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Coronals and Velars: Support for Blust

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Robert Blust raises the issue of the *t > *k* change that is widely attested in Austronesian languages, but infrequently in other language families. He offers both structural and perceptual explanations for the "naturalness" of this change, but admits that the data raise more questions than can be answered. I offer support for the view that this change is not unnatural, based on the distribution of stop types cross-linguistically, and the patterns that are found. I introduce another kind of argumentation, that of typologically determined systemic naturalness, in the spirit of Evolutionary Phonology.

1. INTRODUCTION: OBSTRUENT SYSTEMS. Blust (2004) highlights the fact that the cross-linguistically unusual *t > *k* sound change is frequent in Austronesian languages. I do not wish to question his conclusions or methodology but to point out that there are alternative "explanations" for the same data that come from a different methodology. Investigating the occurrence of different types of stop systems cross-linguistically allows us an insight into what is freely permitted, and what is merely tolerated, in terms of natural inventories. In essence, the conclusion that we can draw from this survey can be summarized in (1).

(1) Languages just like *k* (more than *t*).
(or: Velar is less marked than Alveolar.)

I will show how a comparison of obstruent systems across a range of languages gives insights into the relative markedness of various places, and so offers support for the structural account of the change, raised by Blust but left as unconvincing (Blust 2004:388). The typological account allows for *t > *k* to emerge as a natural change, while counterpredicting *d > *g*. The fact that there are different rankings of preferences for obstruents as opposed to fricatives or nasals, for instance, means that we counterpredict the existence of, for instance, *s > *x* or *n > *ŋ* changes, which are much more rare even than the rare *t > *k*.

I begin the typological investigation from first principles, by examining obstruent patterns in a number of languages. Initially I restrict the investigation to languages that do not have a manner (or *VOT*) contrast in their stop system. This is to allow for maximal overlap with the Austronesian cases reported in Blust (2004), and to acknowledge the fact that voicing contrasts in obstruent inventories are clearly secondary to place contrasts. Table 1 shows obstruent (stop and affricate) patterns in languages from around the world, selected on the basis of not having any contrasts in manner. They represent, then, some of the "sim-

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pler" phonological systems in terms of largyngeal complexities. "No." in the leftmost column refers to the number of contrastive places in which obstruents occur in the language. The languages shown are representative of the obstruent system described in the remaining columns. No attempt has been made to represent the relative frequency of the different systems (see Maddieson 1984 for such details, or the UCLA Phonological Segment Inventory Database [UPSID]), but rather simply a listing of one representative of each "type" of obstruent system. It is immediately clear that obstruent inventory systems that do not contrast for manner modally have 3–5 contrasts. More than this is attested, though rarely, and systems with fewer than this, while common in terms of number of languages displaying the system type, are not common in terms of diversity of types, relying on a

TABLE 1. TYPES OF SINGLE-MANNER OBSTRUENT SYSTEMS

NO.	LANGUAGE	OBSTRUENTS															
2	Abau	p				□							k				
3	Māori, etc.	p				t							k				
	Samoan	p				t							□				ʔ
	One	p				t							□(k)				(ʔ)
	Nyawaygi	p		t̻		□							k				
	Hawaiian	p				□							k				ʔ
4	Cayuga	□				t	ts						k				ʔ
	Burrara	p				t					c		k				
	Ainu	p				t				tʃ			k				
	Molof	p				t							k	kʷ			
	Lani	p				t							□	kʷ	q		
	Fore	p				t							k				ʔ
5	Ao	p				t					c		k				ʔ
	Pawnee	p				t				tʃ			k				ʔ
	Pitjantjatjara	p		t̻		t			ʈ				k				
	Wulguru	p		t̻		t					c		k				
	Tamil	p			t̪	□			ʈ	tʃ			k				
	Miwok	p				t			ʈ				k				ʔ
	Greenlandic	p			t̪	□	ts						k		q		
	Kombai	mb				nd					ɟ		ŋg	ngʷ			
	Rukai	p				t	ts						k				ʔ
	Wichita	□				t	ts						k	kʷ			ʔ
	Oirata	p				t			ʈ				k				ʔ
	Kwerba	p				t				tʃ			k	kʷ			
	Urubu-Kaapor	p				t							k	kʷ			ʔ
	Ifira-Mele	p	pʷ			t				tʃ			k				
6	Kwerba (Aurimi)	b	bʷ			t				tʃ			k	kʷ			
	Nunggubuyu	p		t̻		t			ʈ		c		k				
	Wik Mungkan	p		t̻		t					c		k				ʔ
	Jingulu	p				t			ʈ		c	kʲ	k				
	Záparo	p				t	ts			tʃ			k				ʔ
	Tonkawa	p				t				tʃ			k	kʷ			ʔ
7	Jamul Tiipay	p			t̪	t				tʃ			k	kʷ			ʔ
	Mbabaram	b		d̻		d		dʷ			ɟ		g	gʷ			
	Yanyuwa	p		t̻		t			ʈ		c	kʲ	k				
	Kitanemuk	p				t	ts		ʈʂ				k	kʷ			ʔ
8	Tlingit	□				t	ts	tɬ		tʃ			k	kʷ	q	qʷ	
9	Cocopa	p			t̪	□			ʈ	tʃ		kʲ	k	kʷ	q		ʔ

