

Constraints on Geminate in Buginese and Selayarese

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1. Introduction

The phonological patterning of geminates in Buginese and Selayarese, closely related Western Austronesian languages spoken in South Sulawesi, Indonesia, depends on morphological structure. In Buginese all segments—voiceless obstruents, voiced obstruents, and sonorants—can occur as geminates tautomorphemically (Podesva 1998a, b), as shown in (1).

(1) Buginese morpheme-internal geminates

VOICELESS OBS.	VOICED OBS.	SONORANTS
pappa? 'piece'	tabba 'to fry'	samməŋ 'vocal noise'
tattəŋ 'to shake'	sadda 'voice'	palla? 'garden'

The data in (2), prefixed by *maC-*, illustrate the patterning of geminates at the prefix-root boundary. As with the monomorphemic forms in (1), voiceless obstruents and sonorants can appear at the prefix-root boundary. However, glottal stop plus voiced obstruent sequences surface instead of geminate voiced obstruents in the same environment, illustrated in (2).

(2) Buginese geminates at the prefix-root (*maC+ROOT*) boundary

VOICELESS OBS.	VOICED OBS.	SONORANTS
mappasa? 'to go to the market'	maʔbusə? 'to eat (rude)'	mammusu? 'to go to war'
mattapa 'to smoke (meat)'	maʔdeceŋ 'to ask forgiveness'	mallebo 'to form into a ball'

* The collection of Buginese data was supported in part by NSF grant no. SBR-9511185 to Abigail Cohn. I would like to thank Abby Cohn, Penny Eckert, Will Leben, and Draga Zec for their helpful suggestions for improvement at various stages of this work. Special thanks go to Edward Flemming for insightful comments and thought-provoking discussions. All errors are of course my own.

The distribution of geminates in Selayarese (Mithun & Basri 1986) slightly differs from the Buginese pattern. The pattern found at the prefix-root boundary in Buginese, namely that geminate voiced obstruents cannot appear, is the morpheme-internal pattern in Selayarese, as evidenced in (3).

(3) Selayarese morpheme-internal geminates

VOICELESS OBS.	VOICED OBS.	SONORANTS
ʔappa 'to find'	<i>Do not occur as geminates.</i>	ʔamma 'father'
attiʔ 'drop (of liquid)'		balli 'price'

Neither voiced obstruents nor sonorants appear as geminates at the prefix-root boundary, as shown by the data in (4). These forms are prefixed by *taʔ-*,¹ which according to Mithun & Basri (1986) indicates that the absolutive argument is a semantic patient.²

(4) Selayarese geminates at the prefix-root (*taʔ*+ROOT) boundary

VOICELESS OBS.	VOICED OBS.	SONORANTS
tappelaʔ 'to get lost'	taʔbessolo 'to slip'	taʔmuri 'to smile'
tattuda 'to bump against'	taʔdoʔdoʔ 'to be sleepy'	taʔlesaj 'to be removed'

To summarize thus far, all classes of sounds (voiceless obstruents, voiced obstruents, and sonorants) can appear as geminates tautomorphemically in Buginese, but voiced obstruents do not appear at the prefix-root boundary. In Selayarese, voiced obstruents do not occur within a single morpheme, and neither voiced obstruents nor sonorants appear at the prefix-root boundary.

In this paper I present an Optimality Theoretic (Prince & Smolensky 1993) account of the Buginese and Selayarese facts. I treat the geminate patterns at the prefix-root boundary in both languages as a consequence of

1. The prefix-final consonant of the Selayarese prefix (*ʔ*) differs from that of the Buginese consonant (*C*) in keeping with the traditions established by Sirk (1983) for Buginese and Mithun & Basri (1986) for Selayarese. The different representations are justified in part by the behavior of the prefix when attached to roots beginning in vowels; in such forms in Selayarese the prefix remains *taʔ-*, while the Buginese counterpart takes the allomorph *m-* rather than *maC-*.

2. Selayarese is an ergative language, as is Buginese.

the interaction between conflicting markedness constraints. One of these constraints requires adjacent consonants to share features (AGREE), and the other two prohibit geminate voiced obstruents (*DD) and geminate sonorants (*RR). The markedness constraints and their interactions at the prefix-root boundary are discussed in §2. The focus of §3 is the morphological conditioning of geminate distribution. I present a root faithfulness account of the Buginese and Selayarese facts, which I support with an examination of geminate patterns at both the prefix-root and root-suffix boundaries. In §4 I outline the ways in which *DD and *RR, when taken as universal constraints, work to constrain permissible geminate inventories cross-linguistically. I conclude in §5.

