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Universals in Phonology

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ABSTRACT

This article asks what is universal about phonological systems. Beginning with universals of segment inventories, a distinction is drawn between descriptive universals (where the effect of different theoretical frameworks is minimized) vs. analytic universals (which are specific-theory-dependent). Since there are few absolute universals such as "all languages have stops" and "all languages have at least two degrees of vowel height", theory-driven or "architectural" universals concerning distinctive features and syllable structure are also considered. Although several near-universals are also mentioned, the existence of conflicting "universal tendencies" and contradictory resolutions naturally leads into questions concerning the status of markedness and synchronic explanation in phonology. While diachrony is best at accounting for typologically unusual and language-specific phonological properties, the absolute universals discussed in this study are clearly grounded in synchrony.

1. Introduction

My colleague John Ohala likes to tell the following mythical story about a lecture that the legendary Roman Jakobson gives upon arrival at Harvard University some time in the 1940s. The topic is child language and phonological universals, a subject which Prof. Jakobson addresses in his *Kindersprache, Aphasie und allgemeine Lautgesetze* (1941). In his also legendary strong Russian accent, Jakobson makes the pronouncement, "In all languages, first utterance of child, [pa]!" [1] He goes on to explain that it is a matter of maximal opposition: "[p] is the consonant most consonant, and [a] is the vowel most vowel." As the joke continues, a very concerned person in the audience raises his hand and is called on: "But, professor, my child's first utterance was [tʃik]." Prof. Jakobson carefully considers this surprising remark. In his mind he systematically compares [tʃ] and [p], [i] and [a], and [k] and Ø, obviously with some concern. He then asks the man the following questions: "Did your child have any other initial consonant than [tʃ]?" The man answers no. "Did your child have any other vowel than [i]?" Again, the man answers no. "My last question: Did your child always have the final [k]?" "Yes," the man replies. At this point Prof. Jakobson's face lights up as he triumphantly exclaims: "Axa! Don't you see? Phonyetic [tʃik], phonological /pa/!"

The above joke, I assume totally fabricated, never fails to get a laugh out of phonologists, who, I suspect, see a bit of themselves in this caricature. While funny, there is in fact a serious undertone to the above exchange. The story is quite impressive in how succinctly it reveals several major questions we face as phonologists interested in universal properties of sound systems: (1) What level of representation are we interested in? (2) How different can the levels be from each other? (3) What are the limits of theoretical interpretation? (4) How can claims of universality be validated or falsified? In other words, if [tʃik] is not a counterexample to the claim, what would be?

[1] Cf. "Ordinary child language begins, and the aphasic dissolution of language preceding its complete loss ends, with what psychopathologists have termed the 'labial stage'. In this phase speakers are capable only of one type of utterance, which is usually transcribed as /pa/" (Jakobson and Halle 1956:37).

In response to an invitation from the editor of *The Linguistic Review*, the present paper attempts to evaluate the current state of our understanding of phonological universals.[2] As it turns out, the Jakobson story is quite useful for sorting out the issues that must be addressed, if not resolved, in order to have confidence in the alleged phonological universals which have been variously "discovered", "deduced" or "hypothesized". For example, a traditional line of research in phonology concerns the comparison of segmental inventories for typological and universal purposes, e.g., to determine if there are specific consonants and vowels that must be present or features thereof that must be exploited in all languages. However, as a prerequisite, one is immediately faced with a number of decisions concerning how to establish the inventories that are to be compared. Among these are those listed in (1).

(1) a. the level: morphophonemic vs. phonemic vs. phonetic?
b. the function: contrastive vs. demarcative vs. allophonic
c. the domain: morpheme, word, phrase etc.

Consider, for example, the possible claim that all languages have voiceless stops (cf. §2). Is this a claim about the input consonants ("underlying representations") of morphemes, surface ("phonemic") contrasts derived from the comparison of words in isolation, or allophonic ("phonetic") realizations of the input segments anywhere within the phrase level? If the claim does not concern the phonetic level, but a more abstract level of representation, a second question concerns the latitude a phonologist can take in (re-)analyzing a system to fit an alleged universal. Phonologists adhering to different theories will certainly draw different conclusions. This brings us to the following paradox concerning the role of theory in cross-linguistic research: While one needs theory to describe languages, one has to abstract away from individual theories to evaluate the resulting descriptions. That is, one has to "normalize" the data according to some general standard that minimizes the differences between the interpretations that different theories accord to the data. The final question is how to do all of the above in such a way that it is clear what would falsify a claimed universal.

It is these kinds of issues that I would like to explore in this study. It is particularly timely to take stock of what we know about universals of sound systems, given recent trends within the field of phonology. Since I have already referred to the problem of representations, consider the position taken by the four frameworks in (2).

(2)

Framework	Representations	in terms of
Structuralist phonology	contrastive	phonemes, allophones
Generative phonology	morphophonemic	URs, (ordered) rules
Non-linear phonology	syntagmatic, geometric	tiers, trees, grids, domains
Optimality theory	n/a (?)	ranked, universal, violable constraints

[2] In producing this appraisal I have profited from discussions with a number of colleagues who have shared their work and insights with me, especially Nick Clements, Andrew Garrett, Carlos Gussenhoven, John Harris, Sharon Inkelas, Keith Johnson, Aditi Lahiri, Ian Maddieson, Fritz Newmeyer, John Ohala, Richard Rhodes and Leo Wetzels. I also am grateful to the editor and to two anonymous reviewers for comments on the original subumssion, as well as to Charles Chang, Marc Ettlinger, Erin Haynes, Yuni Kim, Teresa McFarland, Ruth Rouvier, Ange Strom-Weber, and Sam Tilsen for their stimulating participation in my Spring 2007 Seminar on Codas and Finals.

If structuralist phonology gave us a framework to exploit the phonemic insight, classical generative phonology provided the first tools to do morphophonemic analysis in a general and revealing way. Non-linear (autosegmental/metrical) phonology expanded these capabilities by incorporating syntagmatic representations. This in turn facilitated the developments in lexical phonology and prosodic domain theory, which emphasized the relation of phonology to morphology and syntax. Whether by allophonic statement, rule, or principle, and despite their differences, all three frameworks shared two concerns: (i) What are the underlying representations? (ii) How do we bring these underlying representations to the surface? These questions dominated phonological analysis and inspired periods of descriptive prosperity, which in turn provided the database required to test for phonological universals. Specifically, such phonological investigations allowed Maddieson (1984, 1991) and Maddieson and Precoda (1990) to establish the UCLA Phonological Segment Inventory Database (UPSID), the most widely used database for typological and universal research in phonology.

In recent years, however, there has been a general trend away from questions of underlying representations. This has been due to two strong influences: (i) optimality theory, whose output orientation has pushed phonology towards the surface; (ii) technology, whose increasingly accessible tools have made phonology more instrumental, experimental, computational, and statistical. As a result, much of current phonological research has become more functional, more phonetic, more quantitative, and some might argue, more complete and explanatory (Boersma 1998, Hayes, Kirchner and Steriade 2004). Just as there were "shallow" minority approaches to phonology in the 1970s (e.g. Hooper [Bybee] 1976), some researchers have come to question the reality of underlying forms and the need to distinguish two levels at all. While this probably doesn't make the above problems disappear, the trend does mean that phonologists have been more willing to look at things from a phonetic perspective: If the claim "All languages have voiceless stops" is true at any level, it would be because there is a functional (e.g., perceptual, communicative) motivation for languages to exploit such sounds—or rather, the formant transitions which make [p, t, k] audible.

On the other hand, there still is a lot of abstract modeling going on in optimality theory (e.g., McCarthy, in press) and elsewhere (e.g., Calabrese 2005, Scheer 2004). What this means is that we have to consider universals from both the inductive approach represented by Maddieson (1984), drawing on the UPSID database of 451 languages (Maddieson and Precoda 1990), as well as deductive claims of theories which either extract from typically smaller databases or are perhaps even "free standing theories" (Prince 2007). While this appears to correspond to Newmeyer's (2007) distinction between "surface" vs. "deep" universals in syntax, I prefer a slightly different take: For each case, we have to determine to what extent the result or claim is intended as a "descriptive universal" vs. an "analytic universal". For example, the claim "All languages have voiceless stops", if taken to be a descriptive statement, would be falsified by Yidiny, whose only stops are /b, d, ɟ, g/, pronounced [b, d, ɟ, g] (Dixon 1977:31). If taken to be an analytic statement, the stops could be reanalyzed /p, t, c, k/, with redundant voicing. The first interpretation is based on observation (i.e., the phonetic shape of outputs) coupled perhaps with what Dixon (1997:128) calls Basic Linguistic Theory: "the fundamental theoretical concepts that underlie all work in language description and change, and the postulation of general properties of human language." The second is specific-theory-dependent. In this case Yidiny would fail to be a counterexample by any theory that would necessarily interpret the single set of stops [b, d, ɟ, g] as underlyingly voiceless. As the example highlights, descriptive universals are typically more straightforwardly falsifiable than analytic universals. Returning to the above anecdote about the mythical Jakobson event, we now understand the joke: The audience takes the claim as a descriptive universal, whereas the professor's response is to save it by converting it to an analytic universal. It is therefore important to determine the intention behind each claimed universal,

which researchers do not always make explicit. We will observe this problem in much of the discussion to follow.

The remainder of this study is organized as follows. Drawing heavily on the UPSID database, §2 provides a brief overview of what is known about universals of phonological inventories, first of consonants, then of vowels. §3 then turns to consider what I'm calling "architectural universals": those universals which are claimed by specific theories, models or research agendas. §4 then addresses the issue of universal tendencies. In §5 I conclude by briefly considering whether phonological universals should instead be approached from a diachronic perspective.

2. Universals of phonological inventories

In this section I address the traditional question of what is universal about phonological inventories. Consonant systems will be treated in §2.1, followed by vowels in §2.2. While some of the difficulties inherent in doing research on phonological universals were referred to in §1, it may be useful to consider what is meant by a phonological universal. On the face of it, the term "phonological universal" would suggest a property that every phonology should respect. This of course implies that every language does in fact have a phonology. For our purposes let us take this to mean a structured or relational sound system that is not equivalent to the articulatory or acoustic properties of the phonetics, whose universal properties have also received attention (cf. Maddieson 1997). It is hard to imagine what a language without a phonology might look like, perhaps the extreme characterization in (3):

(3) A language without a phonology would lack
   a. a fixed inventory of distinctive segments
   b. any sequential constraints on segments

In the terminology of Martinet (1960), such an impossible language would fail to systematize both paradigmatic oppositions as well as syntagmatic contrasts. The same word might be pronounced indifferently as [pa], [ap], or even [tʃik]. In this "anything goes" situation, it would make little sense to talk about input and output or anything "phonemic". Minimally, one cannot have a phonological system in the absence of distinctive consonant and vowel phonemes whose linear ordering is significant. However one wishes to model phonology, we expect at least two levels whose distributional constraints and alternations may be relatively slight vs. quite extensive.

While the above characterization is a minimum, there is much more that we expect of all phonologies with respect to their segmental inventories and combinatorics. Concerning inventories, one might first seek to establish what the upper and a lower limits are as to what is possible: How few contrastive segments must a phonological system have in order to be viable? At the other end of the scale, how many contrasts can a phonological system support without becoming too "crowded"? As mentioned, the most extensive resource available to investigate these and other questions is the UPSID database of 451 languages (Maddiesion and Precoda 1990), which contains languages with as few phonemes as 11 (Pirahã, Rotokas) and as many as 141 (!Xu).[3] Pirahã is reported to have 8 contrastive consonants and 3 contrastive vowels, while Rotokas has 6 contrastive consonants and 5 contrastive vowels. This raises the question of whether a phonology could have fewer than 11 phonemes, and if so, how few? At the other

[3] Unless otherwise noted, citations and calculations from UPSID were obtained with the web interface developed by Henning Reetz: http://web.phonetik.uni-frankfurt.de/UPSID.html.

extreme, it can be noted that even !Xu does not exploit all of the distinctive oppositions which are humanly possible. Might there be a language with significantly more than 141 phonemes?

Similar questions arise concerning sequential constraints. Perhaps the simplest situation is one where all sequences are iterations of CV, i.e. where words are CV, CVCV, CVCVCV etc., and there are no restrictions on distributions. At the upper limit of sequential possibilities are languages with complex sequences of Cs and Vs—ultimately, words consisting solely of consonants or vowels (see §2.3).

All of the above is, of course, well-known and unsatisfyingly general: We would like to establish that all languages have specific consonants and/or vowels. However, as mentioned in §1, the study of universals is fraught with difficulties. Up until now I have used the term "phoneme" as if phonologists all agree on how to do phonemic analysis and establish phonemic representations, which is of course not the case. Hockett (1963:24) perceptively notes in this regard that "phonemes are not fruitful universals." His example concerns the analysis of /a/ as an open feature on consonants in Kabardian such that /ka/ would constitute a single unit phoneme (cf. §2.2). Just as one should not typologize on the basis of an individual linguist's analytical preferences, universals are necessarily based on the assumption of uniform comparability across languages. This is what Ian Maddieson attempts to create in UPSID. In each case, he has a choice between sticking to the original phonemic analysis or in reinterpreting it by some consistent standard. The task is extremely difficult, compounded by the question of how similar the phonemic system should be to the phonetic realizations. This, in turn, is related to the question of what we mean by "contrastiveness" and how it is encoded. Despite these problems it is possible to extract universal properties both of consonants and vowels, as we shall see in the following two subsections.

