

Deconstructing Markedness: A Predictability-Based Approach *

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0. Introduction

Since first proposed as a linguistic term by Trubetzkoy (1939), the notion of markedness has come to occupy a position of considerable importance in phonology and other areas of linguistics. However, since Trubetzkoy's time, markedness has acquired a much broader meaning. The term "unmarked" is generally synonymous with, for example, simpler, more common, easier to produce, acquired earlier, etc. It is no longer limited to relations between elements on a language-specific basis, as Trubetzkoy assumed. Rather, markedness has come to refer to the universals of language (e.g., Jakobson 1963, 1990; Greenberg 1966), determined by Universal Grammar (Chomsky and Halle 1968, Kean 1975, and many others following them). Further, it has grown from a simple classificatory term to a predictive scientific concept (e.g., Kiparsky 1985, Calabrese 1995, Rice 1996, de Lacy 2002).

There are many serious problems with the notion of markedness, as I outline in section 1. The result, I suggest, is that markedness is not predictive and hence, not a scientific concept. The root of the problem is this: due to the vagueness of the concept, markedness, it is unclear what markedness diagnostics, e.g. neutralization, simplicity, deletion, are actually diagnosing. What we are lacking is a clear understanding of the basis of markedness.

I argue that it is *predictability*; that is, traditional markedness diagnostics are actually providing evidence for a linguistic element's predictability within a system. An element with greater predictability patterns as less marked than a corresponding, less predictable, one. Predictability is determined by a complex of fac-

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tors, some language-specific and some universal, as discussed below. This paper focuses primarily on the contribution of one language-specific factor: language experience. As I hope to show, this approach is superior to traditional views of markedness for a number of reasons: first, it correctly predicts observed language patterns both at the language-specific and universal level; second, it correctly reflects the probabilistic nature of markedness; and finally, it is quantifiable, thus moving us closer to a predictive, scientific theory of sound patterns.

1. Problems with the Traditional Approach to Markedness

Developing a predictive and unified theory of markedness has not been a trivial undertaking. In fact, a wide range of diagnostics have been proposed (see Rice 1999 for discussion) including: phonetic instability, articulatory simplicity, perceptual salience, neutralization, epenthesis, assimilation, segment deletion, distribution, structural complexity, language acquisition, sound change, creole genesis, cross-language frequency, and implicational relations. Yet, much of the criteria assumed to provide evidence for markedness has been brought into question for the reason that sound patterns contradicting markedness claims are commonly observed at the level of the individual language, e.g., assimilation (Hume and Tserdanelis 2002, Hume 2003), passive neutralization (Hume 2003), underspecification and default values (Steriade 1995; Clements 1988, 1993; Mohanan 1993; Calabrese 1995), neutralization (Odden, p.c.), epenthesis (Vaux 2002; also, see below), cross-language phoneme frequency (Battistella 1990, Rice 1999), implicational relations (Rice 1999), creole genesis (Thomason 1993), child language acquisition (e.g., Menn 1983, Beckman et al. 2003), sound change (e.g., Lass 1975, Ladefoged 1984).

Consider assimilation, for example. When comparing members of a feature class in assimilation, it is commonly assumed that “the unmarked pole of an opposition is lost or obscured, with the marked pole remaining...In assimilation, the marked features within a class are active...the unmarked features, on the other hand, are passive, or inert...overridden by other features” (Rice 1999:4). Put another way, marked features resist modification while unmarked features are subject to change. Problematic for this view of markedness is the observation that virtually any place of articulation can pattern as unmarked in some language (Hume and Tserdanelis 2002, Hume 2003).

