]

Dean of the Graduate School

EXAMINING COMMITTEE:

Jack S. Damico

Paul R. Hoffman

Ray Daniloff

M. Jane Collins

[signature]

Date of Examination:

30 November 1990