2.1. Consonants

In this section the goal is to determine what must be present in a consonant inventory, i.e. with what is generally known as "absolute universals". A wide range of consonant systems are attested in the world's languages, as can already be seen from Trubetzkoy (1939) and Hockett (1955). With 95 consonants (of which 24 are clicks), !Xu contains the largest system of surface-contrastive consonants in UPSID followed by Archi with 81. Obviously these systems are not going to be useful for the purpose of determining the minimal consonant system which a language requires in order to be a language.

At the opposite end is Rotokas, which has only the six contrasting consonants in (4).

(4)

Firchow and Firchow (1969)			UPSID (Maddieson 1984)		
p	t	k	p	t	k
ƀ	ř	g	β	ɾ	g

As seen, Rotokas has two series of consonants. Maddieson (1984:367) interprets Firchow and Firchow's [ƀ] and [ř] as a voiced non-sibliant fricative and a voiced tap, respectively (I have replaced Maddieson's [D] with [ɾ]). Rotokas has received a lot of attention for having the smallest consonant system of the 451 languages in UPSID, as well as for its lack of nasality (either on consonants or vowels). While it clearly has a series of voiceless stops /p, t, k/, the question is how to interpret the other series, consisting of a fricative /β/, a tap /ɾ/, and a stop /g/. I reproduce below what Firchow and Firchow (1969:274) say about the realization of these phonemes (I assume that their [ǥ] is IPA [ɣ]):

> "The allophones of /ƀ/ are [ƀ], [b], and [m], which fluctuate freely in all positions...."

"The allophones of /ř/ are [ř], [n], [l] and [d], which fluctuate freely in all positions...."

"The allophones of /g/ are [g], [g̈], [ŋ], which fluctuate freely in all positions. The allophone [g̈] is predominantly heard word medially...."

Especially given the above fluctuations, many phonologists would be tempted to interpret these consonants as the underlying voiced stops /b, d, g/, or perhaps as the archiphonemes /B, D, G/, specified only for place and voicing. Although Firchow and Firchow identify these consonants simply as "voiced" in their table on p.273, neither they nor Maddieson abstract away in presenting the phonemic system in terms of a natural class of stops /b, d, g/, continuants /β, ɾ, ɣ/ or nasals /m, n, ŋ/. Maddieson (1991:196) states his methodology as follows: "Segments are positively specified for those attributes possessed by the most basic allophone of the segment in question. In most cases this is the most frequent allophone, but sometimes there are reasons for thinking that another phonetic form is more basic, particularly when the more common form seems like a relaxed variant of the other." The /β, ɾ, g/ analysis was apparently established on the basis of these being the most frequent allophones. However, [β] and [ɾ] can be interpreted as "relaxed variants" of [b] and [d], which would yield an underlying system /p, t, k, b, d, g/, more in line with the phonological [±voice] analysis. Firchow and Firchow mention that the nasal allophones "predominate" in the Aita dialect whose consonant system they therefore present as /p, t, k, m, n, ŋ/ (but see Robinson 2006, who found a contrast between /b, d, g/ and /m, n, ŋ/ in Aita, which he reconstructs to Proto-Rotokas). As Firchow and Firchow further explain, "In Rotokas Proper, however, nasals are rarely heard except when a native speaker is trying to imitate a foreigner's attempt to speak Rotokas" (p.274).

The above should amply demonstrate Hockett's point concerning the precariousness of establishing universals on the basis of individual phonemes. Assuming that we do not analyze the voiced series as nasals, Rotokas establishes that a consonant system need not include nasals, laterals, or glides. If the voiced series is interpreted as /b, d, g/, or if /b̷/ and /ř/ are approximants, Rotokas would also establish that a language does not need fricatives (or affricates). All of these gaps are supported by several other languages in the UPSID database.

Continuing to consider the other small consonant inventories in UPSID, it turns out that only 10/451 or 2.2% have 10 contrastive consonants or fewer, as summarized in (3).[4]

(5) Languages in UPSID with 10 or fewer contrastive consonants

			T = 36				D = 21			N = 13		F = 10			G = 6	
6	:	Rotokas	p	t	k		β	ɾ	g							
8	:	Hawaiian	p		k	ʔ		l		m	n			h	w	
		Nasioi	p	t	k	ʔ	b	ɾ		m	n					
		Pirahã	p	t	k	ʔ	b		g				s	h		
		Taoripi	p	t	k			l		m		f	s	h		
9	:	Gadsup	p	t	k	ʔ	β	d		m	n					y
		Roro	p	t̪	k	ʔ	b	ɾ̪		m	n̪			h		

[4] I do not include the quotation marks on segments, e.g., "t" and "d", which indicate that Maddieson was not able to determine whether the stops were dental or alveolar. This notation can be recovered from UPSID directly. An anonymous reviewer has pointed out that Bruce Moren and Ove Loventz have also addressed the issue of how to analyze languages with small segmental inventories in some detail:
URL:http://www.phil.muni.cz/~docekal/egg/handouts/MorenWeek1bho.pdf

10 :	Ekari	p	t		k		b	d		gl	m	n			w	y
	Maxakalí	p	t	tʃ	k	ʔ	mb	nd	ndʒ	ŋg				h		
	Sentani	p	t		k			d			m	n	f	h	w	y

I have arranged the consonants in terms of five general classes of segments of decreasing frequency: voiceless and glottal stops (T), voiced stops or continuants (D), nasals (N), voiceless fricatives (F), glides (G). I have grouped /β, ɾ, l/ with /b, d, g/ since none of the above languages contrasts voiced oral stops and continuants.[5]

The above minimal systems show several striking properties. First, all of the languages have voiceless stops. Second, no other language organizes its small consonant inventory into two series (of whatever sort), as Rotokas does. Beyond this there is a lot of variation. Maxakalí is the outlier in at least two ways. First, it has the only underlying prenasalized consonants, as Maddieson interprets them. In Gudschinsky, Popovich and Popovich's (1970) analysis, the nasals /m, n, ɲ, ŋ/ partially denasalize to [mb, nd, ndʒ, ŋg] before an oral vowel (a common occurrence in Amazonian languages; see also Wetzels 2007). Second, /tʃ/ and /ndʒ/ (or /ɲ/) are the only palatals other than the glide /y/ and the only affricates in the 10 languages. (However, Maxakalí would be like Rotokas in having only two series of consonants except for its /h/.) Also noteworthy is the laterally released /gl/ of Ekari. It is also interesting to note that all but Hawaiian, Pirahã, and Maxakalí are spoken in New Guinea.

The languages in (5) suggest certain tendencies both in terms what occurs in small consonant inventories and what does not (no voiced strident fricatives /v, z/, no ejectives, implosives etc.). As Lindblom and Maddieson's (1988) note, more complex or "marked" sounds are more likely to occur in larger inventories. We do clearly see that all of the languages have voiceless stops—but is this a universal? Within the 451 languages in UPSID, only four Australian languages or .9% lack voiceless stops: Bandjalang, Dyirbal, Mbabaram, and Yidiny.[6] In each of these a single series of voiced stops is posited. While there is some phonetic variation in some cases, Dixon's (1977:32) statement about the Yidiny stop system /b, d, ɟ, g/ is quite clear: "Stops are almost always voiced. Partly voiced allophones are sometimes encountered word-initially." To save the universal, can these stops be instead interpreted as /p, t, c, k/, which happen to be redundantly voiced?

The question is: Given that UPSID is based on contrastiveness, why was the non-contrastive voicing of [b, d, ɟ, g] analyzed as underlying? This points to the dual phonemic-phonetic nature of the database: On the one hand, UPSID is designed to capture contrasts, e.g. whether dental and alveolar stops contrast. When there is a contrast, /t̪/ and /t/ are uncontroversially set up. On the other hand, when there is no contrast and the realization is invariant, the entry is based on the phonetics (if known): there are, therefore, both /p, t̪, k/ and /p, t, k/ systems. When there are allophones, however, one of them has to be chosen to represent the contrast. UPSID sometimes agrees with the interpretation in the original source (e.g., Rotokas), sometimes does not (e.g., Maxakalí).

Turning to Yidiny, a reasonable option is to exploit contrastiveness: Since the voicing of [b, d, ɟ, g] is predictable, voicing need not be specified in the underlying representations. Now, under the claim that voicing is universally privative (Anderson & Ewen 1987, Lombardi 1991,

[5] In other languages there are in fact alternations between [l] and [d] which make it difficult, perhaps arbitrary, to decide between an /l/ vs. /d/ representation. Thus, UPSID follows my analysis of Fe'fe' (Bamileke) with /d/ which becomes [l] except after a nasal (Hyman 1972), while Vennemann (1972) posited an /l/ which becomes [d] after a nasal.

[6] North Carolina Cherokee is reported only to have the stops /d, g, ʔ/, taken from Bender and Harris (1946), who analyze [t] and [k] as /hd/ and /hg/.

Lahiri and Reetz 2007), the lack of specification is equivalent to voiceless. We therefore can express the universal in one of the two ways in (6).

(6) Consonantal Universal #1

a. Every phonological system has stops (= descriptive)
b. Every phonological system has stops which are laryngeally unspecified (= analytic).

The formulation in (6b) holds, of course, only if [-voice] is never needed (cf. the discussion of [-round] in §3). What's important is that there is no corresponding universal requiring languages to have oral continuants, nasals, etc.

Assuming that the ten languages in (5) are representative of the smallest consonant systems, and that six contrastive consonants is the absolute minimum, neither formulation in (6) is sufficient. We still need a way to rule out unattested systems such as those in (7).

(7) a. /p, t̪, t, c, k, q/
b. /t, t^h, d, d^h, n, l/

Although (underspecified) stops are the only manner universal which holds across languages, a consonant system cannot consist of a single series of stops, as in (7a). Firchow and Firchow (1969:276) point out that the following universal of Hockett (1963:26) cannot work for Rotokas: "Every phonological system contrasts phonemes that are typically stops with phonemes that are never stops." Since /p, t, k, b, d, g/ is a reasonable analysis of Rotokas, we cannot require that an underlying consonant system include non-stops. What we can require to rule out (7a), however, is that a consonant system exploit a second feature. In the spirit of Hockett, we might state the second universal as in (8).

(8) Consonant Universal #2

Every phonological system contrasts phonemes which are [-cont] (= stops) with phonemes that are specified with a different feature.

In Rotokas the second feature is [+voice], whereas features such as [+cont], [+nasal], etc. might also be possible.

This still does not take care of the impossible system in (7b), which consists solely of alveolar consonants. We need to add that all languages exploit place of articulation:

(9) Consonantal Universal #3

Every phonological system contrasts phonemes for place of articulation.

Taken together, we now predict that the following unattested systems of six consonants might in fact be possible:

(10) a. /p, t, k, ʋ, ɾ, ɣ/ (stop vs. approximant)
b. /p, t, k, m, n, ŋ/ (oral vs. nasal)
c. /p^h, t^h, k^h, p, t, k/ (aspirated vs. unaspirated)
d. /p, t, k, f, s, x/ (stop vs. fricative)

(10a,b) are very similar to the variation already found in Rotokas. Many systems have the contrasts in (10c) and (10d) to exclusion of voiced obstruents, but they seem always to have

more, e.g. voiced stops, nasals, liquids, and/or glides. I see, however, no principled way to rule these out.

The systems in (10) exploit three places of articulation x 2. The universal in (9), says nothing about the number of places of articulation which must be distinguished. As Hockett (1963:27) aptly noted: "No phonological system has fewer than two contrasting positions for articulation for stops." There are many languages missing any one stop of the series /p, t, k, b, d, g/, especially /p/ and/or /g/, or any two from the same place of articulation. However, when all consonants are taken into consideration, UPSID reveals that languages may lack bilabials (e.g., Wichita[7]) or velars (e.g., Klao, Vanimo), but not coronals. The diglossic situation in Samoan in (11) shows that a language can lack /t/, /d/ and /n/ (Duranti 1994:44-45):

(11) a. Tautala lelei 'good speech'

p	t		ʔ
m	n	ŋ	
f	s		
v	l		

(+ /k, h, r/ in borrowings)

b. Tautala leanga 'bad speech'

p		k	ʔ
m		ŋ	
f	s		
v	l		

So-called good speech has the alveolar oral and nasal stops /t, n/, whereas these become the corresponding velars /k, ŋ/ in bad speech. As Duranti puts it: "The first is always used in writing and most of the time in shows, church services, and other church-related activities. The second, bad speech, is characteristic of both casual every day interaction and traditional formal events...." (p.44). While bad speech is lacking /t/ and /n/, it still has the coronals /s/ and /l/. We thus can propose the fourth consonantal universal in (12).

(12) Consonantal Universal #4

Every phonological system has coronal phonemes.