Developing a predictive theory of markedness has also proven difficult due to apparent inconsistencies and contradictions among the diagnostics themselves. Consider, for example, perceptual salience, a term commonly used to refer to the number and quality of the acoustic/auditory cues in the speech signal that a listener may use to identify a given sound or sound sequence. A sound with weak phonetic cues, and hence low salience, is more likely to undergo phonological processes such as assimilation, reduction and deletion, than sounds with better cues. In cases such as this, the member of the opposition with *low* salience is considered unmarked. On the other hand, sounds and sequences with good cues and

thus higher salience are also considered unmarked. The CV syllable is a prototypical example, widely considered to be the universally unmarked syllable type. Perceptual salience is thus used in apparently contradictory ways to refer to the same markedness value: an unmarked element can have low salience or it can have high salience.

Another example illustrating seemingly contradictory predictions of the diagnostics involves epenthesis and deletion. The epenthetic vowel or consonant is generally taken to correspond to the unmarked segment of a language. Deletion of one member of a class of sounds also denotes unmarked status. What this means is that an unmarked sound is not only more apt to delete, it is also more apt to be inserted. To put another way, the unmarked segment is both the most preferred and the least preferred segment in the language.

Due to problems such as these, an objective definition of what would validate or falsify markedness is lacking. Is markedness falsified if the evidence from different criteria conflict? If not, how do we determine the markedness status of an element? For example, a sound that is perceptually salient may be relatively simple from a production perspective. Does this make it marked in a system or unmarked? Given the lack of an objective statement of what markedness is, the concept tends to be used as is convenient; patterns that support a particular view of markedness are used as evidence for that view while those that do not, tend to be labeled “irregular,” “exceptional,” or “irrelevant.”

Following Menn (1983), it is clear that markedness does not explain anything; it is something that needs to be explained. As I argue below, the concept predictability is able to do just this.

2. Predictability

Markedness is best considered a probabilistic notion with predictability positively correlated with unmarkedness. As I show below, observed markedness patterns follow from this approach in a straightforward manner. In short, an element that is predictable within a system is less crucial to successful communication than one that is less predictable. Consequently, a predictable element is a more likely candidate for reduction, deletion, change, etc. Recall that these are all traditional diagnostics for unmarkedness. Interestingly, a more predictable element is also more likely to be the epenthetic segment, another diagnostic of unmarkedness, since language users are biased towards predictable elements (see below). Thus, by taking into account the predictability of a segment in a language system, we are able to predict both its instability and a speaker/hearer’s bias towards it. Further, unlike traditional approaches to markedness, cross-linguistic variability is not only accounted for, it is predicted, as I briefly discuss below.

There are several factors that come into play in determining the predictability of a given linguistic element. As I lay out in greater detail in Hume (2004b,c), these include perceptual salience, articulatory simplicity, functional load, social factors (e.g., prestige value), and the speaker/hearer’s experience with the usage

of linguistic elements, e.g. sounds, words. All are crucial in determining how predictable an element will be in a language system. It is the influence of language experience that I focus on in this paper. Cross-linguistic variability and hence, language-specific markedness patterns result from the contribution of the system-dependent factors: functional load, social factors, and experience.

3. Experience

Experience is important because it is correlated with *expectation*. As described by Feather (1982), expectation, like other cognitive concepts, recognizes “the individual’s capacity to process information so that it becomes organized and set within a context of meaning. These organized residues of experience then become important filters for future information processing, serving as benchmarks, criteria, or reference frames against which new information can be tested. They also guide the form that behavior takes.” Formally, expectation is the probability (P) of x given y .

(1) EXPECTATION: $P(x|y)$

The more experience that one has with some element, the greater is the expectation that that element will occur. Experience is thus also correlated with *predictability*.

