

## **Markedness and the Language User<sup>1</sup>**

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**ABSTRACT.** The traditional approach to markedness over the past half century has been to posit certain language universals, build a theory based on these universals, and then attempt to fit speaker/listener variability into the common theoretical mold. In this paper I propose an alternative approach that begins at the level of the individual language user. The basis of markedness is argued to be the cognitive process, EXPECTATION, which is quantified in terms of probability. This approach correctly predicts patterns in individual languages to diverge from so-called universal patterns since EXPECTATION is tied to the individual speaker/hearer and defined according to the context, linguistic and/or extralinguistic, in which a pattern occurs. Since seemingly similar language patterns can differ in many ways from one language to the next due to e.g., the context in which it occurs, the person using it, the frequency with which it appears, etc., we correctly predict cross-linguistic variability based on differing levels of EXPECTATION. Yet, we also predict similarities across languages given that language is spoken by humans with common physiological and cognitive abilities.

**Keywords:** markedness, universals, expectation, probability, variability

### **1. Introduction**

The search for language universals has been an important goal of modern linguistics. Universal laws, of which markedness is assumed to be one, are proposed to underlie language acquisition, relations among linguistic elements in synchronic systems, language change and language loss (see, e.g. Jakobson (1963), Greenberg (1966)). With the establishment of markedness as a universal law of language, taking it to the next level and viewing it as an innate property of human language was a relatively minor step. Thus, with the advent of generative linguistics (Chomsky & Halle (1968)) markedness was reconceptualized as a property of languages determined by Universal Grammar rather than as a property of individual languages, as assumed by Trubetzkoy (1939). In this view, markedness theory is accorded a biological basis (Kean (1975)) and markedness values are assumed to be predetermined universally. Interestingly, in the roughly eighty years since the concept of markedness was originally proposed, it has grown from being a classificatory term to a predictive scientific concept as evidenced by that fact that markedness considerations are used to form the bases of theories of grammar such as the organization of place features (e.g. Rice (1996)), or the ranking of constraints in Optimality Theory (Prince & Smolensky (1993), de Lacy (2006)).

As a consequence, our approach to markedness has been to assume that universals exist, build a theory based on these universals, and then attempt to fit the variability observed across languages into the single theoretical mold. The approach outlined in this paper takes a different approach which harkens back to Trubetzkoy's (1939) view that the markedness value of a given element is dependent upon the language system in question. Even more specific, I propose that

we will be able to gain a clearer understanding of what we have been referring to as markedness by placing greater emphasis on the examination of patterns at the level of the language user. We begin with the language patterns of individual speakers/hearers in order to understand the complexity of the many contributing factors, linguistic and extra-linguistic, influencing those patterns. Markedness is thus calculated at this level with universal markedness emerging as an aggregate of these calculations. The result would be a theory that predicts both individual and cross-linguistic markedness.

In the section to follow I point to some of the problems with our current conception of markedness then in the following section sketch out in broad strokes the alternative approach building on the cognitive process, EXPECTATION.

## 2. Markedness: Problems and Challenges

In order to predict whether a particular sound pattern is marked or unmarked, we look to the sound that patterns asymmetrically from others within its class. A number of diagnostics commonly used in the literature to pinpoint the unmarked sound are given in (1).

- (1) An unmarked sound patterns asymmetrically from other sounds in being:
  - a. the target of phonological processes such as reduction, deletion, assimilation
  - b. the result of phonological processes such as epenthesis, neutralization, metathesis
  - c. more widely distributed
  - d. more phonetically variable
  - e. easier to produce
  - f. easier to identify (good perceptual cues)
  - g. more confusable with other sounds (poor perceptual cues)
  - h. more frequent in a language
  - i. more frequent across languages
  - j. acquired earlier
  - k. preserved in creole formation

Besides the fact that the predictions of these diagnostics are commonly falsified (see, e.g. Hume (2006)), this set of diagnostics raises questions such as the following. Why should frequency play a role in determining how a sound patterns? Why should a sound's distribution be relevant in predicting markedness and more specifically why is the sound with the *broadest* distribution considered unmarked? Why should the unmarked sound be more phonetically variable than the marked? What is the connection between epenthesis and deletion; that is, why should the unmarked sound be the one that is epenthesized but also the one that deletes? How can the unmarked sound be both easier *and* harder to identify? What does markedness predict if the diagnostics make different predictions? Since markedness is tied to the notion that one element patterns asymmetrically from others, why do such asymmetries exist?