That is, all languages have at least a contrast between coronals and one other place of articulation: "languages in all parts of the world have at least one coronal consonant—there are no exceptions in UPSID, and also none are known outside the sample...." (Maddieson 1991:200). This allows us to conclude that six-consonant systems such as in (13a-c) should also be possible vs. the system in (13d):

(13) a. /t, k, b, d, n, ŋ/ (no labials)
/t, k, n, ŋ, l, s/

b. /p, t, b, d, m, n/ (no velars)
/p, t, m, n, l, s/

c. /p, k, m, ŋ, l, s/ (no coronal stops or nasals)

d. /p, b, k, g, m, ŋ/ (*no coronals)

The above logical discussion of potential six-consonant systems should give us some pause, however, concerning the UPSID sample: Had Rotokas not been among the 451 languages, we would not know, first, that such a small consonant system is possible, and second, that a

[7] UPSID includes /m/ as the only bilabial consonant of North Carolina Cherokee, which Bender and Harris (1946:20), however, characterize as "very rare... It occurs only in a few morphemes, mostly obvious foreign borrowings...."

consonant system of whatever size can consist solely of an opposition between two classes, e.g., [±voice]. Even other six-consonant systems not in UPSID apparently have at least three classes, e.g., /t, k, b, d, ɸ, s/ in Western Lakes Plains languages such as Iau (Bateman 1990) and Kirikiri (Clouse and Clouse 1993).

In summary, we have been able to establish four universals that characterize all consonant systems. If correct, they can be taken as *definitional* of a consonant system. In the next subsection I consider universals of vowel systems.

2.2. Vowels

Compared to consonants, vowels are ideal for universals/typological research. First, there is a relatively small number of vowels per language, compared to consonants.[8] Second, in most languages vowel contrasts are based on a relatively small number of features. These properties have allowed phonologists to establish typologies of underlying vowel contrasts such as the one of Trubetzkoy (1969:69 [1939]) in (14), where sonority = aperture and timbre = color (front/round):

(14) a. triangular systems, e.g. /i, e, u, o, a/
"in which all vowel phonemes possess distinctive properties based on sonority. Distinctive properties of timbre are found with all vowels except the maximally open vowel phoneme. The latter phoneme is outside the oppositions of localization."

b. quadrangular systems, e.g. /i, e, u, a/
"in which all vowel phonemes not only possess distinctive properties based on degree of sonority but also distinctive properties of timbre"

c. linear systems, e.g. /ɨ, ə, a/
"in which the vowel phonemes possess specific degrees of sonority but no distinctively relevant properties of timbre"

Crothers (1978) critiques the distinction between triangular and quadrangular stems on the basis that nothing seems to follow from whether there is a front-back distinction among low vowels or whether a language has an odd vs. even number of vowels. There also are vowel systems which are not as symmetric as the above triangular and quadrangular characterizations suggest. However, as we will see, it is useful to distinguish at least between vowel systems which incorporate frontness and/or roundness vs. the linear or *vertical* systems which do not.

Following the same strategy as for consonants, we note, first, that the smallest vowel systems in UPSID contain three vowels. The following 23 languages in UPSID have only three short vowels in their vowel inventories:

[8] The vowel inventory of a language is, however, not universally smaller than its consonant inventory: Iau (Bateman 1990) six consonants and eight vowels, while Wãnsöhöt (Puinave) (Girón Higuita and Wetzels 2007) has eight consonants and eleven vowels. Leo Wetzels (personal communication) has informed me of several Nambikwaran languages which have oral, nasal, creaky and nasal creaky vowels, hence more vowels than consonants: Kithãulhu (18V, 13C), Sararé (16V, 9C), Lakondê (16V, 11C), Latundê (16V, 11C).

(15) a. /i, u, a/ (11) : Aleut, Arrernte, Diyari, Dyirbal, Gugu-Yalandyi, Inuit, Kalkatungu, Ngiyambaa, Tsimshian, Western Desert, Yidiny
b. /ɪ, ʊ, a/ (4) : Bella Coola, Caddo, Garawa, Yanyuwa
c. /i, ʊ, a/ (1) : Haida
d. /ɪ, ʊ, ɐ/ (1) : Yolngu
e. /i, u, æ/ (1) : Shilha
f. /i, ɯ, a/ (1) : Jaqaru
g. /i, o, a/ (1) : Pirahã
h. /ə, o, a/ (1) : Qawasqar

Five additional languages have three short vowels, but three or more long vowels: Arabic, Gadsup, Ngizim, Ojibwa, Totonac. Despite the apparent differences in phonetic detail, many of the languages show variations on the expected high front, back round and low central unrounded vowels of the "vowel triangle" /i, u, a/. The low vowel is slightly raised in Yolngu (which also exhibits an entirely lax vowel inventory) and fronted in Shilha. The back vowel is unrounded in Jaqaru and lowered in Pirahã. Finally, all vowels are non-high in Qawasar, which also lacks a front vowel.

On the basis of the above minimal inventories we can establish the universal in (16).

(16) Vocalic Universal #1

Every phonological system contrasts at least two degrees of aperture.

As Maddieson (1997:636) puts it, "No language is known which does not have some distinctions of height."[9] Vowel systems which have four or more vowels also abide by this universal. Thus, there no "horizontal" vowel systems of the sort in (17).

(17) a. /i, ɨ, u/, /i, ü, u/, /e, ə, o/, /e, ø, o/
b. /i, ü, ɯ, u/, /e, ø, ɤ, o/

As the systems in (15) already indicate vowels systems may fail to exploit either frontness or roundness. Two languages in UPSID lack a front vowel:

(18) a. Qawasar

ə		o
a		

b. Yessan-Mayo

ɨ		
ɜ		
a		ɒ

On the other hand, the following four languages lack any rounded vowel:

(19) a. Jaqaru

i		ɯ
	a	

b. Alawa

ɪ		ɯ
e		a

c. Nunggubuyu

ɪ		ɯ
	ʌ	
	a	

d. Nimboran

i	ɨ		ɯ
e		a	ɤ

[9] For this to hold as underlying phonological universal, it is necessary that a three-vowel system /i, u, a/ be analyzed with an aperture feature, e.g. {i}, {u} and {a}, and not solely along a color dimension of Front, Round and Ø (neither).

We have already seen Jaqaru, repeated in (19a), which has a minimal triangular system with /ɯ/ occurring instead of /u/. /ɯ/ also occurs in the place of /u/ in Alawa in (19b), where I have arranged the four vowels as a 2 x 2 grid: front vs. non-front, high vs. non-high. It is harder to interpret the four vowels of Nunggubuyu in (19c) in this way, since /ʌ/ occurs instead of /e/. Finally, Nimboran lends itself to a horizontal 3 x 2 display: front, central and back vowels which are either high or non-high.

Unless we were to dictate that the languages in (18) and (19) must be reinterpreted to contain front and/or round vowels, it appears that languages can exist perfectly well without one or another. Another strategy might be to determine if these features are exploited elsewhere in these languages, e.g. on glides. Both Qawasar and Yessan-Mayo have the glide /y/ (and Yessan-Mayo has the glide /w/). Although I am not sure this will hold up, on the basis of UPSID it is possible to establish the vocalic universal in (20).

(20) Vocalic Universal #2

Every phonological system has at least one front vowel or the palatal glide /y/.

Turning to roundness, of the languages in (19), all but Nimboran have the rounded glide /w/ (as well as /y/). Since Nimboran has neither we are not able to establish a rounding universal corresponding to the one in (20). It is clear from Anceaux's (1965) allophonic statements that Nimboran does not exhibit rounding even at the phonetic level. (One should not be confused by his orthography, where "y" represents /ɨ/ and "u" and "o" represent /ɯ/ and /ɤ/, respectively.) Rather than rounding, we can instead establish the universal in (21).

(21) Vocalic Universal #3

Every phonological system has at least one unrounded vowel.

In fact, there is no language in UPSID that has only one unrounded vowel, rather two seems to be the minimum (found in 23 languages).[10]

Besides unrounded vowels, no language in UPSID lacks back vowels. (52 languages have the minimum of one back vowel.) However, it is harder to establish the corresponding universal in (22).

(22) Vocalic Universal #4

Every phonological system has at least one back vowel.

This is because UPSID has reanalyzed all of the alleged vertical vowel systems. Commenting on aperture and vertical systems, Ladefoged and Maddieson (1996:286) state:

> "All languages have some variations in vowel quality that indicate contrasts in the vowel height dimension. Even if a language has only two phonologically contrastive vowels, the differences will always be in this dimension rather than the front-back dimension. Thus, in native vocabulary, the Chadic language Margi has *i*, *a* and the Australian language Eastern Arrernte has *ə*, *a*. Among the Caucasian languages, Ubykh and Abkhaz have only two phonological vowel heights, with the contrasts usually represented as *ə* and *a* (Catford

[10] If ROUND is a privative feature (cf. §3.1) which may be absent from a vowel system, the universal presence of two or more unrounded vowels could naturally follow from the need to have at least two vowels differing in aperture.

> 1977). None of these two-vowel languages make any phonological use of the front-back, or the rounding, dimensions in their vowel systems. The same is true of some of the other Caucasian languages, such as Kabardian, which have three phonologically contrastive vowels...."

The most famous case of a vertical vowel system is Kabardian, which has been analyzed in at least the following ways in (23).

(23) a. /ɨ, ə, a/ (Ladefoged and Maddieson 1996)
b. /ə, a/ (Halle 1970)
c. /a/ (Anderson 1978)
d. No vowels (Kuipers 1960)

Basing himself on Kuipers (1960), Lass (1984:160) presents the phonetic qualities of Kabardian as in (24a), at the same time positing the three phonemes in (24b) distinguished only by underlying height:

(24) a.

i		ɨ	ü	u
e	ɪ		ʊ	o
ë	ə	ӧ	ʌ	
a				ɑ

b. /'Close'/ → [i, ɪ, ɨ, ʊ, ü, u...] /'Mid'/ → [e, ë, ʌ, ӧ...] /'Open'/ → [a, ɑ...]

In UPSID, Kabardian has the short vowels /ɨ, ɜ/, but also the long vowels /i:, e:, u:, o:, ɐ:/. However, as Anderson (1978:47) points out:

> "These claims concerning Northwest Caucasian vowel systems are certainly dramatic: so much so that when a phonologist who has been made aware of them first has an opportunity to hear the languages themselves, one of the most striking things about them is how ordinary and undramatic they sound in this regard.... Indeed, in phonetic terms, the set of vowels and of syllable structures in Kabardian or Abaza is quite pedestrian."

There are two important observations to make about vertical vowel systems. First, they seem always to involve only (underlying) central vowels, e.g., /ɨ, ə, a/, /ɨ, a/, /ə, a/. Vertical systems with all front or all back vowels, or any mixture of front, back and central vowels, have generally not been proposed, e.g., /i, e, a/, /u, o, a/. Second, vertical systems of central vowels are proposed only if front and rounded vowels are derived by transfer of these features from surrounding consonants. In other words, there is no language whose *phonetic* system of oppositions is [ɨ, ə, a], [ɨ, a], or [ə, a]. Underlying /C^{y}ɨ/, /C^{w}ɨ/ and /Cɨ/ are typically realized [Ci], [Cu] and [Cɨ] on the surface. As Flemming (1999) puts it: "Central vowels yield sub-optimal front back contrasts. In the absence of contrast, effort minimization dictates contextual variation, and avoidance of extreme articulations."

The issue here concerns the different ways in which languages systematize the color features Front and Round (or their elemental representations {i} and {u}). The summary in (25) shows at least some of the possibilities concerning the contrastive use of these features (cf. Hyman 2007):[11]

[11] Recall that Nimboran shows that rounding need not be present at all, whereas no language has been found that lacks both a front vowel and palatal glide.

(25) a. on vowels and consonants /i, e, u, o, a/, /k, k^y, k^w/
b. on vowels only /i, e, u, o, a/, /k/
c. on consonants only /ɨ, ə, a/, /k, k^y, k^w/
d. on whole morphemes /CVC/, /CVC/^{y}, /CVC/^{w}

Both (25c) and (25d) translate into what we have been calling vertical vowel systems. In (25c) the /^{y}/ and /^{w}/ features spread from consonants to vowels. On the other hand, (25d) treats /^{y}/ and /^{w}/ as prosodies, as in the following Mafa paradigm (Barreteau and le Bleis 1987, 1990; Ettlinger 2004):

(26)	Stem	Imperfective /^{y}/	Perfective /^{w}/	Gloss
a.	tə̀v	tív	túv	'scale'
	ngəh	ngih	nguh^w	'hide'
	kərɗ	kirɗ	kurɗ	'grind'
b.	pán	pén	pón	'wash'
	saf	šef	sof	'breathe'
	zám	žém	zóm	'spit out'
	tsák	čék	tsók	'take a little'
	ndzáv	nǰév	ndzóv	'raise'

It would thus be possible to analyze the imperfective and perfective forms of /pán/ 'wash' as /pán/^{y} and /pán/^{w}, respectively.

If the underlying vowels of a vertical height system are necessarily central (as distinct from back), then the universal is (22) is not accurate. However in order to rule out phonetic systems such as [ɨ, ə. a], we must adopt a conditional universal such as in (27).

(27) Vocalic Universal #5

A vowel system may be contrastive only for aperture only if its vowels acquire vowel color from neighboring consonants.