The impact of experience on language learning, language change, language processing, and language production is well-established (see, among others, Zipf 1932; Bybee, e.g. 1985, 2001; Jurafsky et al. 2001; Frisch 1996; Frisch et al. 2000; Luce 1986; Lindblom 1990; Pierrehumbert 1994; Pitt and McQueen 1998; Raymond, Dautricourt, and Hume to appear; Saffran, Aslin, and Newport 1996; Saffran, Newport, and Aslin 1996; Vitevitch and Luce 1999; Dell et al. 2000; Makashay 2001). In language acquisition, for example, experience with the ambient language shapes an infant’s expectations regarding language, revealed as a preference for aspects of his/her native language (Aslin et al. 1981; Best et al. 1988; Jusczyk 1997; Polka and Werker 1997; Werker et al. 1981; Werker and Tees 1984). Psycholinguistic research in speech and word processing also shows that the ability to process speech is facilitated by a listener’s familiarity with various dimensions of the native language’s phonological system including: the language’s sounds (Pitt and Samuel 1990), phonotactics (Hallé et al. 1998, Massaro and Cohen 1983, Pitt 1998, Pitt and McQueen 1998), patterns of contrast (Lahiri and Marslen-Wilson 1991, Otake et al. 1996, Dupoux et al. 1997, Harnsberger 2001, Hume and Johnson 2003), and syllable structure (Cutler and Norris 1988, Pallier et al. 1993, Pitt et al. 1998, Treiman and Danis 1988). For example, listeners are biased to parse consonant clusters that are phonotactically impermissible into permissible sequences (Hallé et al. 1998, Massaro and Cohen 1983, Pitt 1998). Pitt (1998) found that an epenthetic schwa was more likely to be perceived between the consonants of phonotactically illegal consonant clusters

(e.g., [tlæ] → [təlæ]) than legal clusters (e.g., [træ] → [təræ]). It is also uncontroversial that how words are processed is influenced by factors such as their frequency of occurrence and the predictability of sequences of sounds in the word (e.g., Savin 1963, Luce 1986, Luce and Pisoni 1998, Pitt and McQueen 1998, Vitevitch and Luce 1999, Frisch et al. 2000). For example, the higher the frequency of the word, the greater the likelihood is that the listener will identify the word correctly (Luce 1986). As I discuss below, experience also plays a role in synchronic phonological patterns.

Language experience and predictability are useful concepts when it comes to understanding markedness since, as it turns out, most of the traditional diagnostics fit into one of two categories: (a) they provide evidence for the result of predictability, or (b) they contribute to one's experience with a particular element and, as a result, influence what is predictable within the system of an individual speaker/hearer or the language more generally. I illustrate these two points just below.

4. Diagnostics that Feed Experience

Consider first traditional markedness diagnostics that contribute to one's experience with a linguistic element. As shown in Figure 1 these include distribution, neutralization, articulatory simplicity, perceptual salience, and structural simplicity. Each of these diagnostics provides evidence of a speaker/hearer's experience with some element of his/her language, and thus the degree of predictability of the element in question.