Perhaps most importantly, why is the set of diagnostics in (1), as opposed to any other set, correlated with the unmarked? That is, what underlies the diagnostics? An unsatisfactory answer to this last question is that *markedness* unifies the diagnostics. Clearly, the problem with

this response is that it is circular: it provides no insight into what markedness actually is. Markedness does not explain the diagnostics, nor do the diagnostics explain markedness (Menn (1983), Lass (1975), Boersma (2003), Hume (2002)). Markedness is best considered a descriptive term, not a scientific concept.

### 3. The Expectation Model of Markedness

I would suggest, however, that there is a single property that underlies the diagnostics and provides a straightforward explanation to the questions raised above. The property is EXPECTATION<sup>2</sup>, a cognitive process of the language user; all speakers/hearers have expectations (either conscious or subconscious) about language patterns that they produce and perceive. These expectations reflect the person's experience with the patterns of his or her language. In language, as in other cognitive domains such as music (Huron 2006; Jones, Johnston and Puente 2006) and vision (Haith, Hazan and Goodman 1988), experience guides EXPECTATION and, in turn, influences an individual's behavior.

The fact that EXPECTATION influences human behavior is of particular relevance for our understanding of markedness. Although we often refer to the way that *languages* behave, it is in fact the behavior of the *language user* that is really at issue. It is the user that, for example, perceives the sound that becomes the epenthetic vowel or omits one sound as opposed to another. If we are to understand why certain sounds behave asymmetrically, we need to understand what it is that causes the language user to treat sounds differently. I suggest that EXPECTATION, defined as the probability function in (2), is at the root of this asymmetry.

$$(2) \quad \text{EXPECTATION} = p(x | C)$$

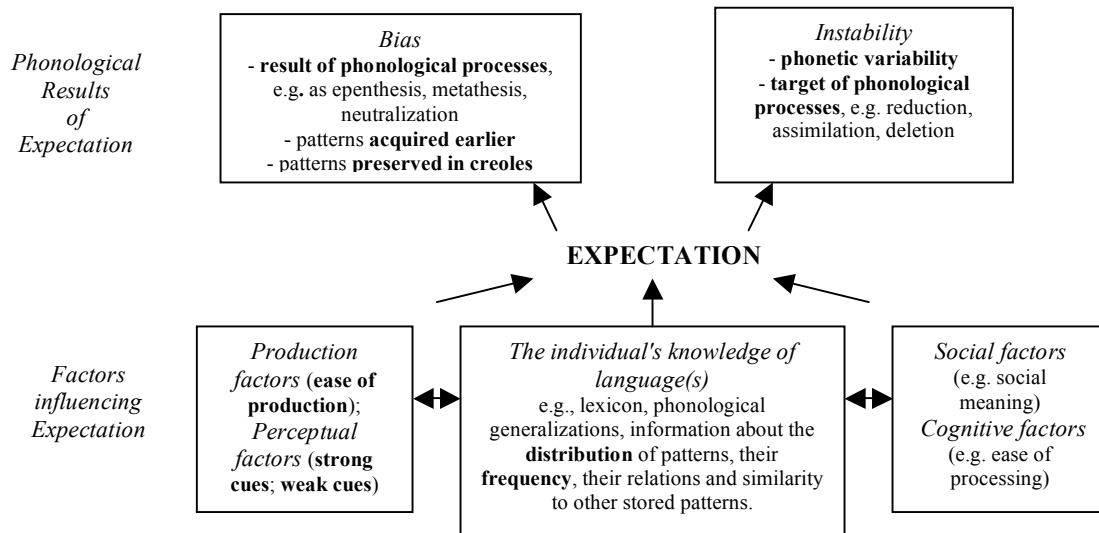
EXPECTATION is the probability of some random outcome  $x$  occurring in  $C$ , where  $x$  ranges over a subset of linguistic elements in language  $L$  and  $C$  is a specific context defined in linguistic and/or other terms, e.g. socially. Thus,  $L_x = \{x_1, x_2, x_3 \dots x_n\}$ , where  $x$  represents a set of features, phones, syllables, words, etc.