This universal in effect incorporates the information that went into the actual analytic decision to assign the color features to consonants (or as prosodies) rather than to the vowels themselves. This is not the only such conditional universal. As indicated in (28), there are five different ways in which languages systematize the feature Nasal (cf. Cohn 1993; Clements and Osu 2003):

(28) a. on vowels and consonants /ĩ, ũ, ã/, /m, n, ŋ/
b. on consonants only /m, n, ŋ/
c. on vowels only /ĩ, ũ, ã/
d. on whole morphemes /CVC/^{N}
e. absent entirely

Among the UPSID languages, Lushootseed, Quileute, Pirahã, and Rotokas lack nasality in their phonological systems, to which we can add several Lakes Plain languages of Indonesia (Papua): Doutai (Donohue et al 2006), Iau (Bateman 1990), Obokuitai (Scott and Jenison 1991), Sikaritai

(Martin 1991), Kirikiri (Clouse and Clouse 1993).[12] The feature Nasal is therefore not a universal. The options in (28a,b) are the most familiar; those in (25c,d) correspond to the Front/Round options in (25c,d). With respect to (28c) we note that such relatively marked systems are possible only if the nasal feature on vowels spreads also onto consonants. As in the case of vertical vowel systems, a conditional statement is required:

(29) Vocalic Universal #6

A vowel system can be contrastive for nasality only if there are output nasal consonants.

This can mean either underlying nasal consonants or nasal consonants derived in the context of the underlying nasalized vowels.

To summarize, despite the fact that vowel systems are smaller than consonant systems, we have found it possible to establish approximately the same number of "absolute" universals for both. There are doubtless others I could have considered. One is Ferguson's (1963) claim that a language never has more nasalized vowels than oral vowels, which Maddieson (1991:196) shows to be validated in UPSID. Like consonantal universal #4 and vocalic universal #6, Ferguson's is a conditional universal: If a language has nasalized vowels, it cannot contrast more of them than oral vowels. The other universals discussed in this section and §2.1 are intended as requirements on all languages, i.e. as absolute universals (cf. §4), e.g., all languages have stops and vowels which differ in height. The next subsection briefly considers why such unconditional universals take the shape they do.

2.3. Discussion

The major consonantal and vocalic universals proposed in the preceding subsections can be restated as a requirement that all languages exploit the configurations schematized in (30).

(30) a. [+cons] with [-cont] and Place, Place with Cor

b. [-cons] with Aperture

All languages have stops and coronals, and all vowel systems exploit vowel height. In the case of consonants, another feature is required (e.g., voice, nasality), as well as a second place of articulation besides coronal. In the case of vowels, most languages also have front and/or rounded vowels. Why should this be?

Before addressing this question, let us address an even more basic question which we have simply asssumed: Why do all languages have consonants and vowels? As far as I know, no one has ever challenged this assumption, despite the fact that languages can do quite well with words and utterances that consist solely of voiceless consonants, sonorant consonants, or vowels:

(31) a. Bella Coola (Nater 1984:5), cited by Shaw (2002:1)
xɬpʼχʷɬtɬpɬɬs kʷcʼ 'Then he had had in his possession a bunchberry plant'

[12] UPSID reanalyzes Wichita with an /n/ phoneme, vs. Garvin (1950) and Rood (1975) who have an /r/ which is realized [n] initially and when geminated. Since Wichita lacks bilabial consonants, there is no /m/. The earlier studies thus analyze Wichita with no phonemic nasals.

b. Quiotepec Chinantec (Robbins 1975:128)
m:^{24}m$^{\text{ʔ}}$m^{24} ‘our (excl.) sandal’

c. Hawaiian (Pukui and Elbert 1971)
aea:ea ‘a small green fish (sp.)’
uouoa ‘fish (sp.), known as false mullet’

Just as there are no languages which have only consonants or only vowels, there also are no languages which have only sonorants, such as in the Igbo utterance *ọ́ nà áŋwà ílù áwọ̀* ‘he is trying to bury a toad’. Since sonorants are also the best bearers of tonal distinctions, they should in principle be able to provide enough possibilities for phonemic contrast without having to call on obstruents. Why, then, do all languages have both obstruents and sonorants?

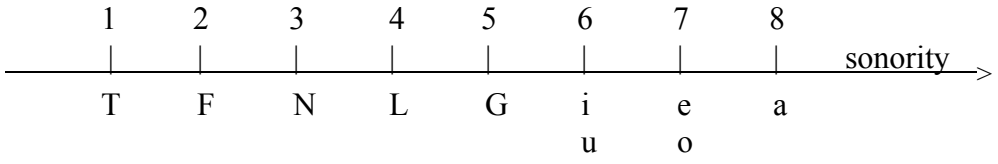
Adopting Clements’ (1990) representation of the relative “sonority” of (non-syllabic) consonants and vowels in (32),

(32)

O	>	N	>	L	>	G	>	V	
-		-		-		-		+	syllabic
-		-		-		+		+	vocoid
-		-		+		+		+	approximant
-		+		+		+		+	sonorant
0		1		2		3		4	rank

we see that languages are required only to exploit the two ends of the scale: obstruents (0) and vowels (4), as in Rotokas. In fact, if we hierarchize stops, fricatives, sonorant consonants, and vowels by height, as in (33),

(33)



we see even more clearly that languages obligatorily exploit the two ends of the sonority hierarchy: all languages have contrastive stops and contrastive vowel heights. What we thus have is a requirement that the opposite extremes of the sonority hierarchy appear in all languages. The explanation for this thus reduces to why stops and open vowels are at opposite ends. According to Ohala (1992:326) the observed sonority differences are best interpreted in terms of “salient modulations” in the speech signal: The best perceptual landmarks occur in CV sequences consisting of a voiceless obstruents and open vowels. Gordon (2005:647) suggests that voiceless consonants may even provide a “perceptual boost” to the following vowel in the relatively rare languages where onsets affect syllable weight.

According to this approach, CV should be the preferred sequence (vs. VC), and indeed, most or all languages have CV syllables (cf. §3). As often noted, many languages only have open syllables.[13] By Clements’ “sonority cycle principle”, “...the preferred syllable type shows a

[13] Although I think most phonologists consider this statement to be non-controversial, Blevins (2004:163) refers to “the small percentage of world languages having only open syllables.” Not wanting to be biased by the large number of African languages which lack codas, I took a look at the Organised Phonology Data entries at the Papua New Guinea SIL website (http://www.sil.org/pacific/png/png_pubs.asp?pubs=online&by=lang), where I found that out of

sonority profile that rises maximally toward the peak and falls minimally towards the end, proceeding from left to right" (Clements 1990:301). Or, as Gussenhoven and Jacobs (2005:138) put it, "syllables prefer to start with a bang and end with a whimper." Ohala (1992:326) speculated that the "larger modulations have more survival value than lesser ones and so will, in the long run, persist in languages." Finally, Harris (2006:1491) addresses these modulations in informational terms:

> "There is an inherent property of speech that seems at first sight paradoxical: most of the sound energy is concentrated in vowels, while most of the linguistically significant information is concentrated in consonants. Very crudely speaking, this means that the 'sonority cycle' is inversely phased in relation to a cycle of linguistic information. Points of sustained high intensity (vowels) modulate the carrier signal to a lesser extent than intervening points (consonants) which, though of lower intensity, involve relatively greater and more rapid spectral changes. Having available a more extensive range of modulations bestows on energy troughs a greater potential to bear linguistic information than peaks."

While the above represent some of the attempts to explain the premium languages place on obstruent-vowel sequences, the assumption is that such sequences are so highly valued that no language would pass up the possibility of having stops and vowels—vs. nasals, liquids and glides, which stand in between. This contrasts with many other near-universals: The vast majority of languages have at least one bilabial consonant, contrastive nasality, front vs. back vowels, etc. The advantages that these and other common sounds have are apparently not great enough to ensure that they will be exploited in all phonological systems.

It may seem disappointing not to have identified more segmental inventory universals than were already known to phonologists 20+ years ago: "The issue of language universals is difficult because there appear to be so few absolute universals. In the domain of phonology, we cannot move much beyond the statement that all languages utilize consonants and vowels. Perhaps the most specific statements we can make would be to say that all languages have plain stop consonants and low vowels (Maddieson 1984)" (Bybee 2001:191). Three ways to increase the number of universals are to make them more abstract, "implicational", and/or diachronic, as discussed in the next three sections.

3. Architectural universals

The previous section ended with some hints of how the consonant and vowel universals presented in §2.1 and §2.2 may be explained in perceptual terms. This kind of explanation is what Comrie (1984:87) calls "functional": "language would be a less-efficient communication system if the universal in question were not to hold." A second kind of explanation is what Comrie calls "the formal approach", identified with the Chomskyan paradigm: "explanations for language universals are to be sought purely within the formal system of language description, for instance by trying to establish higher-level formal generalizations from which many of the particular properties of individual languages will follow logically" (p.87). Today, the distinction between formal vs. functional approaches to language has become blurred, particularly in phonology. The distinction I would like to make in this section, therefore, is not one between form vs. function, rather, I would like to push the descriptive vs. analytic distinction of §1 and §2 a bit further. Whereas the universals of §2 consisted mostly of descriptive statements concerning

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321 languages, at least 44 (13.7%) have only open syllables. I don't know what the percentage would be if a larger, non-areal sample were instead consulted, but I suspect it would be higher.

segment inventories, with abstract analysis held to a minimum, in this section I consider theory-specific universals which, for want of a better term, I will call "architectural". Most phonologists assume that certain constructs are universal. In many cases the constructs are cited as evidence for distinguishing phonology from phonetics, as in Sapir's (1925) justification of the phoneme. In the following subsections I will discuss, first, some universal claims concerning distinctive features and then turn to prosodic universals.

3.1. Features

Besides segments, most phonologists believe in phonological features, elements, or other primitives. The following succinct summary can be found on Nick Clements' website under "Feature Theory":

- Features are *universal* in the sense that all languages define their speech sounds in terms of a small feature set
- Features are *distinctive* in that they commonly distinguish one phoneme from another
- Features *delimit* the number of theoretically possible speech sound contrasts within and across languages
- Features are *economical* in allowing relatively large phoneme systems to be defined in terms of a much smaller feature set
- Features define *natural classes* of sounds observed in recurrent phonological patterns.
- Patterns of *markedness*, underlying crosslinguistic universals, involve the distinction between marked and unmarked features

(http://nickclements.free.fr/featuretheory.html)

Much of the history of phonology has involved determining the identity and nature of these features: What is the correct, universal set? Which ones are privative, binary, or even perhaps multivalued? How are they exploited by phonological systems? (Cf. Clements' 2003 notion of "feature economy" as a phonological universal.). I will consider two examples, both concerning universal claims about vowel features.

The first, originally from Chomsky and Halle (1968), is presented in (34).

(34) No vowel can be [+high, +low].

This follows from the definitions of these features:

(35) a. "HIGH-NONHIGH. High sounds are produced by raising the body of the tongue above the level that it occupies in the neutral position; nonhigh sounds are produced without such a raising of the tongue body." (p.304)

b. "LOW-NONLOW: Low sounds are produced by lowering the body of the tongue below the level it occupies in the neutral position; nonlow sounds are produced without such a lowering of the body of the tongue." (p.305)

c. "BACK-NONBACK: Back sounds are produced by retracting the body of the tongue from the neutral position; nonback sounds are produced without such a retraction from the neutral position." (p.305)

Chomsky and Halle go on to say: "The characterization of the vowels in terms of the three features above is quite straightforward and differs little from that found in most traditional phonetics books. We must observe only that the phonetic characterization of 'low' and 'high'

rules out sounds that are [+high, +low], for it is impossible to raise the body of the tongue above the neutral position and simultaneously lower it below that level" (p.305).

The same claim is adopted as the "prohibition" *[+high, +low] by Calabrese (2005:122). According to Calabrese, "Prohibitions identify configurations that are never possible for articulatory and/or acoustic/perceptual reasons" (p.121). Indeed, we could get the same result if HIGH and LOW were acoustically defined in terms of conflicting low and high F_1 values (cf. Jakobson and Halle's 1956:29-30 COMPACT and DIFFUSE). For Calabrese, "Prohibitions are always active, and thus inviolable, across languages" (p.122).

As Chomsky and Halle indicate, this move has the result of distinguishing the phonetic continuum of vowel height (F_1) from its phonological characterization in terms of three discrete categories: Vowels are either high, mid, or low. This naturally raises the question of how to deal with languages which appear to have more than three contrastive vowel heights. In UPSID, 19 languages (of which 14 are African) have four contrasting front unrounded vowels, while 17 languages (of which 11 are African) have four contrasting back rounded vowels. Two such systems are presented in (36)

(36) a. Pacoh (Austro-Asiatic)

i	ɨ	u
e	ə	o
ɛ	ɜ	ɔ
æ	a	ɒ

b. Luo (Nilo-Saharan)

i		u	
ɪ		ʊ	
e		o	
æ	a	ɒ	(= Tucker's /ɔ/)

Since the two features HIGH and LOW cannot capture all of the oppositions in (36), the strategy has been to introduce another feature such as ATR or TENSE. This is particularly motivated in cases where the vowels form groups with respect to vowel harmony. Thus, Tucker (1994:16) recognizes two sets in Luo: an "open category" /ɪ, ʊ, ɛ, ɔ/ vs. a "close category" /i, u, e, o/, which generally do not cooccur with each other in the same word. While /a/ is neutral, since it occurs with both sets, its realization is [ɐ] when it occurs in the context of /i, u, e, o/, otherwise [a]. In support of this division, Tucker adds that "*Open* vowels are pronounced with a tight, squeezed, "hard" voice quality, while the *Close* vowels are pronounced with a 'hollow' voice quality", a variation on other observations concerning the feature ATR (Stewart 1967).[14]

It is not my purpose here to show that four vowel heights are needed, rather it is to distinguish between the two universal statements in (37).