small number of different obstruents. In all, 38 different system types are shown in table 1. Much can be made in the way of implicational universals on the basis of this classification of system types and the ways in which they are constructed, but the only material I have highlighted is the material *not* present: I have indicated the absence of a *p*, *t,* or *k*, the "building blocks," or primary places of articulation, of most obstruent systems.

In table 1 the distribution of places of articulation in small-obstruent systems is not random. Overwhelmingly, a small-obstruent system shows a preference for contrasts at the bilabial, alveolar, and velar places. The next most common contrastive stops are *ʔ* and either *tʃ* or *c* (the fact that no systems with a single-manner contrast distinguish these two places means that we can consider *tʃ* and *c* as representing a single contrastive place). The most frequent obstruents that we can expect to find in a system representing the primary places are *p, t,* and *k.*

More interesting for us is the fact that there are exceptions to these trends. There are three attested stop-system types that lack bilabial stops: we can see examples of these from Cayuga, Wichita, and Tlingit, all languages of North America (these system types are not high in frequency). Similarly, alveolar stops are missing in the Abau, Hawaiian, Nyawaygi, Tamil, Greenlandic, and Cocopa style systems. In the last three of these languages, the presence of a *t̪* renders the absence of *t* less surprising, though the fact that, for instance, Jamul Tiipay does contrast the dental and the alveolar consonants means that we cannot assign *t̪* and *t* to the same contrastive place in the same way that *tʃ* and *c* were. The absence of *t* in Hawaiian is discussed at length in Blust 2004; suffice it to say that the shift of *k > *ʔ* can be seen as initiating a drag chain that resulted in the *t > *k* change. The systemic motivations for this, which result in a subsequent gap, are the subject of the present article. In Abau and Nyawaygi there is an alveolar stop phonetically, but distributional facts make it more attractive to treat this phoneme as an *r,* with stopped allophones in predictable environments (e.g., following a nasal). In Nyawaygi the 'opening up' of the dental-alveolar place probably initiated a drag chain that caused the laminal stop to take on dental articulation as its major allophone, rather than palatal articulation, as is found in related languages to the north (e.g., Warrgamay, Dyirbal).

The surprise comes when we examine "missing" velar stops: Samoan, and perhaps Lani, are the only examples we have of languages with this pattern. The Lani case is somewhat akin to those languages that do not have a *t,* but do have a *t̪,* and in fact the Lani *q* is not as back as uvular stops in some languages, though it is audibly further back than a normal velar stop, except when following a front vowel (in which case it is velar). Samoan, discussed in Blust, does not have a *k* in formal speech (but does informally), following a *k > *ʔ* change similar to the one that has applied in Hawaiian. One, listed with both the velar and glottal stop in parentheses, is in the process of losing its *k*, shifting it to *ʔ* (in some cases) or Ø (in others). Importantly, there are only two cases of consonantal patterns in which the obstruent inventory does not include a velar stop, compared to three system types lacking a bilabial stop, and five system types lacking an alveolar stop. This is despite there being a great number of possible, and otherwise plausible, obstruent systems without a velar stop, of which those listed in table 2 are only a sample.