EXPECTATION is positively correlated with unmarkedness. Thus, in a language containing the set of sounds  $\{x, y, z\}$  where any of the three sounds can occur in a particular context ( $C$ ), if there is a higher EXPECTATION that  $x$  as opposed to  $y$  or  $z$  will occur in  $C$ ,  $x$  is considered less marked than  $y$  and  $z$ . Asymmetrical patterns in language thus reflect an imbalance in the expectation levels among members of a class.

Calculating the expectation value, i.e. probability<sup>3</sup>, that some sound, for example, will occur in a particular context is not a trivial undertaking. Due to page limitations, I am unable to delve too deeply into this matter; I refer the reader to Hume (2008) where it is laid out in more detail. Briefly, the calculation of expectation depends on a number of contributing factors which include: the individual's knowledge of language, articulatory demands, perceptual factors, social meaning and processing complexity. The extent to which these factors are weighted is an empirical question. While this brief description undoubtedly raises many questions, the main point that I hope to convey is that EXPECTATION has a mathematical basis with several factors contributing to its calculation.

In the EXPECTATION model of markedness, as illustrated in (3), traditional markedness diagnostics fall naturally into two general categories. They characterize (a) properties of language that result from a language user's expectations; or (b) properties that influence a language user's expectations about a language pattern. (Traditional markedness diagnostics appear in boldface.) The first class of properties can be further classified into EXPECTATION effects of BIAS or INSTABILITY. Bias effects reflect the fact that an individual's expectations lead to perceptual and production preferences for certain sound patterns. These biases form the basis of markedness diagnostics referring to (a) the results of phonological processes such as epenthesis, metathesis and neutralization, (b) earlier acquisition, and (c) preservation in creole formation. Expectation also leads to the INSTABILITY of expected patterns as captured in the markedness diagnostics which refer to (a) phonetic variability, and (b) the result of phonological processes such as reduction, assimilation and deletion. High expectation leads to **instability** of the relevant pattern, resulting in phonetic variability and making it prone to be the target of reduction, assimilation and deletion.

(3) The Relation of Markedness Diagnostics to EXPECTATION



Consider the following illustration. Imagine listening to a conversation that includes the sentences in (4) where the words 'for' and 'four' are inaudible for some reason, e.g., there is too much noise in the room, the speaker is talking too fast, you are distracted, etc.

- (4) a. *I was so hungry when I got home from work last night, I ate **for** hours.*  
 b. *I was so hungry when I got home from work last night, I ate **four** pizzas.*

It is quite likely that you would be able to recover the word 'for' and understand the meaning of sentence (4a) even if the word were inaudible. This is because there is little uncertainty as to which English word will come between 'ate' and 'hours' in this sentence. That is, there is a high EXPECTATION that the word 'for' will occur in this context, higher than other English words including 'big', 'an', 'through', 'apple', 'four', etc.<sup>4</sup> In the second sentence, on the other hand, there is less certainty concerning which word will occur between 'ate' and 'pizzas' since there are numerous words in English that could appear in this context, including 'one', 'two', 'three', 'cold', 'pepperoni', 'John's', etc.