(37) a. languages can only contrast three vowel heights: high, mid, and low (= descriptive)
b. languages can only contrast three vowel heights: [+high, -low], [-high, -low] or [-high, +low], but not [+high, +low] (= analytic)

The first is a descriptive claim, while the second is theory-dependent: Calabrese's prohibition depends crucially on HIGH and LOW being the correct way to characterize vowel height. While HIGH and LOW have the advantage of being defined to allow only three values (vs. Wang's 1968 HIGH and MID, which allow four vowel heights), this is only a virtue if the maximum of three

[14] While languages tend to have at least one tense vowel, often two or more, e.g., /i/ and /u/, some languages have been analyzed with only lax vowels, e.g. Kuman /ɪ, ɛ, ʊ, ɔ, a/ (Hardie 2003), whose /ɪ/ and /ʊ/ have the allophones [i] (word-finally) and [u] (in open syllables). For some generalizations concerning ATR harmony, see Archangeli and Pulleyblank (1994), Casali (2003).

contrastive heights is the right result.[15] Other theories which have treated height quite differently have found it useful to distinguish four vowel heights. This is true both of Clements' (1991) hierarchical feature Open as well as the several approaches adopting elemental {a}, which may be n-ary (Schane 1984), or show different head/dependency relations (Kaye, Lowenstamm and Vergnaud 1985; Anderson and Ewen 1987). If it were to be determined that phonologies do not contrast more than three values of vowel height, any of these theories could take appropriate measures to guarantee this. As stated, however, *[+high, +low] is merely definitional: a vowel (or consonant, for that matter) cannot be simultaneously high and low. Logically, *[+high, +low] is no different than the constraint *[±back]: a segment may not be simultaneously front and back. In this connection, it should be noted that the Chomsky and Halle feature BACK (35c) only allows a binary front-back distinction. One wonders, therefore, how the Nimboran front-central-back vowel system in (19d) would be accounted for. No doubt, another feature would have to be invoked to save the claim that no language contrasts more than two values along the front-back dimension.

My second example involving features also has to do with vowels, in this case the following proposed universals concerning the feature ROUND:[16]

(38) a. No language can have unround vowel harmony
b. ROUND is a privative feature, i.e., there is no [-round]

While cases of labial (rounding) harmony abound, it is frequently questioned whether non-labial harmony exists: "No examples of [-round] harmony systems have been put forward" (van der Hulst and van de Weijer 1995:505). Steriade (1995) accounts for this gap by assuming that Round is a privative feature. The non-existence of [-round] would also account for certain transparency effects: "A possible answer [to why ROUND harmony goes through an /i/ in Mongolian] is that [-round] does not exist: the feature is universally and permanently privative. The chief predictions of this approach are that [-round] will never give rise to assimilation or dissimilation. We can refer to the absence of an autosegment—and unrounded vowels will form a natural class on the basis of the absence of [round]—but absence cannot spread and repeated absence does not violate the OCP and cannot lead to dissimilation. These predictions are largely correct" (Steriade 1995:148).

A potential candidate for unround harmony comes from Ineseño (Applegate 1971). As indicated in (39), there are six underlying root vowels vs. three underlying prefix vowels:

(39) a. underlying root vowels

i	ɨ	u
e	a	o

b. underlying prefix vowels

i		u
	a	

As seen in (40), the prefixes /a-/ and /u-/ undergo VH (Applegate 1971:7):

(40) a. /a-/ → e / __ C_o e

/qal-wala-tepet/ → [qel-wele-tepet] 'to roll up and tie bundle'
of tying-with body/bulky obj.- roll

[15] Another issue to consider in this context is which approach to vowel features best captures the relation to consonant place of articulation. For instance, in Chomsky and Halle (1968) velars are [+high, -low], while uvulars are [-high, -low].

[16] This discussion of a possible case of unround harmony draws from Hyman (2002).

b. /a-/ → o / __ C_0 o

/aqpala-woyoc/ → [oqpolo-woyoc] 'to wear down crookedly'
of grinding-twist/be crooked

c. /u-/ → ɨ / __ C_0 ɨ

/su-yul-c'ɨ/ → [sɨ-yɨ-c'ɨ] 'to heat'
caus-of heat-be sharp

The examples in (38a,b) illustrate that prefixal /a-/ assimilates to a following root /e/ and /o/, respectively. We can refer to these as front and round harmony. The interesting process is (38c), which shows that prefixal /u-/ becomes unrounded when the root begins with /ɨ/. As seen, all three harmonies meet the two canonical properties of vowel harmony, being both root-controlled (Clements 1981) and unbounded in their application.

The question is how to account for what looks to be a case of unround harmony in (38c). To show the robustness of the process, in (41a) I present Applegate's (1971:3) table of vowel sequences in bisyllabic stems:

(41) Vowel sequences found in bisyllabic stems

a. Surface (Applegate 1971:3)

	i	ɨ	u	e	a	o
i	i-i	i-ɨ	i-u	i-e	i-a	i-o
ɨ		ɨ-ɨ				
u	u-i		u-u	u-e	u-a	u-o
e	e-i		e-u	e-e		
a	a-i	a-ɨ	a-u		a-a	
o	o-i		o-u			o-o

b. Interpretation

	i	ɨ	u	e	a	o
i	i-i	i-ɨ	i-u	i-e	i-a	i-o
u	u-i	**ɨ - ɨ**	u-u	u-e	u-a	u-o
e	e-i		e-u			
a	a-i	a-ɨ	a-u	**e - e**	a-a	**o - o**
o	o-i		o-u			

In the interpretation in (41b), surface [ɨ-ɨ], [e-e] and [o-o] are reanalyzed as /u-ɨ/, /a-e/ and /a-o/, respectively. This allows the statement of the generalizations in (42).

(42) a. /ɨ/ can only occur stem-finally
b. /ɨ/ can only be preceded by /i, u, a/
c. /i/ and /u/ can follow /i, u, e, a, o/, but not /ɨ/, which must be final

As seen, /ɨ/ may not be preceded by /e/ or /o/, and because of the harmony in (40c), /ɨ/ will only be preceded by an unround vowel (and not [e]).

The question is how to express u-Cɨ → ɨ -Cɨ? Two possible implementations are given in (43).

(43) a. Unround harmony: spreading of [-round]

u - Cɨ
‡ ⟍ |
[+R] [-R]

b. Delinking of privative Round

u - Cɨ
‡
[R]

The first option in (43a) accepts that [-round] exists and simply spreads right-to-left, parallel to the front and round harmonies which affect /a-/. The second option in (43b) keeps ROUND as privative and delinks it when followed by /ɨ/. The first proposal is incompatible with the privative interpretation of ROUND, while the second is incompatible with the idea that there is no

"assimilatory delinking": "*no harmony process will ever involve subtraction* (i.e. the dissociation of an element)" (Rennison 1990:202, his emphasis). Other approaches might be to drive the delinking by Steriade's (1995:161) "indirect licensing": "Nonperipheral vowels must be licensed, in at least one associated segment, by membership in the root morpheme." However, this presumably requires some feature to be present on root /ɨ/, e.g. [-round]? One might try to derive derounding from some notion of phonetic similarity, but how can this be expressed without reference to [-round]?

On the other hand, one could question whether the process in (40c) is one of featural vowel harmony at all. Nick Clements (personal communication) has suggested that it might be full vowel copy, or perhaps spreading of either the vocalic or V-place node of Clements and Hume (1995). Unfortunately, all three harmonies involve full assimilation, so it is unclear whether this is feature spreading, feature delinking, node-spreading, or node-delinking. The question is whether the data would be unambiguous if, say, /u/ unrounded to [ɨ] whenever followed by /i/, /e/ or /ɨ/?[17] As Bickel (in press) puts it, "absolute universals can never be falsified by individual data. Their validity can only be evaluated by exploring whether they are consistent with other absolute universals that are claimed simultaneously."

The Ineseño example shows two things. First, there is often confusion as to whether a claim is meant to be taken as a descriptive generalization of the sort, "No language has iterative unrounding of vowels triggered by an unround vowel", or whether it is an analytic claim of the sort, "If a language were ever to have iterative unrounding of vowels triggered by an unrounded vowel, my theory would not treat it as [-round] spreading" (perhaps not even as vowel harmony), thereby allowing the architectural universal "ROUND is privative" to stand.

The second lesson from the example is that claimants should make clear what they would accept as a potential counterexample. Consider the claim that there is no vowel length harmony. Hyman and Udoh (2007) propose that an apparent agreement in length which is both root-controlled and iterative would be a counterexample, as in the hypothetical examples in (44), where lim- and li:m- are roots and -il-, -an- and -a are suffixes:

(44)	a.	/lim-il-e/	→	lim-il-e	b.	/li:m-il-e/	→	li:m-i:l-e:
		/lim-an-a/	→	lim-an-a		/li:m-an-a/	→	li:m-a:n-a:

This would be highly unexpected given that harmony refers to features, and that length is not represented featurally. Would phonologists adhering to models in which length cannot harmonize be ready to accept such data as counterevidence? If not, what would they require to falsify the universal claim? The same problem arises in the next subsection, where we briefly consider prosodic universals.

3.2. Prosody

Up until now I have been considering universals which pertain to consonants, vowels, and the features or structures that define them. What about prosodic universals? First, considering the three traditional suprasegmentals of tone, length, and stress (Lehiste 1970, Greenberg and

[17] Cf. Unrounding triggered by -i suffixes in Kpokolo (Kaye et al 1985). An anonymous reviewer points out the (ad hoc) possibility of positing a feature found only on /ɨ/, e.g., High, with /i/ and /u/ being represented as Front and Round and /e/ and /o/ having an addition Open specification. In this case it could be the High specification that spreads onto an /u-/ prefix, forcing Round to delink, because of a constraint against *Round, High. There are doubtless other "fixes" that one could imagine, none of them having any Ineseño-internal support, as far as I know.

Kaschube 1976), the first two are clearly not universal. That leaves stress. Given that stress is generally represented in abstract metrical terms, while tone = features and length = C/V or X slots (or moras), could it be that all languages have stress? Such a possibility is entertained by Goedemans and van der Hulst (to appear), who use the term "accent": "A comprehensive typology of accent manifestation remains to be developed, but given the broad area of cues and functions it is likely that many more languages may have word accent than just those in which accent is manifested as 'pitch' or 'stress'. As a working hypothesis, we might assume that all languages have accent." To these authors words are necessarily hierarchically structured with a most prominent "head" (which they refer to as "accent"). Stated this way, the claim is virtually impossible to disprove: Even if repeated studies fail to produce phonological or phonetic evidence that a specific language has metrical stress (as I prefer to call it), this may be because the researchers simply didn't look hard enough. However, it is too easy to place the burden on skeptics of an unfalsifiable claim. Those who believe in the above architectural universal should find it irresistible to look at languages which are described as not having stress—including the many languages which appear to be quite adequately described in terms of tone. My own view is that if a language makes it so difficult for a trained linguist to find the stress, maybe its speakers have the same problem. That is, maybe it's because it's not there.

The same issues arise in the study of the syllable. While there is a growing literature questioning the role of the syllable in accounting for phonotactics (see especially Steriade 1999, Blevins 2003), the debate has generally not gotten to the point of denying the universality of the syllable itself—or the CV/VC asymmetries which have motivated the syllable (Ohala and Kawasaki 1984; Ohala 1992). Any language which has metrical stress necessarily hierarchizes syllables rather than, say, the segments (or moras) within them. Many tone systems assign tones by syllable, and so forth. However, as in the case of stress, it is hard to falsify such claims of universality as the ones in (45).

(45) a. universality: all languages have syllables
b. exhaustivity: "All consonants and vowels belong to some syllable." (Greenberg 1962:74)
c. markedness: all languages have CV syllables: "CV (Consonant + Vowel) is the only universal model of the syllable." (Jakobson and Halle 1956:37)

Each of these universal claims has been challenged. Similarly to those who would say that some languages lack stress, Hyman (1985) claims that Gokana has no syllables. Again, one cannot show that a construct does not exist. Rather, Gokana fails to show any evidence of syllables in its segmental or prosodic phonology and morphology. For example, the language gives no evidence of how to syllabify the last sequence of the sentence: *mɛ́ɛ́ ɛ̀ kɔ̄ mm̀ kɛ̄ɛ̀ɛ̀ɛ̄ɛ́* 'who$_i$ said I woke him$_i$ up?' Imposing an arbitrary syllabification (every V is a syllable, every two Vs are a syllable, etc.) adds nothing to our understanding of Gokana.