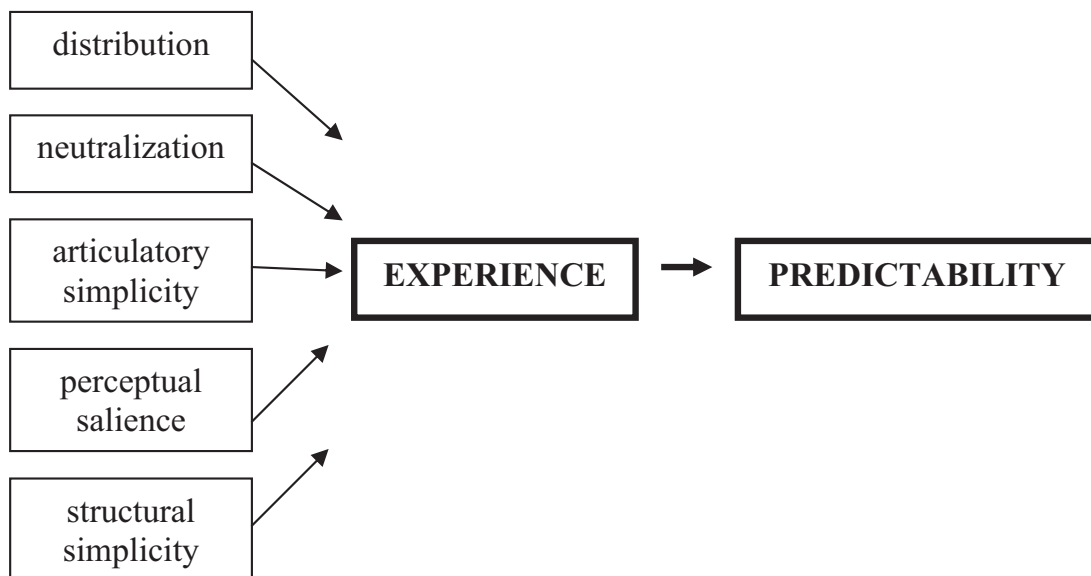


Figure 1. Traditional markedness diagnostics that feed experience with a particular linguistic element

Distribution has long been considered a diagnostic of markedness: the element with the wider distribution is deemed unmarked. Linking distribution to an element's predictability is straightforward: given two elements x and y , if x has a wider distribution than y , chances are that the language user will have more experience with x than with y . Thus, the probability of x occurring is greater than the probability of y occurring. This is nicely illustrated in Mielke's (2003) cross-linguistic study of the perception of /h/ by native listeners of Turkish, Arabic, English, and French, calculated as a function of the sensitivity measure d' . A higher d' value indicates that the listener is more sensitive to the presence of /h/; that is, /h/ is more easily identified. All subjects listened to identical stimuli produced by a male Turkish speaker. The results, shown in Figure 2, reveal that Turkish and Arabic listeners have a high degree of sensitivity to /h/, and are able to detect it in most contexts. English and French listeners, on the other hand, had much lower sensitivity to /h/. Interestingly, these findings correctly reflect the listener's experience with the sound. In Turkish and Arabic, /h/ is widespread, occurring in most contexts. In English, on the other hand, /h/ has a restricted distribution, occurring only in prevocalic position. /h/ does not occur in the French system at all. In sum, listeners with the greatest experience with /h/ are best able to detect the sound's presence. The observation that there is no significant difference between Turkish and Arabic, and between English and French, may reflect ceiling and floor effects, respectively.