The only conclusion we can draw from the fact that, of the otherwise plausible obstruent systems that lack anything velar, very few are attested in real languages, is that velar stops are extremely unmarked, and their absence is extremely marked. This can be seen in table 3. Considering only those attested obstruent systems that have a gap for a primary place of articulation, and considering only the obstruents attested in those primary places, we have table 3. It is clear that the "Bilabial & Alveolar" combination, in which a language displays *p* and *t*, but not *k*, is disfavored (the prevalence of "Alveolar & Velar" systems reflects the fact that Cayuga, Wichita, and Tlingit are all North American languages, an area where the general tendency to favor bilabial stops is to some extent neutralized, a nice illustrative case of areal typology overriding otherwise global trends).

Based on these data, particularly the frequencies of different systems with "missing" primary obstruents, we can derive the simple constraint rankings for obstruents shown in (2). A constraint such as "Velar" should be read as "have an obstruent in the velar place" when applying to a language. Note that the differences, in terms of measures of the frequency of different system types, between these differently ranked place constraints is not very high, and only the opposite ends of the rankings can be taken as significant: velar obstruents are more preferred, or less marked, than alveolar ones.

(2) Velar » Bilabial » Alveolar

Exceptions can, of course, be found: certain languages from northcentral New Guinea have seen a loss of velar stops through glottalization, with no hint of any replacement

TABLE 2. POSSIBLE OBSTRUENT SYSTEMS LACKING A VELAR STOP (IN ADDITION TO TABLE 1)

NO.	LANGUAGE	OBSTRUENTS										
2	*Imaginary1	p								□	q	
	*Imaginary2	p						tʃ		□		
	*Imaginary3				t			tʃ		□		
3	*Imaginary4	p			t			tʃ		□		
	*Imaginary5				t			tʃ		□		ʔ
	*Imaginary6				t	ts				□		ʔ
4	*Imaginary7	p			t				c	□		ʔ
	*Imaginary8	p	t̼		t			tʃ		□		
	*Imaginary9	p			t			tʃ		□		
5	*Imaginary10	p		t̪	t				c	□		
	*Imaginary11	p			t					□		ʔ
6	*Imaginary12	p		t̪	t				c	□		ʔ
	*Imaginary13	p			t	ts		tʃ		□	q	ʔ
7	*Imaginary14	p	t̼		t				c	□	q	ʔ
	*Imaginary15	p		t̪	t	ts	tɬ	tʃ		□		ʔ

TABLE 3. GAPS IN PRIMARY PLACES OF ARTICULATION

NO.	LANGUAGE	OBSTRUENTS		
2	Abau	p	□	k
3	Samoan	p	t	□
	Hawaiian	p	□	k
	Cayuga	□	t	k
5	Wichita	□	t	k
8	Tlingit	□	t	k

waiting for the voiceless series (though in some languages the lost *g has been replaced by *ɟ (Donohue 2002). The point is that this scale predicts what system types are more likely than others.

Similarly, combining constraints yields the following ranked possibilities for languages that realize obstruents at only two of the three primary places of articulation. Again, the important thing to note from (3) is that a system with two stops at bilabial and velar places is preferred over a system with two stops at bilabial and alveolar places.

(3) Bilabial & Velar » Alveolar & Velar » Bilabial & Alveolar

It is clear that bilabial, alveolar, and velar stops are the primary places of articulation, and that they are not equally ordered: velar and bilabial stops are preferred to alveolar ones. In the absence of a velar stop, for whatever reason, it is not surprising for a more highly marked stop to shift to reinstate the less marked stop. We have seen, based on a cross-linguistic survey, that velars are the least marked of stops, and that (surprisingly?—evidence from child language acquisition would suggest otherwise) alveolars are the most marked.

Given, for example, the language "*Imaginary$_7$" from table 2 with the obstruents *p, t, c,* and *ʔ,* we would strongly expect the missing velar place to be filled by the palatal stop shifting backwards; similarly, we would expect "Imaginary$_1$" with just *p* and *q* to shift the uvular stop to a primarily velar articulation, on cross-linguistic grounds. Note that, especially in the case of the putative *q > *k* change, there are no perceptual motivations for such a change, nor any constraints on the structural oppositions and their expression. The only principled reason we have for expecting the realignment of the dorsal stop is a typological one that allows us to identify velar as less marked than uvular. But in a smaller system without a [+high] or [+back] stop, such as Samoan in table 1 and table 3, what can be done to fill the missing, but desired, velar place? From (2) we can see that the presence of a bilabial stop is more highly favored than the presence of an alveolar one, and so the alveolar one is sacrificed. It is, thus, quite natural for a *t > *k* sound change to happen, if two preconditions are met:

1. The position occupied by an earlier velar stop has been vacated;
2. The obstruent system is small enough so that there are no stops more similar to a velar one other than a bilabial one.