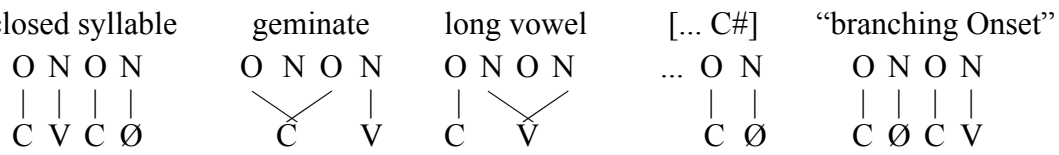
The claim of exhaustivity has been challenged by a number of researchers. Bagemihl (1991) argues that Bella Coola words consisting solely of obstruents, e.g. *c'ktsk^{w}c'* 'he arrived' do not have syllables. Instead, the segments in question are "moraically licensed", a concept which Lin (1998) also applies to Piro.

On the basis of certain Australian languages, the universality of the CV syllable has also been questioned. Breen and Pensalfini (1999), for example, claim that Arrernte only has VC syllables, such that the word *at^w.ér.em* 'is fighting' has the indicated syllabification. The arguments have to do with distributions, allomorphy, and prosodic morphology which show that speakers manipulate VC units.

In each of the above cases, there is no "knock-out argument". Anyone determined to maintain the universals in (45) can continue to do so, the worst consequence being an indeterminate or more awkward analysis. One can establish syllables in Gokana, assign extrasyllabic consonants to syllables in Bella Coola and Piro, and reanalyze Arrernte in terms of CV syllables. Architectural universals have this property: It all depends on your model and on what complications you are willing to live with.

Perhaps the most dramatic architectural universal concerning phonological representation is the claim by Lowenstamm (1996:419) that "syllable structure universally... reduces to CV." Scheer (2004) further develops Lowenstamm's idea as CVCV or "a lateral theory of phonology" which "holds that syllable constituency boils down to a strict consecution of non-branching Onsets and non-branching Nuclei in all languages. There are no Codas and no Rhymes..." (p.1). He gives the following "constituent structure of some basic phonological objects" (which others would call complex syllables):

(46)



As seen, there are only alternations of O and N and of C and V. Given the lateral relations that Scheer will develop, there is no need for syllable trees. A closed syllable will be one with an empty nucleus after the second C (cf. Kaye 1990), while a geminate is a branching C linked to two onsets separated by an empty nucleus. Similarly, a long vowel is a branching V linked to two nuclei separated by an empty onset. For Scheer, a word-final consonant will have the same representation as an internal coda consonant. This view differs from Piggott (1999) who has internal codas, but allow for both word-final codas as well as defective word-final onsets, or from Harris and Gussmann (2002), who have word-internal codas but only word-final onsets.

The above will appear very abstract to many phonologists. At the same time a considerable amount of descriptive work has been produced within the above framework and government phonology in general. My goal here is not to evaluate the representations in (46), but rather to point out that CVCV represents the ultimate architectural universal highlighting Bickel's point that "absolute universals can never be falsified by individual data." Like optimality theory (Prince and Smolensky 1993), CVCV is a "research programme" (Scheer 2004:1) based on universal claims which are too interwoven to take up here. (There are, for instance, principles of government and licensing that need to accompany the above representations.) We are far from the kind of descriptive universals like "Every phonological system has stops."

Despite the obvious differences in views, the above brief discussion of the syllable can be taken as phonology's strongest case for the universality of a prosodic constituent. Goedemans and van der Hulst (to appear) would go along with a universal metrical foot. Perhaps others in the prosodic domain theory tradition would propose some or all of the higher level domains also as universals (Selkirk 1984, Nespor and Vogel 1986), but the case is even harder to make (cf. Schiering, Hildebrandt and Bickel 2007). That we cannot take for granted that languages contrast at most three vowel heights and two degrees of front-back, that ROUND is a privative feature, and that all languages have CV syllables may appear to be a blow to those seeking absolute structure-based universals that depart from the continua found in the speech stream. In the next section I therefore consider both conditional universals and universal tendencies.

4. Conditional and violable universals

The preceding sections have dealt almost exclusively with absolute universals, whether arrived at descriptively or analytically, whether close to the level of observation, or involving abstract formal modeling. However, in traditional universals research a distinction is made between absolute, implicational, and statistical universals (see especially Greenberg, Osgood and Jenkins 1963 who make further distinctions). In (47) I give an example of each, taken from the Konstanz Universals Archive (http://typo.uni-konstanz.de/archive/intro/):

(47) a. *Absolute universal*: "A language may contrast up to five levels of tone, but no more." (Maddieson 1978:338)
b. *Implicational universal*: "A differentiation of rounded vowels according to degree of aperture cannot arise as long as the same opposition is lacking for unrounded vowels." (Jakobson 1941:56)
c. *Statistical universal*: "If a language has only one primary fricative its primary allophone is most likely to be /s/." (Nartey 1979:4)

In my view the three categories are not as clearly distinct as sometimes assumed. In preparation for this study, I consulted the Konstanz Universals Archive (KUA) which assembled 2028 proposed universals from the literature, along with commentary (many of the proposed universals have since been falsified). Of these 542 mention phonology. I eliminated a number of these which concerned the relation of phonology to morphology or syntax, including intonation. This left 487 which refer to phonology proper (although some are more phonetic than phonological per se). Taking the "standardized" rather than original version of these universals in KUA, I made a quick pass to classify the 487 universals according to the following three categories:[18]

(48) a. *Unconditional* vs. *conditional*: Unconditional (U) universals hold of all phonological systems independent of whatever else co-occurs; conditional (C) universals are dependent on something else occurring in the system.
b. *Positive* vs. *negative*: Positive (P) universals refer to properties of "all languages", while negative (N) universals refer to properties of "no language".
c. *Absolute* vs. *statistical*: Absolute universals refer to properties that must or must not occur (whether conditional or not), while statistical (S) universals refer to properties which tend to occur or not occur.

It should be noted that my use of the term "absolute" is different from the literature, where it generally refers to what I am calling "unconditional". According to the definitions in (48), we should get the eight types of universals in (49).

(49) a. UPA : All languages have X
b. UPS : All languages tend to have X
c. UNA : No language has X
d. UNS : Languages tend not to have X
e. CPA : If a language has X, it must also have Y
f. CPS : If a language has X, it tends to have Y
g. CNA : If a language has X, it must not have Y
h. CNS : If a language has X, it tends not to have Y

[18] Given the structure of the database, this work was very time-consuming, or I would have redone it with the original rather than standardized versions of the universals.

Seven of the eight types are documented in KUA:

(50) UPA : Every language must have at least one Primary Nasal Consonant in its inventory (Ferguson 1963:56) [KUA #775]
UPS : A syllable will be the more preferred, the greater the Consonantal Strength of its onset is. (Vennemann 1988:12) [KUA #1704]
UNA : A voiced and glottalized consonant cannot be combined in either initial or final clusters (Greenberg 1978:257) [KUA #856]
UNS : Injectives tend not to cluster with plain consonants. (Greenberg 1970:131) [KUA #762]
CPA : IF there are aspirated stops (especially voiceless labial and alveolar), THEN there is /h/. (Hagège 1982:936) [KUA #126]
CPS : If a nasal vowel system is smaller than the corresponding basic vowel system, it is most often a mid vowel that is missing from the nasal system. (Crothers 1978:135) [KUA #707]
CNA : IF there are no initial consonantal clusters, THEN there is no V.CCV division of two-segment clusters. (Bell 1971:45) [KUA #1241; standardized]

Among the conditional negative universals, I identified 13 which are CNA, but none which are CNS. This may be a gap. An example of CNA from early distinctive feature theory concerned the acoustic feature FLAT, which could be used to characterize labialized, velarized, pharyngealized and retroflex consonants. The assumption was that no language would contrast such segments, hence the CNA universal: "If a language has contrastively labialized consonants, it can't also have retroflex consonants." Most claims of this sort have been shown to be wrong. The same is true of many of the 542 potential universals mentioning phonology in KUA, e.g. the above UPA universal proposed by Ferguson (1963). Still, the database is immensely useful as an historical record of ideas and proposals and, of course, for its extensive bibliography.

If there are counterexamples to many or most of the phonological universals which have been hypothesized, it may be that we are placing too high a premium on absolute universality. Another traditional view has been that universals are only "tendencies". Much of the work done under the heading of "universal markedness" takes this view. The violable constraints of optimality theory (Prince and Smolensky 1993) are often reminiscent of the "universal tendencies" observed by functionalists in the 1970s. I like to refer to the ranked, universal but violable constraints of OT as *ideals*: A vowel would like in principle to be nasalized before a nasal consonant, which in turn would like not to appear before a voiceless fricative, etc. While nasalization and nasal effacement are often successfully counteracted by faithfulness constraints, one can also get a conflict between two different markedness constraints, e.g., concerning consonant types and tone:

> "Since L-H and H-L tend to become L-LH and H-HL as a natural horizontal assimilation [tone spreading], it can now be observed that the natural tendency of tones to assimilate sometimes encounters obstacles from intervening consonants. Voiceless obstruents are adverse to L-spreading, and voiced obstruent are adverse to H-spreading. The inherent properties of consonants and tones are thus often in conflict with one another. In some languages (e.g. Nupe, Ngizim, Ewe, Zulu), the consonants win out, and tone spreading occurs only when the consonants are favorably disposed to it. In other languages (e.g. Yoruba, Gwari), the tones win out, as tone spreading takes place regardless of the disposition of intervening consonants." (Hyman 1973:165-166)

The issue of markedness as an approach to universals in phonology would deserve a full treatment in its own right. For recent overviews and implementations, see Clements (2007), Hume (2003, 2007), Rice (2007a,b) and de Lacy (2006). My interest here is simply to ask what is meant by "universal tendency"? Researchers generally converge on two essential ingredients. The property in question should (i) appear with some frequency in the world's languages and (ii) be motivated in some general sense. To repeat an example from our earlier discussion, languages tend to have CV syllables because the release of a consonant into a vowel is generally more salient than the transition from a vowel into a consonant. There is no comparable frequency or grounding that could be invoked in favor of VC syllables. Thus, languages which are claimed to favor VC over CV syllables are infrequent and have a limited distribution in Australia.

Recent work on markedness has revealed that so-called unmarked properties or *ideals* may not only fail to materialize, but languages may in fact embrace their opposites. This pertains both to distributional generalizations as well as alternations. Pater (1996, 1999), for example, proposed the violable universal constraint *NT which prohibits sequences of nasal + voiceless stop. Many languages require that prenasalized consonants or clusters be voiced (ND), either in their phonemic inventory or in outputs. Many show active alternations by which stops become voiced after a nasal, i.e., NT → ND. Hayes and Stivers (1995) provide a detailed account of the phonetics of post-nasal voicing, which again is both frequent and motivated. However, as pointed out by Hyman (2001), there is a smaller set of languages such as Tswana, Scots (Harris 1994:85-6), and Roman dialect of Italian (Rohlfs 1949) which allow NT but prohibit ND—and Tswana even has alternations involving postnasal devoicing, i.e., ND → NT. The same study shows, more generally, that corresponding to each "unmarked" N+C process is a less frequently occurring, but attested "marked" N+C process, as summarized in (51).

(51) Post-nasal processes (languages cited are all Bantu) (Hyman 2001:169)

Unmarked	Schema	Languages	Marked	Schema	Languages
postnasal voicing	NT → ND	Yao, Kikuyu, Nande, Bukusu	postnasal devoicing	ND → NT	Sotho-Tswana, Makua, Bubi
postnasal affrication	NS → NTS NZ → NDZ	Kongo, Yaka, Tuki, Venda	postnasal de-affrication	NTS → NS NDZ → NZ	Shona, Rwanda, Kinga
postnasal aspiration	NT → NT^h	Cewa, Swahili, Pokomo	postnasal deaspiration	NT^h → NT	Zulu, Ndebele, Xhosa, Swati
postnasal nasalization	ND → NN	Ganda, Matuumbi	postnasal denasalization	NN → ND	Kongo, Yaka, Punu

The unresolved question is whether we need two sets of opposite constraints whose ranking is not universally fixed: (i) *NT, *NT^h, *NS, *NTS vs. (ii) *ND, *NZ, *NDZ, *NN.[19]

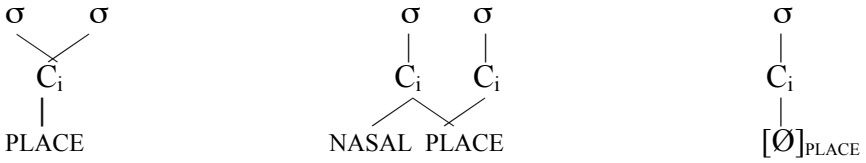
The situation just outlined concerning NC distributions and processes is not isolated. A second example concerns coda constraints. Coda properties have received considerable attention in the literature mostly because so many languages place systematic restrictions on their codas and word-finals. The apparent neutralization of laryngeal contrasts in codas is often cited (Lombardi 1991), but see also Blevins (2003). In this section I will instead focus on place of articulation constraints on codas.