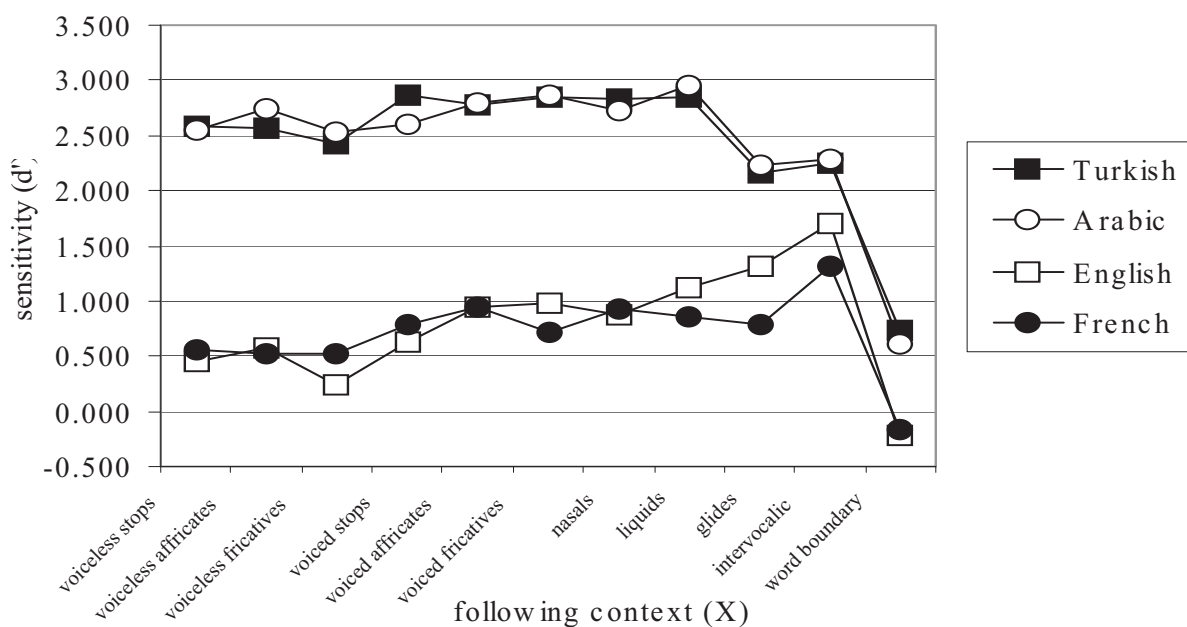


Figure 2. Sensitivity (d') to [h] before another sound or word boundary (VhX) (Mielke 2001, 2003)

Since first proposed by Trubetzkoy (1939), neutralization has also been widely acknowledged as a markedness diagnostic. Neutralization involves the loss of contrast among elements in some context. For example, in languages with final devoicing such as German, Polish, and Russian, the contrast between voiced and voiceless consonants is arguably neutralized in word-final or coda position; only one member of the opposition survives and this member is considered unmarked. Like distribution, neutralization influences predictability. If only one member, x , of an opposition, x - y , occurs in a particular context, the language user only has experience with x in that context. It is therefore this member that is most probable and thus, predicted.

Phonetic criteria such as articulatory simplicity and perceptual salience are also equated with unmarkedness. As noted further above, high perceptual salience has been proposed as an explanation for the pervasive presence of, e.g., CV syllables in languages, or clusters with [s] as opposed to other fricatives. The reason is because sound sequences with richer cues tend to be more stable in a language and consequently, typically occur in more words than those with weaker cues (Makashay 2001). Thus, all else being equal, speakers/hearers will generally have more experience with sounds/sequences with higher salience. As a result, high salience can also provide evidence for the predictability of an element.

A similar conclusion can be drawn with respect to articulatory simplicity: consonants produced with less complex articulations tend to occur more frequently in a language than those with more complex articulations. As a result, speakers/hearers will have more experience with these sounds and their predictability will be higher. Of course, articulatorily complex segments do occur in languages and can be frequent. For example, the [ðV] sequence has a high token frequency in English, occurring word-initially in many common function words, e.g. *though, this, the, that*. In this context, therefore, the speaker/hearer has considerable experience with the sequence and it is accordingly highly predictable.

This is precisely what we expect given that language experience, and hence predictability, is dependent upon two factors: (a) the elements that are in a language system's inventory, and (b) the extent to which these elements are used. Thus, even articulatorily complex sounds or sequences with low salience can be predictable within a system provided that they are used a great deal. The reason why articulatorily simple sounds and perceptually salient sequences are typically unmarked is then simply because, due to their inherent phonetic nature, they tend to occur more frequently in systems and, as a result, are used more.

The same point can be made with respect to structural complexity. Language users are generally more familiar with simpler structures since they tend to be used more. Polish syllable structure, for example, contains word-initial onsets of up to four consonants. An examination of their frequency reveals that two-consonant clusters occur in 88% of words, three-consonant clusters occur in 10% of words, and four-consonant clusters are limited to only 2% of words (Bethin

1992). Two-consonant clusters are thus the most predictable clusters in the language.

To summarize, the traditional markedness diagnostics noted above provide evidence for a speaker/hearer's experience with some element of his/her language. As we have seen, some elements are more apt to occur in a language system than others due to their inherent phonetic nature. However, presence within a system is not sufficient to determine the predictability (unmarkedness) of an element; we must also take into account the extent to which the elements are used.

5. Predictability Effects

In this section I consider another group of well-known markedness diagnostics and show how they follow from the proposed model. They differ from the set above in that they provide evidence for the *effects* of predictability. These diagnostics can be further divided into two sets, as shown in Figure 3. One illustrates the *instability of the predictable* and includes diagnostics such as reduction, deletion, and assimilation. The other set exemplifies the *bias towards the predictable* as evidenced in processes like epenthesis, metathesis, and dissimilation.