Because, in Samoan, the earlier *k has become *ʔ,* and because the only other obstruents are *p* and *t,* both preconditions are met, and the change is expected. Blust concludes his article with a cautionary note that not all of the cases of *t > *k* involve small consonant systems, or a "missing" velar stop. In cases where the stop inventory is fuller, the change is, as Blust notes, harder to reconcile. I can offer the generalizations that define both the "hot spots" for obstruent occurrence, but also define the secondary places for obstruents in terms of these primary places. Given, say, an obstruent system *p *t *tʃ *k *k^w that subsequently loses the *k (> *ʔ* ?), we do not expect the *k^w to shift, losing its roundedness, because rounding is, in a phonological system characterized by underspecification, the defining feature of that stop. It is not true that all obstruents are equal, as we have seen. A drag chain that fills a "missing" *k* position, while depriving the obstruent system of a *t is* an improvement, while one that filled the missing *k* with a *p* would not be, in general.

The cases Blust presents from Austronesian languages deal with voiceless consonants, and Blust raises the fact that voiced stops behave quite differently, with *d > g being (almost?) unheard of. The following section addresses the behavior of voiced stops.

2. VOICING. The unmarked choice for the feature [voice] in an obstruent is voiceless. Languages will usually display voiceless obstruents before they display voiced ones, and if there is a discrepancy in the number of obstruents, a language will normally have more voiceless obstruents than voiced ones. This can be captured with the constraint in (4). (This constraint is, of course, violable locally; Kombai in table 1 shows modally voiced [and prenasalized] stops, and the same is true of many languages of northeast Australia.)

(4) *Voice

It has been claimed that the presence of voicing contrasts at the velar place implies the presence of voicing contrasts at the bilabial place (as shown in [5]). This can be rewritten in terms of constraints as shown in (6).

(5) Voice[velar] $\subset$ Voice[bilabial]

(6) *Voice/velar » *Voice/bilabial

Combining (6) with (2) and (4), we arrive at (7). The statement is that, of velar and bilabial obstruents, the most restricted obstruent is a *g*, and the least restricted is a *p*, with *b* and *k* falling in the middle in terms of their appearance in systemic typology.

(7) *Voice[velar] » *(Voice[bilabial], Voiceless[velar]) » *Voiceless[Bilabial]

What, however, of alveolar stops? I wish to claim that, if anything, the ranking of velar and alveolar on the scale in (2) reverses when we have systems with contrastive manner: the alveolar series is "firmer" in its cross-linguistic stability, while the peripheral stops, including the velar series, are marginalized. To establish this requires that we examine a range of different discrepancies that are found between the voiced and voiceless members of the obstruent inventories in different consonant systems. I shall only consider systems in which the contrast is between a voiceless and a voiced (not prenasalized) member, with only brief excursions into implosion. I shall not consider aspiration contrasts.

TABLE 4. NEUTRAL RELATIONSHIP BETWEEN VOICING VALUES

NO.	LANGUAGE	OBSTRUENTS								
3	Wambon, etc.	p	t				k			
		b	d				g			
4	Gapapaiwa	p	t				k	kʷ		
		b	d				g	gʷ		
	Kâte	p	t				k		k͡p	
		b	d				g		g͡b	
4+	Chamorro	p	t	ts			k			ʔ
		b	d	dz			g			
	Lango	p	t		tɕ		k			ʔ
		b	d		dʑ		g			
5+	Tübatulabal	p	t	ts		tʃ	k			ʔ
		b	d	dz		dʒ	g			

3. ALL NEUTRAL. The languages in table 4 exemplify very simple voiced/voiceless contrasts at three, four, and five places of articulation. The conventions are the same as for tables 1–3, with the addition of "+" to indicate the presence of a place for which voicing cannot be contrastive. With respect to the relative markedness of any one place over another, no judgments can be made, because voicing is contrastive everywhere it can be. Note that all of these systems realize the three primary places of articulation in addition to anything else. Note also that there are no systems with only two places of articulation that realize a neutral voicing distinction.