The differing expectations associated with 'for' vs. 'four' in the sentences above have consequences for how each word is perceived and produced. Since expectation facilitates perception and production (Huron (2006) inter alia), the high expectation of 'for' in the context above creates a perceptual and production bias towards the word. Listeners are biased to perceive 'for' even if it is inaudible, an effect well established in the psycholinguistics literature (see Samuel 1981 on phoneme restoration). From a production perspective, the high expectation of 'for' suggests that its full presence is not crucial for conveying the meaning of the message. In other words, even if the word is not clearly produced, its canonical form can be inferred from the context of the sentence. This can result in instability in how the word is realized making the word prone to phonetic variability and reduction ('for' is pronounced as [fɔr] sometimes and as [fɹ] other times), or even deletion. On the other hand, there is a lower expectation that the word 'four' will occur in (4b) and thus less of a perceptual and production bias towards the word; consequently, the word will be more phonetically stable. This effect was illustrated in early studies by Fidelholz (1975) and Hooper (1976) who showed that there was more reduction in the first syllable of frequent words like 'forget' than in less frequent words such as 'forgo'.

A language user's EXPECTATION regarding a particular language pattern is thus correlated with two opposing results on linguistics systems: INSTABILITY and BIAS. All else being equal, the greater the level of EXPECTATION about a particular sound pattern, the greater the bias towards producing and perceiving that pattern, and the more likely there will be instability in its phonetic realization.

An individual's EXPECTATION about a language pattern is influenced by his/her knowledge of language(s), as indicated in (3). This knowledge includes, at a minimum, a lexicon and generalizations over the lexicon stored as symbolic representations (of e.g., features, sounds, syllables, etc.). From this stored knowledge, we are able to extract statistical information about sound patterns, about the distribution of patterns in the system, about how often these elements are used by the speaker/hearer, and about their relation and similarity to other stored elements. Knowledge of language, in this view, thus includes both qualitative (e.g. what the properties of the pattern are) and quantitative (e.g. how often a pattern occurs) information.

As indicated in (3) by the arrows going from INSTABILITY and BIAS at the top of the diagram to the individual's *knowledge of language* in the center, the results of EXPECTATION loop back and influence a person's knowledge of language. Thus, the result of any phonological change, e.g. vowel epenthesis or syncope, will modify an individual's phonological knowledge, qualitatively and/or quantitatively. An individual's knowledge of language also impacts factors relating to production, perception, social meaning and cognition (for discussion, see Hume & Johnson (2001)). These factors, fine-tuned by the individual's experience, also influence EXPECTATION.

The EXPECTATION model draws on evidence from a range of sources. The link between statistical patterns and markedness has precedent in works such as Greenberg (1966), Lass (1975), Boersma (2000, 2003), and Hume (2004). It also draws on converging evidence from experimental research on speech and word processing that consistently shows that statistical patterns in language influence how a person perceives and produces language (e.g., Hooper

(1976), Bybee (1985, 2001), Baayen & Lieber (1991), Frisch et al. (2000), Pollack et al. (1959), Savin (1963), Luce (1986), Luce and Pisoni (1998), Moder (1992), Pitt and McQueen (1998), Vitevitch and Luce (1999), Wang and Derwing (1994)). These findings are influencing theoretical approaches as evidenced by the emergence of stochastic models of language and language change (e.g. Broe (1993); Boersma & Hayes (2001); Frisch (1996); Pierrehumbert (2001, 2003); Frisch, Pierrehumbert & Broe (2004); Bod, Hay & Jannedy (2003) and articles therein).

The EXPECTATION approach is advantageous for a number of reasons. First, under the assumption that EXPECTATION underlies traditional markedness diagnostics, the diagnostics are independently predicted and the problems outlined in Section 2 are avoided, as discussed below. Second, the approach correctly predicts markedness patterns in individual languages to diverge from so-called universal markedness patterns since EXPECTATION is tied to the individual speaker/hearer and defined according to the context in which a pattern occurs. Since a language pattern can differ depending on context, who is using it, and the language system in which it occurs, we correctly predict cross-linguistic variability resulting from differing levels of EXPECTATION. However, because EXPECTATION is constrained by human perception, production and cognition, "universal markedness" effects are also explained. Third, an EXPECTATION-based approach to markedness provides the means of developing a predictive, unified and quantifiable theory of the observations. The mathematical measure of EXPECTATION is probability and as such probability theory becomes the linguist's tool in calculating the EXPECTATION value of linguistic elements.