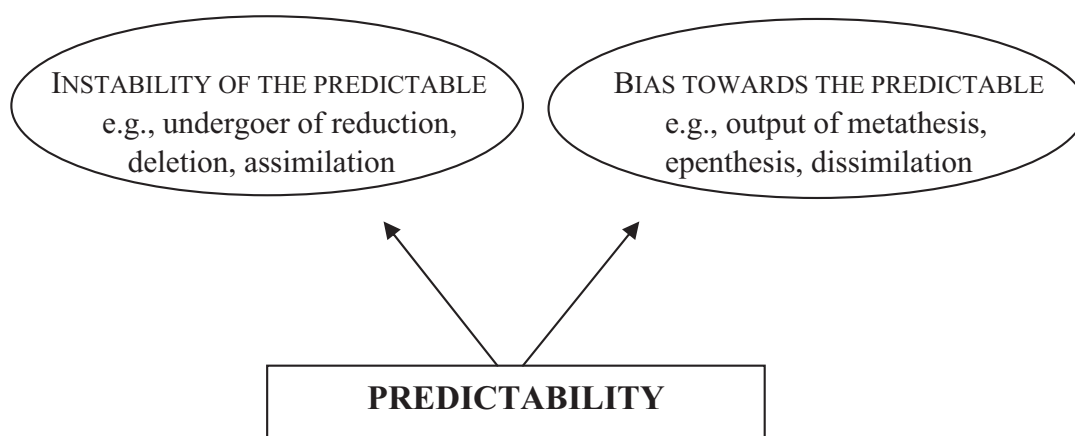


Figure 3. Observed effects of predictability

5.1. Instability

Instability of the predictable incorporates the observation that elements that are predictable within a system are more likely to undergo change, such as reduction, deletion, and assimilation. The reason for this is because predictability reduces an element's surprise value in the system and hence, the amount of information that it contains (Zipf 1932, Shannon 1949, Applebaum 1996). As a result, the greater the predictability of an element, the less information content it has and, I argue, the more expendable it is. The most expected, i.e. unmarked, category is thus the one with the least information content. The view of information content as a quantifiable alternative to markedness is developed more fully in Hume (2004b,c). I

offer some illustrations below but refer the reader to the works just noted for more detailed discussion.

It is widely assumed that the phonologically unmarked segment in a system is the segment which is least stable phonetically. That is, it is most likely to undergo processes such as reduction, deletion, assimilation, etc. According to this view, the alveolar coronal stop can be considered the unmarked consonant type in English. Support for this proposal comes, for example, from data from the Buckeye Speech Corpus of over 100,000 words of conversational speech (Pitt et al. 2005), which shows that 17% of all word variants involve *t/d* changes, the most of any consonant type. Similarly, in Sri Lankan Portuguese Creole, labial *m* can be considered unmarked since it is the least stable nasal in the language (nasals include labial, coronal, dorsal) (Hume and Tserdanelis 2002). The word-final labial nasal optionally deletes; dorsal and coronal nasals do not. The labial nasal also undergoes place assimilation to a following consonant; the coronal nasal does not.

The observed instability of *t/d* in English and *m* in Sri Lankan Portuguese Creole finds a straightforward explanation when we take into account their predictability within each language. In Sri Lankan Portuguese Creole, users have more experience with *m* than with other nasals. The labial nasal is twice as frequent as its nearest competitor *n* (Hume and Tserdanelis 2002). Interestingly, the velar nasal occurs in only a few words in word-final position and like the highly frequent labial, it undergoes assimilation. The fact that one of the words in which it occurs is the highly frequent indefinite article is perhaps not surprising. I suspect that the high token frequency of the velar nasal led to its instability and thus resulted in its patterning with the labial nasal rather than with the coronal. With respect to English, it is clear that users have more experience with *t/d* than with any other consonant in the language. In the Buckeye corpus, 40% of all transcribed words have *t* or *d*, the highest by far of any consonant. Further, some very frequent words contain *t/d*, including the three most frequent words in the corpus: *and*, *to*, *that*. In addition, it is well-established that higher rates of *t/d* reduction in English correlate with factors such as higher lexical frequency (Bybee 2001, Jurafsky et al. 2001, Patterson and Connine 2001) and predictability from the following word (Raymond, Dautricourt, and Hume to appear).