The classic case that has received considerable attention is codas which are restricted to homorganic nasals and the first half of a geminate consonant, as in Japanese. The basic insight of Ito (1986), Goldsmith (1990), and others who have followed their lead is that codas cannot

[19] For a recent rejection of *ND, see Zsiga et al (2007).

independently license place of articulation. Given their branching structure, represented informally in (52a,b), heterosyllabic $C_i.C_i$ and $N_i.C_i$ are well-formed in Japanese, since the place of the coda is shared—and hence licensed—by the following C_i onset:

(52) a. geminate $C_i.C_i$ b. homorganic $N_i.C_i$ c. placeless coda



Heterorganic $C_i.C_j$ sequences are prohibited in Japanese, which also allows only the so-called placeness nasal as a word-final consonant. One variation on Japanese comes from languages which prohibit geminate consonants but allow heterosyllabic $N_i.C_i$, e.g. Orokaiva (Larsen and Larsen 1977) and many Bantu languages, if Downing's (2005) analysis of NC as heterosyllabic is correct. Another variation concerns languages such as Spanish, which allow only coronals in coda position (Harris 1983). If coronals are underspecified and hence placeless, as in (52c), they would not violate coda non-licensing of place. If coronals are more generally unmarked and unspecified for place, as variously proposed (cf. Paradis and Prunet 1991), the prediction is that there should be languages which allow geminates, homorganic nasals, and coronals in codas position, and possibly laryngeal consonants.

The Ito and Goldsmith solutions have the virtue that they refer to the branching structure of $N_i.C_i$ and $C_i.C_i$. What I would like to show now is just the opposite: Some languages require that heterosyllabic consonants be *non*-branching. What this means is that a C.C sequence will either be heterorganic or will be the kind of homorganic sequence that is not interpretable as sharing a single root or place node. In Apinaye the following consonants can occur in coda position: /p, t, č, m, n, ɲ, v, r, ž/ (Burgess and Ham 1968:8). However, depending on what follows them, these coda consonants are subject to the deletion processes in (53).

(53) a.	a stop before homorganic stop:	/tɛp + pič/	→	tɛ: pič	'just fish'
b.	a stop before homorganic nasal:	/pɛp + mɛč/	→	pɛ: mɛč	'good fish'
c.	/p/ and /m/ before /v/:	/tɛp + vər/	→	tɛ: vər	'to fish'
d.	/r/ before /r/:	/pur + rač/	→	pu: rač	'big field'
e.	/č/ before /ž/:	/moč + ža/	→	mo: ža	'this cow'
f.	/k/ before any C except /r/ or /ʔ/:	/kok + pič/	→	ko: pič	'just wind'

As seen, deletion always results in compensatory lengthening of the preceding vowel. All but (50f) have to do with the deletion of a homorganic consonant. /v/ and /ž/ are not affected, since they are realized as [-cons] [w] and [y] in coda position.

Since heterorganic consonant sequences are permitted across syllables, it is clear that coda licensing of place cannot elucidate the facts of Apinaye. The only potential homorganic codas that occur in Apinaye involve nasal+oral stop sequences. Note that such sequences are subject to vowel lengthening: /tɔm + pič/ → *tɔ:m pič* 'just freckle', /meɲ + ža/ → *mɛ: ɲža* 'this honey'. There are two possible analyses of these outputs. The first is to transfer the nasal coda to the following onset, with the vowel lengthening to fill its slot, as Clements (1986) proposed for Luganda (cf. "All nasal continuants before homorganic occlusives are very short" (p.17).) Apinaye does allow initial NC clusters, e.g., *mrõ* 'submerge', and nasals become prenasalized before an oral vowel, e.g., /ma/ 'liver' → [mba] 'liver'. The alternative is that in this combination only, Apinaye tolerates a [+cons] coda homorganic to a following onset as a non-

branching structure.[20] If we go with the first account, and if we assume that /ŋ/ is a "placeless nasal" (cf. below), we arrive at the reverse situation from Japanese: Apinaye does not like placeless codas: it does not tolerate geminates, homorganic NC sequences, or "placeless" /ŋ/ and /ʔ/ in coda position (cf. below).

A similar and perhaps more striking case comes from Hayu verb root + suffix morphophonemics (Michailovsky 1988, Michailovsky and Mazaudon 1973):

(54) Hayu alternations in root + portmanteau suffix combinations

Root	*'they ... you sg.'*	*'... it!'*	*'I ... you sg.'*	*'he ... us'*	*'he ... me'*	
sel	sel-me	sel-to	sel-no	sel-kok	sel-ŋo	'thin out a crop for'
pʊt	pʊt-me	pʊx-to	puʔ-no	pʊt-kok	pʊt-ŋo	'spread a mat for'
tshun	tshun-me	tshũ:-to	tshu-no	tshun-kok	tshun-ŋo	'wash dishes for'
pʊk	pʊk-me	pʊk-to	pʊk-no	pʊx-kok	pʊʔ-ŋo	'arouse'
pɪŋ	pɪŋ-me	pɪŋ-to	pɪŋ-no	pĩ:-kok	pɪ-ŋo	'send'
dip	diʔ-me	dip-to	dip-no	dix-pok	diʔ-mo	'pin in wrestling'
mʊm	mʊ-me	mʊm-to	mʊm-no	mũ:-pok	mʊ-mo	'offer food to'

As seen, there are no alternations in the first row involving the root *sel* 'thin out a crop for'. The other verb roots show that Hayu debuccalizes oral and nasal codas when the following suffix begins with a homorganic consonant, as schematized in (55).

(55) a. oral stop + oral stop : $CVT_i + T_iV \rightarrow CVx.T_iV$
b. oral stop + nasal : $CVT_i + N_iV \rightarrow CVʔ.N_iV$
c. nasal + oral stop : $CVN_i + C_iV \rightarrow CṼ:.C_iV$
d. nasal + nasal : $CVN_i + N_iV \rightarrow CV.NV$

In (55a), the resulting *x* is pronounced [x] after back vowels, [ç] after front vowels. In (55b) the stop becomes [ʔ] before a homorganic nasal, apparently retaining the "simultaneous glottal stop" that accompanies stop codas in the language (Michailovsky 1988:53). Debuccalization of a nasal conditions compensatory lengthening and nasalization of the preceding vowel if the input sequence is /$N_i.T_i$/, as in (55c), but not if the input is /$N_i.N_i$/, as in (55d). The only other complication in the above data concerns the bottom right forms, where a constraint *labial + velar creates a labial sequence, which then undergoes debuccalization, i.e., /dip-kok/, /dip-ŋo/ → *dip-pok, dip-mo* → *dix-pok*, *diʔ-mo*; /mʊm-kok/, /mʊm-ŋo/ → *mʊm-pok, mʊm-mo* → *mũ:-pok, mʊ-mo*.

Like Apinaye, Hayu does not tolerate the complex structures that would result from fusion of homorganic consonants (although such sequences do occur across word boundaries and with certain clitics). We know that more than homorganicity is involved, since /sel+to/ and /sel+no/ are not simplified. The generalization is that Hayu does not allow a stop closure to be followed by a homorganic release.[21] In other words, Japanese likes geminate stops and nasals, while Apinaye and Hayu do not. Does it make sense to ask which is the unmarked situation?

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[20] Burgess and Ham do not mention or illustrate homorganic nasals coming together across syllables. If these are well-formed, then Apinaye would be interpreted to tolerate homorganic coda + onset sequences only when the coda is nasali, i.e. $N_i.C_i$ and $N_i.N_i$.

[21] Michailovsky's table on p.64 indicates that coda /t/ and /n/ debuccalize before l-initial suffixes that are found outside the verb paradigm, but that /l/ + /l/ does not simplify. If this is correct, /ll/ is the only word-internal geminate tolerated in the language.

Returning to Apinaye and the discussion of placeless codas, Burgess and Ham (1968:8) state: "The coda in all syllable constructions... consists of all consonants except /ʔ/ and /ŋ/." This fact is particularly striking, as other languages restrict codas to exactly these two consonants, e.g., Babungo (Schaub 1985:268), Khams Tibetan (Namkung 1996:399). We would expect final /ŋ/ and /ʔ/ to be favored by the coda licensing approach if /ŋ/ were placeless like the final nasal in Japanese (Trigo 1988) and like /ʔ/ in Chamicuro (Parker 2001). How far can we get, then, with the idea of placelessness?

There is a long-standing tradition of regarding /ŋ/ as the unmarked nasal coda (Chen 1973, Trigo 1988). However, four situations are actually attested:

(56) a. some languages allow /ŋ/ in both onset and coda position, e.g. Burmese
b. some languages allow /ŋ/ only in onset position, e.g. Apinaye
c. some languages allow /ŋ/ only in coda position, e.g. Tarok (Sibomana 1980:201)
d. some languages do not allow /ŋ/ in either position, e.g. French

(A similar four-way distinction exists for glottal stop as well.) When one looks even at very closely related languages, the diversity one finds makes it difficult to draw generalizations concerning nasal codas. As displayed in (57), of the 44 Grassfields Bantu languages whose finals were catalogued in my undergraduate seminar in Spring 2007, seven out of the eight logical possibilities of final nasals are attested:[22]

(57)

nasal codas			#nasals	#languages	Eastern Grassfields languages
m	n	ŋ	3	25	Mankon, Medumba
m	n	-	2	1	Fe'fe'
m	-	ŋ	2	7	Ghomala', Yemba, Bangwa
-	n	ŋ	2	1	Bafanji
m	-	-	1	3	Bamukumbit
-	n	-	1	0	---
-	-	ŋ	1	3	Awing
-	-	-	0	4	Batcha, Bangou

As indicated, 25 have kept the three inherited nasal codas *m, *n, *ŋ, while the remaining 19 languages have modified them in various ways. All three combinations of two nasal codas exist, while two out of the three single nasal codas exist: no Grassfields Bantu languages has been found that allows only /n/ in coda position. Finally, several languages of the Nda'nda' subgroup of Bamileke have denasalized final nasals, causing merger with oral codas, as has the Fe'fe' village of Babouantou (Hyman 1972:53). The possible codas in Batcha and Babouantou are /p, t, k, ʔ, h/ (Sadembouo 1976:67). It should be noted that all of the languages cited are from the Eastern branch of Grassfields Bantu, and that some are particularly close. Although Bafanji and Bamukumbit are neighboring chefferies, their nasal codas are in complementary distribution. It is thus impressive that we should obtain such diversity, despite both genetic and areal proximity.

The inevitable conclusion to draw is that individual languages do not point to a uniform place of articulation as the unmarked coda (cf. Hume and Tserdanelis 2002, Hume 2003; Rice 2007b). Among the possible conclusions are the following: (i) Markedness scales are universal, but language-specific requirements obscure or override these scales. (ii) Markedness scales are not universal, rather language-specific. (iii) There are no markedness scales. We of course do not

[22] I would like to thank Ben Bascom, Will Schuerm, Jen Smith, and Nancy Ward for their dedicated participation in this project, which is on-going.

want to fall into the much-maligned position taken by Joos (1957:96) that "languages [can] differ from each other without limit and in unpredictable ways", and yet we seem to be getting more contradictions than we bargained for. It's not that we can't provide possible synchronic accounts of whatever we find. Some researchers have pointed out that in the absence of comprehensive theory of what can be a (universal) constraint in OT, "anything and its reverse can be a constraint" (Scheer 2004:385) However, the following descriptive conflict exists whatever the framework: How does one evaluate the contradictions found in languages where "X wants to be Y" vs. languages where "Y wants to be X"? Consider for example the realization of the one underlying coronal strident fricative in the two Bantu languages Haya and (chi-)Bemba in (58).

(58) a. Bemba: s → š / __ i

ši	su
se	so
sa	
<u>š</u>it-a	'buy'
sek-a	'laugh'
súm-a	'bite'
són-a	'sew'
sal-a	'choose'

b. Haya: š → s / __ i

si	šu
še	šo
ša	
<u>s</u>ik-a	'inherit'
šek-a	'laugh'
šuuk-a	'descend'
šon-a	'sew'
šál-a	'cut up'

In Bemba /s/ (and no other alveolar) is palatalized to [š] before [i], while the corresponding /š/ of Haya is *de*-palatalized to [s] before [i]. An admittedly ad hoc proposal is to propose two opposite constraints, *[si] in Bemba vs. *[ši] in Haya, with the repairs going in opposite directions (*ši* → *si*; *si* → *ši*). Again, the facts do not indicate universal directionality.

One response has been to say that that the real explanation is diachronic. Under this view, it may be possible to state inviolable diachronic universals or at least account for the prevalence of certain (unmarked?) situations as arising through natural historical developments. This is the subject of the final section.