In the remainder of this paper, I will expand to a limited degree on how the markedness diagnostics in (1) fit into the EXPECTATION model.

#### **4. Expectation Effects: Bias and Instability**

Recall that the markedness diagnostics signaling a BIAS effect due to high expectation include: the result of phonological processes such as epenthesis, metathesis, neutralization; earlier acquisition; and preservation in creole formation. Generally speaking, support for this approach would come from data showing that the so-called unmarked sound pattern in each case is the most probable (expected) pattern in the relevant context, all else being equal.

With respect to **epenthesis**, this approach is supported by Hume & Bromberg's (2005) study of epenthesis in French, English and Spanish which shows that the vowel that a language user perceives as epenthetic is the vowel with the highest probability of occurring in the relevant context (similar predictions hold for consonants). That is, it is the vowel with the highest degree of expectation associated with it. Recall that factors relating to, for example, perception, production and phonological knowledge contribute to an individual speaker/hearer's expectations. With regards to phonological knowledge, it is particularly instructive that the epenthetic vowels in the three languages studied have among the highest, if not the highest, (token) frequencies among vowels in the relevant contexts in each language, thus contributing significantly to the epenthetic vowel's high probability.

Unlike a traditional markedness approach, this approach makes the strong prediction that two languages with the same phoneme inventory and same patterns of contrast could have different epenthetic vowels, the difference being determined by probability, as a function of patterns of usage, as well as production and perception factors (at least). A comparison of Spanish and Maltese may offer a potential test case. The vowel systems of both languages include [i, e, a, o, u] yet the epenthetic vowel in Spanish is [e], while in Maltese it is [i]. All else being equal, [e] and [i] are predicted to be the vowels with the highest probability of occurring in the relevant phonological contexts in Spanish and Maltese, respectively.<sup>5,6</sup>

Similar results hold for **metathesis**. Consistent with the EXPECTATION model, Hume (2004) shows that in a given language, the structure that is realized as the result of metathesis is more probable than the structure undergoing metathesis (see also Blevins and Garrett 2004). That is, for two sounds or classes of sounds,  $xy$ , to undergo metathesis: a) the structure  $yx$  must be attested in the language; and b) the structure  $yx$  must be more probable than that of the structure  $xy$ . This approach differs from earlier accounts where it has been argued that the result of metathesis has better perceptual cues than the input (e.g. Hock 1985, Hume 1998). In the current model, the reason why 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 expectation and hence, speech processing. Sequences with poorer cues are more likely to undergo metathesis, while those with good cues are most likely to be the result since they tend to be more frequent in systems contributing to their higher probability in the particular context (Hume (2004b)).

Similar predictions are made for the result of other types of phonological processes such as **neutralization**. Since Trubetzkoy (1939) first linked neutralization to the concept of markedness, the process has been widely acknowledged as a markedness diagnostic. The term neutralization describes the loss of contrast among speech sounds in a given 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, the voiceless consonant, and this member is considered unmarked.

In traditional phonological accounts, it is commonly assumed that the member of an opposition that surfaces in a neutralizing context is the simplest articulatorily. In the EXPECTATION approach, the member resulting from neutralization may have the simplest articulation but it need not. Rather, it is the member of the opposition that a language user most expects in the relevant context, based on the factors laid out above. That articulation alone is not sufficient is shown by Vaux & Samuels (2005) who point to numerous cases of neutralization in which the output of neutralization is not necessarily the simplest member of the opposition in terms of production. These cases provide a good testing ground for the EXPECTATION model.

The bias towards the more probable is also supported by patterns of **language acquisition**. For example, Quiché-learning children master /ʃ/ 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.

Similarly, with respect to **creole formation**, Thomason (1993) shows that the properties of pidgins/creoles depend on the properties of the source languages. Those that are common to both varieties 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 that includes glottalized, labialized and uvular (vs. velar) stops, sounds that would typically be considered marked, but which occurred in both the parent languages. The claim that familiar sounds are preserved is consistent with the EXPECTATION model.