4. BILABIAL PRIMACY. The first deviation from the neutral pattern in table 4 is found in those languages for which voicing clearly favors the anterior obstruents, whether through such contrasts only appearing in bilabial, or bilabial and then alveolar, places, or else the unmarked voicing value for the bilabial stops being voiced, while stops articulated further back are voiceless. In table 5 we see that for Barupu, Choctaw, and Tsou the only contrast in voicing is for obstruents appearing in the bilabial position. In Tobati, Kairiru, and Momuna the bilabial stops are basically voiced, while the other stops, further back in the mouth, are basically voiceless. In Dumo the shift of *p > *ϕ* means that there is no longer a contrast in voicing for bilabial stops: only the voiced one remains, and there is a contrast in alveolar stops. Wutung, related to Dumo, preserves *p as *p* and shows the

TABLE 5. BILABIAL PRIMACY

NO.	LANGUAGE	OBSTRUENTS											
3	Barupu	p		t					k				
		b		□					□				
4	Choctaw	p		t			tʃ		k				
		b		□			□		□				
4+	Tsou	p		t			tʃ		k			ʔ	
	(Koasati)	b		□			□		□				
4	Tobati			t				c	k				
		b		□				□	□				
5	Kairiru			t				c	k		q		
		b		□				□	□		□		
5	Momuna			t					k	kʷ			
		b	bʷ	□					□	□			
2+	Dumo			t								ʔ	ʔʷ
		b		d									
3+	Wutung	p		t			tʃ					ʔ	ʔʷ
		b		d			□						
6+	Kwaza	p	t̪	t	ts			cç	k			ʔ	
		ɓ		ɗ									
6+	Tz'utujil				ts'		tʃ'		k'		q'	ʔ	
		p		t	ts		tʃ		k		q		
		ɓ		ɗ									
7+	Jacaltec			t'	ts'	tʂ'	tʃ'		k'		q'	ʔ	
		p		t	ts	tʂ	tʃ		k				
		ɓ											
4+	Maidu	p'		t'			tʃ'		k'			ʔ	
		p		t			tʃ		k				
		ɓ		ɗ			□		□				

extension of the contrast in voicing from the bilabial place to the alveolar place as well. In Kwaza we see a contrast not simply between voiced and voiceless, but between voiced imploded and voiceless; again, the contrast is only found at the front of the mouth. Tz'utujil is an interesting case of a language with a two-way contrast in stops that might be characterized as [±laryngeal gesture] (see Donohue 2003 for discussion relevant to this suggestion). In addition to a plain voiceless series of stops, found for all places, there is a second series that can be realized as either ejective stop or as an imploded stop. The imploded (and voiced) realization is found with bilabial and alveolar places, and the ejectives elsewhere. Although it is a three-way contrasting language, Maidu has been included to illustrate the fact that BILABIAL PRIMACY is also relevant in languages with more than a two-way contrast in stops. Maidu shows a plain voiceless versus ejective contrast for all places, and additionally has a pair of voiced imploded stops for bilabial (and alveolar) place only. This pattern shows bilabial primacy extending to other kinds of voicing, just as Tz'utujil shows different kinds of glottal coarticulation. Similarly we find Palu'e (from Flores, Indonesia) with an imploded stop only for the bilabial place, and plain voiced stops elsewhere: *p t tʃ k ʔ ˀɓ d dʒ g*. In Tukang Besi (Sulawesi, Indonesia) we have (leaving aside the prenasalized stops) *p t k ʔ ɓ ɗ g*. Both these systems show BILABIAL PRIMACY in the realization of implosion (see also Voorhoeve n.d.).

5. VELAR INADEQUACY. A second condition on the realization of voicing contrasts applies: not necessarily bilabial primacy, but VELAR (and UVULAR) INADEQUACY (see table 7). In contrast to the condition of bilabial primacy, which states that voicing is more prevalent in bilabial obstruents, we find no instances of a language in which the basic setting for [voice] is positive for the velar series, and negative for the others. In other words, languages such as shown in table 6 are unattested. A similar, but attested, system could arise in the case of a recent shift of *k > *ʔ*, leaving *p t ʔ b d g*, for instance (Usan is such a system, with the addition of a prenasalized series, *mb nd ŋg*).