5.2. Bias

A speaker/hearer is also biased towards the predictable. Since predictability is a function of experience, this means that patterns that are more familiar to the language user will have a greater chance of being produced and perceived. A listener is especially biased towards the more frequent pattern in a system when information specifying a sound or sound sequence is indeterminate (Pitt and McQueen 1998).

In metathesis, for example, Hume (2004a) shows that the knowledge of the sound patterns of one's language influences how the speech signal is processed and thus, the order in which a sequence of sounds is parsed. To be specific, the

order inferred from the signal, and thus the output of metathesis, is the order that occurs most frequently in the language. In this view, the reason that improved perceptual salience is characteristic of many cases of metathesis becomes an artifact of the nature of sequences subject to the process and of those that influence speech processing. Sequences with poorer cues are more likely to undergo metathesis, while those with good cues tend to be more frequent in a system and thus have a greater impact on how the speech signal is parsed (Hume 2004a:227).

With respect to epenthesis, recall from the discussion of Pitt (1998) above that a vowel is often perceived between the consonants of phonotactically illegal consonant clusters in English (e.g., [tlæ] is perceived as [təlæ]). It should not be surprising that the vowel in question is schwa, the most frequent vowel in the language.

This approach to epenthesis departs from the common view that the epenthetic segment is the consonant or vowel with the weakest phonetic cues, i.e., the least salient segment. Support for the low-salience approach comes from the observation that in many languages schwa or [i] is the epenthetic vowel, and the coronal stop [t] or glottal stop is the epenthetic consonant. In the approach taken here, however, I argue that while the phonetic nature of a sound is an important contributing factor (along with functional load, social prestige, and experience), it is more generally a segment's predictability in a given context that is crucial in determining whether it will be perceived as the epenthetic vowel.

Epenthesis in French illustrates the mismatch between epenthesis and phonetic salience and thus provides support for the predictability approach. While the epenthetic vowel in French is commonly referred to as schwa it is in fact the mid front *rounded* vowel, [ø] (Adda-Decker et al. 1999). This is of particular interest since it is commonly assumed that roundness is marked in front vowels (e.g., Chomsky and Halle 1968). Yet, it is the front rounded vowel [ø] that is the epenthetic vowel rather than the arguably simpler and less salient [ɛ], also a sound in the French inventory. Not surprisingly, [ø] is also commonly deleted, e.g., [pøti] ~ [pti] *petit* 'small'.

The explanation for [ø]'s behavior is not that it is the least phonetically salient vowel in the language, but that it is predictable, a consequence (in part) of its high frequency. For example, it occurs in many highly frequent function words, e.g., *je* 'I', *le* 'the (masc.)', *me/tel/se* '1st/2nd/3rd pers. pronoun'. Further evidence comes from corpus-based studies (Adda-Decker et al. 1999). The BREF corpus of read speech contains 66,500 sentences from 120 speakers. In the corresponding word lexicon, 37% of the words contain optional schwas, as in *petit* 'small'. The count of all schwas would actually be higher since this does not include those schwas that are not in the appropriate phonological context for deletion, e.g., *vendredi* 'Friday'. Similarly, in a 38,000 word subset of the MASK corpus of spontaneous speech (409 speakers), of the 2,000 entries in the word list 35% have schwa. Thus, both token and type frequency point to [ø] as a highly frequent vowel in the language.

The bias towards the predictable can also be observed in patterns of language acquisition. For example, Quiché-learning children master /tʃ/ at an earlier age than English-learning children. The explanation for this difference can be related to the observation that the sound occurs in many words that children are exposed to in Quiché whereas it is relatively infrequent, compared to the other plosives, in English (Pye et al. 1987). That is, Quiché-learning infants have more experience with the sound than do English-learning children.