Recall that INSTABILITY can be observed in the form of phonetic variability and/or the target of reduction, deletion and assimilation. In traditional markedness approaches, the sound that patterns asymmetrically from other sounds in the relevant class with respect to these diagnostics is considered unmarked. In the present approach, the observation that one sound patterns asymmetrically reflects a statistical imbalance among the sounds of the relevant class. The sound (or sounds) with a high level of EXPECTATION will be prone to instability effects, all else being equal.

Support for this approach comes, for example, from patterns of t/d **deletion** in English (Jurafsky et al. (2001), Raymond et al. (2006)). The latter study focuses on alveolar stops /t/ and /d/ when they occur word-internally, e.g. as in *stop*, *better*, *advice*, or *it's*; that is, in any position other than the beginning or end of an orthographic word. Phonological factors such as syllable position contribute to predicting deletion: t/d in coda is more likely to delete than t/d in onset. In addition, word predictability emerged as a conditioning factor for an onset t/d in the flapping context, e.g. *better*: The more predictable the word containing a t/d is from the word that follows, the more likely t/d is to be deleted. For example, in comparing the deletion rates of /t/ in "better" in the sentences "it's *better than* nothing" vs. "it's *better hot* than cold", the /t/ in "better than" is more likely to delete than the /t/ in "better hot" since "better" is more predictable before "than" than before "hot". This finding is consistent with results from studies of word-final alveolar stop deletion (Jurafsky et al., 2001). This effect is also consistent with the EXPECTATION model: words associated with a higher degree of expectation in a given context will be less stable, resulting in more reduction.

One might argue that the instability of t/d in English is due to their weak perceptual cues or relatively simple articulation. These factors naturally contribute to the probability of occurrence of the stops. Yet, phonetic explanations alone are not able to predict all cases of segment instability. For example, Hume & Tserdanelis (2002) show, using traditional markedness diagnostics, that the labial nasal *m* in Sri Lankan Portuguese Creole must be considered unmarked as opposed to both the coronal and dorsal nasals that also occur in the language (coronal and dorsal have traditionally been considered less marked than labial). For example, the word-final labial nasal optionally deletes; dorsal and coronal nasals do not. Further, the labial nasal undergoes place assimilation to a following consonant; the coronal nasal does not. This instability can be traced to the observation that users have more experience with *m* than with other nasals in the language; in fact, the labial nasal is twice as frequent as its nearest

competitor *n*. While this approach runs counter to common assumption that coronal is the unmarked place of articulation, it is consistent with the EXPECTATION model: the labial nasal is predicted to be the least stable nasal in the language (see Hume (2003) for related discussion concerning markedness and place of articulation).

## 5. Factors influencing expectation

How **frequently** an element occurs within a language is often cited as a markedness diagnostic, dating back to Trubetzkoy (1939) and Greenberg (1966): the most frequent (or common) member of a class is unmarked. This receives support from psycholinguistic research in first and second language acquisition, and speech and word processing that has convincingly demonstrated that how a language user produces and perceives language is influenced by the individual's knowledge of his or her language, including the frequency with which linguistic patterns are used (e.g. Aslin et al. (1981), Best et al. (1988), Dupoux et al. (1997), Francis & Nusbaum (2002), Jusczyk (1997), Jusczyk & Aslin (1995), Lindblom (1990), Luce (1986), Polka & Werker (1997), Streeter (1976), Trehub (1976), Werker et al. (1981), Werker & Tees (1984, 1999)).

In terms of the present model, higher frequency correlates with higher expectation, all else being equal. It is important to acknowledge, however, that all is not always equal within a language system. Consequently, simply measuring type or token frequency will not always give an accurate picture of the contribution of language usage on an individual's expectations (for related discussion see e.g., Baayen & Lieber (1991), Bybee (1985, 2001), Frisch et al. (2000), Pollack et al. (1959), Savin (1963), Luce (1986), Luce and Pisoni (1998), Moder (1992), Pitt and McQueen (1998), Vitevitch and Luce (1999), Wang and Derwing (1994)). In order to fully understand the effects of usage on language patterns, several considerations must be taken into account including:

- word frequency
- the number of words that are phonetically similar to the word under study (a dense neighborhood can mitigate the effects of lexical frequency)
- the frequency of the relevant phonological pattern, e.g. phonotactics, contrast, syllable type
- whether or not the words are known to the listener
- the particular task required of the speaker/hearer (e.g. identification, discrimination)

Recall also from (3) that the phonological effects of INSTABILITY AND BIAS will also influence the frequency of language patterns.