5. Diachronic universals

There can be no doubt that many aspects of phonology have an historical explanation. This is particularly evident when a problem concerns an unusual distribution or process. In the Bantoid language Tikar, for example, codas are mysteriously restricted to the labials /p/ and /m/ which can occur internally or finally, and glottal stop, which can only occur before pause (Jackson and Stanley 1977, Stanley 1991):

(59)

a.		b.		c.	
læp	'length'	gbæm	'big hill'	ɓæʔ	'palm wine'
wɛp	'bone'	shim	'tomorrow	zɛʔ	'eye'
sup	'weakness'	wum	'ten'	kɔʔ	'crab'

/p/ is realized voiceless finally or before a voiceless consonant vs. voiced before a vowel or voiced consonant. When a glottal stop is followed by a vowel suffix, one of two things happens. If the preceding vowel is a front vowel, the glottal stop is "replaced" by [l], as in (60b). However, if it is preceded by a back vowel, as in (60c), it simply deletes (as all glottal stops do before a consonant):

(60)		root	$PAST_1$ -i		root	$PAST_2$ -e	
	a.	ɓì	ɓì-i	‘plant’	kwe	kwe-e	‘cry’
		gwe	gwe-i	‘build’	shɛ̀	shɛ̀-e	‘say’
		lù	lù-i	‘invade’	lù	lù-e	‘invade’
	b.	yìʔ	yìl-i	‘sweep’	ɓwìʔ	ɓwìl-e	‘cover’
		hwɛʔ	hwɛl-i	‘roll’	tɛ̀ʔ	tɛ̀l-e	‘pull’
		tæʔ	tæl-i	‘sew’	wæʔ	wæl-e	‘scrape’
	c.	ɓoʔ	ɓo-i	‘beat’	ɗwoʔ	ɗwo-e	‘pierce’
		ɓɔʔ	ɓɔ-i	‘wash’	ɗɔʔ	ɗɔ-e	‘beg’
		pàʔ	pà-i	‘strip’	làʔ	là-e	‘show’

The CV forms in (60a) show that the [l] cannot belong to the past tense suffixes -i and -e. We thus not only have to explain why there is an unusual coda inventory, but also why front vowel + glottal stop behaves differently from back vowel + glottal stop.

The answer is that the [l] represents the historical final consonant *t which would have been weakened to [l] intervocalically. While there are different possible interpretations of the incremental sounds changes that Tikar underwent, it is clear that these result in the three diachronic correspondences in (61).

(61) a. t > l / V __ V
b. t > ʔ / __ pause
c. t > Ø / elsewhere

Before the outputs in (61b,c) could be effected, vowel changes had to occur such that the language only had front vowels before *t. Such VC coarticulations occur in many Grassfields Bantu languages, e.g., before coda *-t*, Yemba (Bamileke-Dschang) allows only /ɛ/ (Bird 1999:454) and Fe’fe’ allows only front /a/ (which contrasts with back /ɑ/) (Hyman 1972:39). The “other” glottal stop would have derived from prepausal *k, which in turn required that vowels before it be back. In this case non-prepausal *k most certainly weakened to [ɣ], which then dropped out in all environments.

A similar skewing is observed among nasalized vowels in Tikar. As seen in (62a), when a front nasalized vowel is followed by a vowel suffix, an [n] in inserted:

(62)		root	$PAST_1$ -i		root	$PAST_2$ -e	
	a.	lĩ	lĩn-i	‘cut’	hwĩ	hwĩn-e	‘buy’
		hwɛ̃	hwɛ̃n-i	‘pick up’	yɛ̃	yɛ̃n-e	‘say’
		ɓæ̃	ɓæ̃n-i	‘stop’	ɗæ̀̃	ɗæ̀̃n-e	‘invade’
	b.	ɗwõ	ɗwõ-ĩ	‘follow’	nõ̀	nõ̀-ɛ̃	‘lie down’
		kwã	kwã-ĩ	‘exit’	tã	tã-ɛ̃	‘pull’
		lã̀	lã̀-ĩ	‘pass’			

When the same suffix occurs after a back nasalized vowel, as in (62b), no consonant is inserted. Instead, the suffix vowel itself becomes nasalized. We can propose that front nasalized vowels derive from final *n, whereas back nasalized vowels derive from *ŋ, which dropped out in all environments. What this means is that the unusual coda system in (63a) derives from the unnoteworthy historical system in (63b).

(63) a. Present-day Tikar

p	(ʔ)
m	

b. Pre-Tikar

p	t	k
m	n	ŋ

A similar situation is found in Bafia, a Cameroonian Bantu language, whose codas are /p, m, s, l, n, ŋ/ and glottal stops which alternate either with [r] or [ɣ]: *ǹɓáʔ* 'spleen' → [ǹɓár à múm] 'the man's spleen', *zòʔ* 'elephant' → [zòɣ̀ɨ cóʔ] 'a forest elephant'. Guarisma (2000:54-5) not only shows that the two glottal stops of Bafia correspond to coda *-t* and *-k* in closely related Lefa, but also the front-back vowel correlations before the two historical final consonants:

(64)

Bafia	Lefa		Bafia	Lefa	
tɨ̀-ɓíʔ	tɨ̀-ɓít	'excrement'	rɨ̀-pɨ̀ʔ	rɨ̀-pɨ̀k	'throw'
zyèʔ	zyèt	'caterpillar (sp.)'	kɨ̀-ɓɔ̀ʔ	kɨ̀-ɓɔ̀k	'yoke'
ǹ-tɛ̀ʔ	ǹ-tɛ̀t	''ten'	rɨ̀-nʌ́ʔ	rɨ̀-nʌ́k	'plait'
rɨ̀-càʔ	rɨ̀-càt	'let'	rɨ̀-lɑ̀ʔ	rɨ̀-lɑ̀k	'buy'
kɨ̀-kwìʔ	kɨ̀-kùt	'scabies'			
rɨ̀-fwéʔ	rɨ̀-fwót	'sniff'	rɨ̀-wóʔ	rɨ̀-wók	'smell, hear'
rɨ̀-wɛ̀ʔ	rɨ̀-wɔ̀t	'criticize'	rɨ̀-kɔ̀ʔ	rɨ̀-kɔ̀k	'crush'

(Cf. Thurgood and Javkin 1975 for discussion of similar VC grave-acute assimilation in Southeast Asia.)

While such historical accounts are useful to explain unusual patterns such as (63a), the question is whether diachrony can help us get a better handle on what is universal in phonology. Bybee (2001:207) believes it can: "...there are universal paths of change for phonology.... Once discovered and stated, these universal paths of change constitute much more powerful universals than any that can be formulated to cover the synchronic states of languages." The question, then, is what is universal about what happened historically in Tikar? We already saw in (57) that related languages have lost one vs. another place of articulation in codas. Could a diachronic perspective have greater success in explain why there is such diversity in the resulting synchronic states?

Here is a possible scenario which I have only begun to explore with respect to the development of codas in the Grassfields Bantu and related Cameroonian languages. First, we can assume that codas are innovated in these languages. That is, like their Narrow Bantu relatives, stems ended in vowels, e.g., monomorphemic C_1VC_2V noun stems or bimorpheme C_1VC_2+V verb stems. In fact, Mankon still has such a C_1VC_2V stem structure (Leroy 2003). More importantly, Mankon already limits intervocalic C_2 consonants to [β, r, ɣ, m, n, ŋ, ʔ]. We thus see that laryngeal neutralization has already occurred in an environment not involving codas at all. The C_1VC_2V constituent functions as a prosodic foot in Mankon much as in Ibibio (Harris and Urua 2001, Akinlabi and Urua 2003), where a foot-internal C_2 is restricted in a number of ways that do not apply to C_1.

There are two possible next steps. First, C_2 consonants may become modified or drop out intervocalically, often depending on the height of the preceding vowel (cf. Hombert 1986). Alternatively, final vowels may drop out after certain consonants. Mankon itself has started to do this only after nasals. This then can be followed by further modification of the now final C_2 consonants. Could it be that the diversity stems from the interplay of these different historical scenarios? Perhaps the labials have survived in Tikar because they were less vulnerable to the

specific processes which eroded alveolars and velars. For the purpose of discussion let us adopt the coda markedness scale in (65a).[23]

(65) a. Coda markedness scale: labial > alveolar > velar.

b. *labial > alveolar *alveolar > velar *velar > Ø
*labial > velar

The changes in coda place of articulation that I have observed in Cameroon are the same as those documented by Chen (1973) for Chinese in (65b) Thus, languages may lack "marked" labial codas because they have become alveolars, or they may lack "unmarked" velar codas, because they have dropped out. The question is: If we understood exactly how every restricted coda system arose historically, would we be able to uncover diachronic universals that are masked by the synchronic diversity? See especially Hajek (1997:161-164) for discussion of the role of place of articulation in the development of nasalized vowels from VN sequences.

Recently Blevins (2004:23) has taken the view that most explanation is in fact historical: "Principled diachronic explanations for sound patterns have priority over competing synchronic explanations unless independent evidence demonstrates, beyond reasonable doubt, that a synchronic account is warranted." How does she fare with universals? Consider the universal Blevins cites on p. 9:

> "There are languages in which stress falls consistently on the first syllable of the word, or the last syllable of the word, but there are no languages in which stress falls regularly on the middle syllable of the word (e.g. the second syllable of a three-syllable word, the third syllable of a five-syllable word, and the fourth syllable of a seven-syllable word)."

She goes on to explain this by adding: "If stress is seen as serving a delimitative function at the level of the phonological word, then word-medial stress... is ruled out, since this does not serve to delimit the word edge (Martinet 1961:87)." (p.13) In the cited work, Martinet emphasizes "la fonction contrastive," i.e., the syntagmatic function of stress. Although "demarcation" has been proposed to be the major diachronic source of word stress (Hyman 1977, Bybee et al 1998), the latter may develop into weight-dependent and lexically contrastive stress. The question of why demarcative stress cannot develop into "middle syllable stress" has not been answered.

But what would a stress system with middle-syllable stress placement actually look like? One possibility is shown in (66).

(66)

1 syllable words:	σ́
2 syllable words:	σ́-σ, σ-σ́
3 syllable words:	σ-σ́-σ
4 syllable words:	σ–σ́–σ–σ, σ–σ–σ́–σ
5 syllable words:	σ-σ-σ́-σ-σ
6 syllable words:	σ-σ-σ́-σ-σ-σ, σ-σ-σ-σ́-σ-σ
7 syllable words:	σ-σ-σ-σ́-σ-σ-σ

In (66) I have placed primary stress (σ́) as close to the middle of the word as possible. Monosyllabic words of course receive obligatory stress on their only syllable. Longer words with an odd-number of syllables also have a single stress placement, since such words have an identifiable middle syllable. What about words with an even number of syllables? In this case

[23] Among other places of articulation, there is a widespread tendency to avoid palatals as codas.

there is no middle syllable per se. What I have indicated above is that such a language might attempt to place stress as close to the middle as possible. I thus have indicated two potential stress placements on two-, four- and six-syllable words. While the fact that many words will not have a middle syllable is enough of a problem, the reason why such systems do not exist has nothing to do with demarcation, stress, or even language: Human beings are simply not good at identifying "middle" for any process or distribution, delimitative otherwise. Unless the mid point of a set of objects is marked for us, we have to calculate: When the suspects in *Law and Order* appear in a line-up, they always hold a card with a number. If asked "Do you think it was the man in the middle who did it?", the witness would have to count both the total and then in from one end. In the case of stress, speakers would both have to anticipate the total number of syllables and then place the stress as they reached the mid point (which, again, doesn't exist in even-syllable words). While stress systems do some pretty amazing things (Hayes 1995), this seems beyond human reach.

What explains, then, the absence of such systems? Certainly not diachrony, which could conceivably provide the following potential input for middle-syllable stress to develop. Consider a language where most words consist of a monosyllabic prefix + bisyllabic stem, hence three syllables. Let us also say that this language has penultimate stress with the relatively few bisyllabic words thus having initial stress. Last step: The language undergoes extensive compounding to create new single word domains with four, five, six and, ultimately, seven syllables. This may have various effects on the original penultimate stress system. However, one thing that will not happen is that the penultimate stress of the predominant trisyllabic words becomes reinterpreted as middle syllable stress, producing the distributions in (66). This is because there is a synchronic constraint that makes such a reanalysis impossible: Humans have trouble counting middles. This, then, turns out to be an example of what I have called Greenberg's Edict (Hyman 2005):

(67) Greenberg's Edict: Synchrony constrains diachrony

> "no diachronic change gives rise to a synchronically nonexistent type" (Greenberg 1966:510)

While Bybee (2001) and Blevins (2004) cite Greenberg for his demonstration that history can explain synchronic properties (cf. Hajek 1997:9), the above edict shows that Greenberg also believed that synchrony constraints diachrony. Or, as I have elsewhere put it: *Diachrony proposes, synchrony dispose*s (Hyman 2005).

To conclude, let us return to the absolute universals said to characterize consonant and vowel systems in §2. Why do all languages have stops and at least a binary distinction in place and in vowel height? As mentioned, diachrony is very good at explaining unusual properties of languages, but it seems to fail outright in having anything to say about absolute universals: There is no reason to think that there are more diachronic paths to creating (voiceless) stops than, say, fricatives, or that the trend is to develop systems with more stops rather than fewer. Similarly, diachronic processes do not guarantee two places of articulation rather than two manners, or two vowel heights rather than a front-back distinction. If languages must have these properties, it would rather have to do with ever-present synchronic constraints that do not allow a language to lose all of its stops and all but one place of articulation and vowel height. Whether the universal exploitation of the two ends of the sonority scale is due to "self-organization" (Lindblom, Macneilage and Studdert-Kennedy 1984) or is innate may, of course, be debated.

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