TABLE 6. UNATTESTED: VELAR SUPREMACY

NO.	LANGUAGE	OBSTRUENTS					
3+	*Imaginary$_{16}$	p	t			□	ʔ
		□	□			g	

TABLE 7. VELAR INADEQUACY

NO.	LANGUAGE	OBSTRUENTS					
3	Dutch	p	t			k	
		b	(d)			□	
3+	'Ala'ala	p	t			k	ʔ
		b	d			□	
3/4	Yawa	p	t			k	
		b	d	dʒ		□	
3/4	Skou	p	t			k	
		b			ɟ	□	
4	Hixkaryana	p	t	tʃ		k	
		b	d	dʒ		□	
4+	Enggano	p	t	tʃ		k	ʔ
		b	d	dʒ		□	

On the other hand, we do find instances of the opposite of the tendency for bilabial place to be the first place to show a contrast in voicing: we often find that velar place is the place most likely to *not* show a voicing contrast. Note that there is no strict line separating BILABIAL PRIMACY and VELAR INADEQUACY in some cases. A language like Tabla, which has *b t d k* as obstruents, is clearly a case of both bilabial primacy (the only bilabial obstruent is modally voiced) and velar inadequacy (despite the presence of voicing contrasts, including stops beyond bilabial ones, there is no voicing contrast for velar obstruents). Abinomn, with *b t̪ d dʒ k kʷ gʷ*, combines modal voicing for bilabial stops with a lack of voicing for (plain) velar stops (as well as a palatal gap—see the discussion of Watam below). 'Ala'ala, on the other hand, might just as easily be described as being an instance of bilabial primacy, with extension of the voicing contrast to the alveolar place, as of velar inadequacy, with the lack of a voicing contrast in the velar place.

6. ALVEOLAR DISCREPANCY. There are, as with all good typological generalizations, exceptions. The four languages shown in table 8 violate the principles of bilabial primacy or velar inadequacy (or both) in some way, and in all cases the presence (or absence) of a contrast for the alveolars is what makes the system unusual. In Tigak we have a language in which voicing is contrastive for velar stops, and for bilabials, but not for alveolar stops. Given that this is not a neutral system, this configuration violates velar inadequacy. In Nyao and Larike we can see that there is a contrast only for alveolar stops, violating bilabial primacy. Toba shows voicing contrasts only for the palato-alveolar, velar, and uvular places, meaning that it violates both bilabial primacy and velar inadequacy. It is, of course, common for other gaps to be found in an obstruent inventory. Kewa, for instance, has *p t c k b d g*, with a palatal gap, and many languages of New Guinea show the opposite, with a missing voiceless palatal(-alveolar) obstruent; Watam shows *p t k b d dʒ g mb nd ndʒ ŋg* (see also the summary of Abinomn above).

Concentrating on the three primary places of obstruent articulation—bilabial, alveolar, and velar—we find that there are seven logical possibilities for ways voicing may be realized, shown in table 9. It may be realized in all places, the "neutral" case. It may be realized in only two of the three primary places of articulation. The first variant is to find voicing absent in the velar place, a situation that is found in many languages. Voicing being absent in the alveolar place, but found in the other two places, is rare, in this sample attested only in Tigak; but importantly, a situation in which voicing is found for alveolar and velar stops, but not for bilabial stops, is not attested. Earlier I mentioned that it can be hard to see

TABLE 8. ALVEOLAR DISCREPANCY

NO.	LANGUAGE	OBSTRUENTS: bilabial	alveolar	palato-alveolar	velar	labiovelar	uvular	glottal
3	Tigak	p	t		k			
		b	□		g			
5	Nyao	p	t	tʃ	k	kw		
		□	d	□	□	□		
3+	Larike	p	t		k			ʔ
		□	d		□			
5+	Toba	p	t	tʃ	k		q	ʔ
		□	□	dʒ	g		ɢ	

whether a particular pattern reflects bilabial primacy or velar inadequacy, because in extension they result in the same patterns. Both BILABIAL PRIMACY and VELAR INADEQUACY can be seen as instantiations of the following harmonic rankings for obstruents (compare with the scale for voiceless obstruents in [2], and the partial scale in [6]). A constraint such as *Voice/Velar can be read as saying "disprefer voiced velar obstruents," and (8) states that this principle is more important than avoiding voicing in other (primary) places.