**Distribution** has also long been considered a diagnostic of markedness: in a class of sounds, the sound with the broadest distribution is considered unmarked (Greenberg (1966)). Linking a sound's distribution to its probability is straightforward: given two elements *x* and *y*, if *x* has a wider distribution than *y*, it is likely that *x* is more frequent than *y*. This would have the effect of increasing the probability of occurrence of *x* over *y* and in turn influencing the language user's

EXPECTATIONS concerning  $x$  and  $y$ , which would add to any production or perceptual advantage that the sound might also have.

The contribution of **production** to high expectation is also straightforward in the present approach. Sounds and structures produced with less complex articulations tend to occur more frequently in a language than those with more complex articulations. The greater occurrence of the simpler sounds thus adds to the articulatory advantage that these sounds have and hence to their probability of occurring in a particular context. Of course, articulatorily complex segments also occur in languages and can be frequent. Click sounds, for example, are extremely frequent in some languages (see, e.g. Miller-Ockhuizen (2001) on clicks in Jul|hoansi). Closer to home, the voiced interdental fricative [ð] in English has a high token frequency in prevocalic position occurring word-initially in many common function words, e.g. *though, this, the, that*. In this context, therefore, the structure is highly probable and, as predicted, the interdental fricative displays EXPECTATION effects of instability in some dialects of English; for example, in African American Vernacular English, the interdental fricative is pronounced as an alveolar stop. This is precisely what we expect: Expectation is influenced both by frequency and phonetic factors.

As pointed out in Section 2, **perceptual** salience has been used in two ways in the markedness literature: an unmarked element can have low salience or it can have high salience. Given that both types of salience are used as a markedness diagnostic, there is no *a priori* means of determining whether a sound should be considered marked or unmarked given its salience. The current approach provides a straightforward explanation. Sounds and structures with **good perceptual cues** tend to occur in more words than those with weaker cues (Makashay (2001)). For example, the CV syllable, e.g. [ta], is generally considered unmarked in contrast to its closed syllable counterpart, e.g. [at]. From a phonetic perspective this is because CV generally has better cues to its identification than VC (e.g., Ohala (1981); Kawasaki (1982)). Thus, a language user will be **biased** towards CV syllables.

Note, however, that this does not mean that VC syllables in the same language cannot also show EXPECTATION effects. By taking into account the class of VC syllables in the language, all else being equal, the VC syllable type associated with the highest level of expectation *in that context* will be prone to the effects of bias and instability. For example, in a language with 3 final consonants [n, m, ŋ], if [m] occurs most frequently in this context (all else being equal), it will be associated with the highest level of expectation and show the results of bias and instability. The case of Sri Lankan Portuguese Creole discussed above illustrates this. For related discussion, see Boersma (2000).

As for sounds with **weak phonetic cues**, and hence low salience, it has been observed that they are more likely than sounds with better cues to undergo phonological processes such as assimilation, reduction and deletion (Jun (1995)). Low salience is thus related to the INSTABILITY dimension of the model. This gains further support by the observation that sounds and structures with weak perceptual cues can also be frequent in languages and hence, influence EXPECTATION, since they are generally simpler to produce than the corresponding sound with stronger cues, e.g. unaspirated vs. aspirated stops; stops as opposed to fricatives.

Thus, the reason why articulatorily simple sounds and perceptually salient sequences are typically unmarked is simply that, due to their inherent phonetic nature, they tend to occur more frequently in systems and, as a result, are used more. This will then contribute to their higher probability of occurrence in a particular context as well as to the user's expectations regarding these sounds. Yet, even articulatorily complex sounds or sequences with low salience can have a high probability of occurrence within a system and pattern as unmarked provided that their usage is high.