Substitution errors provide further evidence. Results from a study of Japanese-learning children 2-5 years old show that they made more than twice as many “backing” errors for /t/ (i.e., /t/ pronounced as /k/) as they made “fronting” errors for /k/ (/k/ pronounced as /t/) (Yoneyama et al. 2003). This runs counter to the claim that back consonants like /k/ are universally marked and likely to be replaced by front consonants like /t/. However, the patterns are straightforwardly predicted by the observation that /k/ occurs more frequently than /t/ in Japanese (adult lexicon and words that a Japanese child is most apt to hear) (Yoneyama et al. 2003; Beckman et al. 2003). As Beckman et al. point out, the higher frequency of /k/ in Japanese also correctly predicts the earlier acquisition of /k/ reported for Japanese and the larger number of errors for /t/. In English, on the other hand, /t/ occurs more frequently than /k/.

Patterns of language development in creole genesis also support the predictability model. Thomason (1993) shows that the properties of pidgins/creoles depend on the properties of the source languages. Those that are common to both varieties, i.e., familiar to the users, are more likely to be preserved, regardless of how phonetically complex they might be. Chinook Jargon (a pidgin), for example, contains a stable phonemic inventory which includes glottalized, labialized, and uvular (vs. velar) stops.

6. Problems with Markedness Revisited and Explained

At the beginning of this paper I noted a number of problems with the traditional approach to markedness. In this section, I return to these problems and show how the proposed model accounts for the patterns in a straightforward manner.

One problem concerned the observation that given standard assumptions, markedness only predicts the patterns that are supposed to be universal; it does not provide predictions regarding language-specific markedness patterns. Yet, many of the criteria assumed to provide evidence for markedness have been brought into question precisely because patterns contradicting markedness are commonly observed at the level of the individual language. In the present account, both language-specific and language-universal patterns are expected. Briefly put, language-universal patterns result from the phonetic factors due to the shared physiological make-up of humans. To the extent that languages differ in terms of the elements that make up their systems and how they are used, expectations of language users and predictability of the elements will differ. We thus correctly predict cross-linguistic variability in observed language patterns.

A further problem with the traditional approach to markedness has to do with apparent inconsistencies and contradictions among the diagnostics. Recall that an unmarked sound can have either low or high salience. Also, an unmarked sound is not only more apt to delete, it is also more apt to be inserted.

The solution to the problem lies in understanding that the diagnostics are actually providing evidence for the predictability of an element. Recall that some traditional diagnostics feed experience and thus increase an element's predictability, while others provide evidence for the effects of predictability. Thus, an element with good cues (e.g., CV syllable) is more likely to be predictable than one with poor cues simply because the former tends to occur more frequently in language systems. All else being equal (e.g., quality of phonetic cues), a more predictable element is also more apt to delete than a less predictable one (instability). Similarly, a predictable sound is more likely to be epenthesized than a less predictable one (bias). Within the current approach, there is no contradiction; all observations fall out of the single metric, predictability.

7. Conclusion

In this paper I have argued that predictability is at the basis of markedness. Unmarked elements are those that have a high degree of predictability within a system (or a given context). While I have focused on only one of the factors crucial to determining the predictability of a linguistic element, the promise of this approach to explaining markedness patterns should be evident.

First, a single metric, predictability, provides an explanation for both the *instability* of an element and the speaker/hearer's *bias* towards that same element. In both cases, the element in question has high predictability. Markedness, on the other hand, is a descriptive label; it doesn't explain anything.

Second, the predictability of an element is dependent upon both universal properties and the language system in which the element occurs. Thus, both universal and language-specific patterns are predicted. Given standard assumptions, markedness only predicts the patterns that are supposed to be universal; it has nothing to say about language-specific markedness patterns.

Third, predictability is quantifiable, thus moving us closer to a scientifically rigorous theory of the observations (see Hume 2004b,c). Markedness is not.

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Elizabeth Hume

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