(8) *Voice/Velar » *Voice/Alveolar » *Voice/Bilabial

It follows automatically that different combinations of any two of these constraints will result in the rankings shown in (9); this scale predicts that, if voicing is found in two members of the three-member set of obstruents, it will be most likely to occur on bilabial and alveolar stops, and not velars, and least likely to occur on the alveolar and velar stops, but not on the bilabials. These predictions exactly capture the frequency-of-system data that are shown in table 9, drawing on tables 4–8.

(9) *Voice/Alveolar & Voice/Velar » *Voice/Bilabial & Voice/Velar » *Voice/Bilabial & Voice/Alveolar

We need to invoke another principle, that of SYSTEMIC SYMMETRY, to account for the languages without gaps; but this goes beyond the scope of this article.

7. CONCLUSION: CONTRASTS AND MARKEDNESS AMONG THE PRIMARY PLACES. We have seen that argumentation from a typological perspective can add insights to the question of sound change and the "naturalness" of those changes when there are not clear system-defining or phonetically differentiating reasons for the change. The fact that, cross-linguistically, velar is less marked than alveolar is motivation enough for the sound change to apply. The fact that, when voicing is added to the picture, velar stops are more marked than alveolars explains why the alveolar > coronal change is attested for voiceless stops, but not for voiced ones.

Nonetheless, local preferences can override these global markedness constraints. We have already seen that bilabial obstruents are more marked than alveolar ones in some parts of North America, especially in the northwest. The fact that these proposed global markedness rankings can be overridden by local conditions is not a failing, but a virtue, of the model, because we must allow for systems that do not conform: formal Samoan, for

TABLE 9. THE REALIZATION OF VOICING AT PRIMARY POINTS OF ARTICULATION

VOICING CONTRASTS	VOICED STOPS			EXAMPLE LANGUAGE(S)
3	b	d	g	Wambon (many)
2	b	d	☐	Dutch (many)
2	b	☐	g	Tigak
2	☐	d	g	*
1	b	☐	☐	Tsou, Choctaw, etc
1	☐	d	☐	Larike, Nyao
1	☐	☐	g	Toba

instance, with its bilabial and alveolar stops, but no velar stop, or an earlier stage of Hawaiian before the *t > *k* change took place.

We have seen arguments for why *t > *k* can be considered more natural than a "shorter" change, such as $*k^w$ > *k*, because the nonprimary consonants are defined in terms of their deviation from the primary ones. This reflects the same assumptions that underlie most standard models of feature geometry that describe the active articulator first, and the passive articulator second; the "primary places" described here are simply the underspecified, least marked, most basic realizations of [labial], [coronal], and [dorsal].

Blust also cites *k > *t* as "almost unknown" (except, perhaps, as a temporary stage in early child language). I know of one language in which *k > *t* is found, and, to confound the picture still further, this involves a merger with *t, which is retained as *t*. This change is found in Pawnee, a Caddoan language from central North America (see table 1). In Pawnee *k has merged with *t as *t*, though not completely. Interestingly, there is still variation in word-final position between *t* and *k*, thus requiring us to set up a separate *k* phoneme, while identifying the process of its loss (thanks to David Rood for discussion on this issue). It seems that the Caddoan family not only ignores the generalization that bilabials are unmarked (Wichita, in table 1, lacks bilabials), as with many languages of North America, but also treats velars as less basic than alveolars.

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(As with Blust's article, there is a skewing in favor of Austronesian data, with 17 of the 74 cited languages belonging to this family. Other frequently cited genetic groups, with the number of member languages referred to, include: Trans New Guinea, 10–12 (depending on what counts); Macro-Skou, 5; Pama-Nyungan, 4; Caddoan, 2; Muskogean, 2; plus miscellaneous others. Areal representation is similarly skewed, reflecting my own access to data and the languages I think of first: Africa, 1; Australia, 9; East Asia, 3; Europe, 1; Indonesia (not New Guinea), 4; New Guinea (Indonesia and Papua New Guinea), 29; North and Central America, 15; Oceania, 5; South America, 5; South Asia, 2.)

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