While in this brief discussion only a subset of the factors influencing EXPECTATION were discussed, it should be clear that there are several contributors that need to be taken into account in calculating EXPECTATION. Understanding the influence of EXPECTATION on language patterns also requires an understanding of how the factors in (3) *interact*. As shown in the figure, qualitative and quantitative aspects of language knowledge both influence and are influenced by all other factors. Based on these interactions, the statistical patterns in an individual's linguistic knowledge may play a lesser or greater role in shaping language. On the one hand, when, due to the confluence of factors, there is a statistical imbalance among, e.g., the sounds of a particular class in terms of the quantitative aspects of language knowledge, the sound with the highest degree of EXPECTATION due to this influence, will be prone to the effects BIAS and INSTABILITY.<sup>7</sup> On the other hand, when there is relative balance among the statistical levels of members of the class, we would expect phonetic, social and processing factors to show a greater effect on sound patterns, again through the EXPECTATION effects of BIAS and INSTABILITY. These points are elaborated on in Hume (2008).

## 6. Conclusion

In this short paper, I have proposed that traditional markedness diagnostics can be unified using a single metric: EXPECTATION. The mathematical measure of EXPECTATION is probability which moves us closer to a scientifically rigorous theory of the observations. This approach correctly predicts patterns in individual languages to diverge from so-called universal patterns since EXPECTATION is tied to the individual language user and defined according to the context in which a pattern occurs. Since seemingly similar language patterns can nonetheless differ from speaker to speaker and from one language to the next, we correctly predict cross-linguistic variability in terms of EXPECTATION.

Finally, in order to understand the complexity of human language it is suggested that rather than beginning with the assumption that language universals exist, it may be more fruitful to place greater emphasis on the examination of language patterns of individual users in order to gain a solid understanding of the many contributing factors and their interaction influencing those patterns. With this as a basis, we would then be in a position to build a theory that predicts both individual and cross-linguistic markedness.

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## Notes

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<sup>2</sup> The concept of expectation is also used in computational modeling of language, mainly with regards to syntactic phenomena. See, for example, various works of Dan Jurafsky (Stanford) and related discussion in Boersma (1998).

<sup>3</sup> One could also use log values instead of probability, the approach taken in, for example, Hume & Bromberg (2005).

<sup>4</sup> Note that this approach does not exclude grammatical class as a factor influencing EXPECTATION. In so far as the sentential context requires a particular grammatical item, the pool of candidates that can occur in that context is delimited by that class. The frequency with which each of the members occurs in the context, as well as the size of the candidate pool will influence EXPECTATION (measured as probability). The higher the frequency of a particular item, the higher the EXPECTATION will be that that item will occur. Frequency is tempered by candidate pool size: the greater the size of the pool, the more potential candidates there are and thus the probability associated with any one item occurring is lower than if the candidate pool were smaller.

<sup>5</sup> It is important to draw a distinction between productive epenthesis and lexical, non-productive epenthesis when it comes to testing the proposed account. I assume that lexical, non-productive epenthesis reflects patterns of language, including their usage, from the period of time in which the particular process of epenthesis was productive. These patterns may be the same as they are in the current state of the language, or they may not be. Since language patterns change over time, it is to be expected that the influence of these patterns on language users' expectations and hence, behavior can also change. Thus, it is not unreasonable to expect patterns of epenthesis to change as sounds patterns and their frequency are modified. For these reasons, I assume that only productive processes of epenthesis, as observed for example in loanword adaptation, can accurately reflect a native speaker/hearer's expectations about patterns in the language.

<sup>6</sup> A further prediction of this approach is that a language may have more than one epenthetic sound and hence, unmarked segment. Such a situation would arise if different contexts favor the occurrence of different vowels. For example, a coronal vowel may be most probable in the context of a coronal consonant, while a labial vowel may be most probable in a labial context. Japanese is one such language where more than one epenthetic vowel is observed, depending on context.

<sup>7</sup> The requisite level of disparity in statistical levels among elements of a class needed to observe such effects remains an empirical issue.

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