2. Geminates at the Prefix-Root Boundary

As discussed by Kager (1999), phonological phenomena are traditionally analyzed as arising out of the competing forces of markedness and faithfulness. I argue that in Buginese and Selayarese the alternation between geminates and ?C sequences results not from a markedness versus faithfulness interaction, but from conflicting markedness constraints.

The data in (2) and (4) illustrate the tendency for prefix-final consonants to assimilate to root-initial consonants. This tendency is due to a constraint prohibiting adjacent consonantal root nodes from differing in their feature specifications, given in (5) as AGREE, the first of the competing markedness constraints. Such a constraint was first alluded to by Prince (1984), who argued in an autosegmental framework that ‘consonant-quality sequences’ were prohibited on the P-tier (phone tier). More recently, a similar constraint against adjacent consonants differing in [voice] has been used by Lombardi (1995) to achieve voicing assimilation. Under this formulation of AGREE, Consonant sequences like heterorganic nasal plus stop clusters stand in violation of this constraint, and geminates satisfy its conditions.

- (5) AGREE – Adjacent consonantal root nodes may not differ in their feature specifications.

AGREE should be understood as a set of constraints, with each constraint in the set requiring adjacent consonants to agree with respect to a particular feature (see Pulleyblank 1997, who refers to this constraint set as IDENTICAL CLUSTER CONSTRAINTS). Since each feature has its own AGREE constraint, a language may privilege some features over others. This appears to be the case in Buginese and Selayarese, in which homorganic nasal plus stop clusters are permitted, as evidenced in (6). This pattern obtains because AGREE (NASAL) is ranked below the rest of the AGREE

constraints, such as AGREE (PLACE), AGREE (CONTINUANT), etc. Notice also in (6) that adjacent consonants may differ in their voicing specifications, thus permitting (voiced) nasal plus voiceless stop clusters. This is captured by the relatively low ranking of AGREE (VOICE). I will therefore assume that in both languages AGREE (PLACE) and AGREE (CONTINUANT) outrank AGREE (NASAL) and AGREE (VOICE). Of the AGREE constraints, AGREE (PLACE) interacts with the other active constraints in Buginese and Selayarese in the most relevant ways; accordingly I ignore the candidates eliminated by the other AGREE constraints and for the sake of brevity I herein use AGREE to refer to AGREE (PLACE) only.

(6) Homorganic nasal plus stop clusters in Buginese and Selayarese

BUGINESE		SELAYARESE	
santaŋ	‘coconut cream’	ʔenteŋ	‘stand’
selanŋka	‘shoulder’	seŋka	‘stop by’
kandora	‘sweet potato’	pundoʔ	‘monkey’
manŋga	‘mango’	seŋgenna	‘until’

As revealed by the forms in (2) and (4), AGREE does not trigger place assimilation across the board. Most analyses of geminates (e.g. Hayes 1989, Samek-Lodovici 1992, Davis 1999) deal with global prohibitions of geminates based on well-formedness constraints on prosodic structure. With Buginese and Selayarese, it becomes clear that constraints on geminates must also refer to segmental content, since only a specific type of geminate—namely the geminate voiced obstruent—is dispreferred. A similar phenomenon has been pointed out in Toba Batak (another Western Austronesian language of Indonesia) by Crowhurst (1998), in which the placement of the infix *-um-* (normally understood as prosodically conditioned) depends on the segmental properties of the stem. The constraint responsible for the absence of geminate voiced obstruents at the prefix-root juncture, which I call *DD, is phonetically grounded by articulatory factors, as discussed by Ohala (1983). In order for voicing to occur, air must flow past the vocal folds to set them into motion. However, in the production of obstruents, all exit valves are nearly closed (completely closed in the case of stops). Oral pressure therefore quickly approaches subglottal pressure, slowing airflow and eventually extinguishing voicing.

(7) *DD – Geminate voiced obstruents are prohibited.

This markedness constraint must rank higher than the other markedness constraint (AGREE), requiring place agreement for adjacent consonants.

AGREE favors output forms containing geminate voiced obstruents, but the higher ranked *DD rejects such candidates. I am assuming that MAX-IO (McCarthy & Prince 1995), given in (8), is undominated in both languages since the prefix-final consonant always has an output correspondent.

- (8) MAX-IO (McCarthy & Prince 1995) – Every segment in the input has a correspondent in the output.

The three constraints are ranked as follows:

- (9) MAX-IO, *DD » AGREE

The tableau in (10) illustrates how these constraints work in prefixed forms beginning in voiced obstruents. Taking the Buginese word *maʔbusəʔ* ‘to eat (rude)’ as an example, a glottal stop plus voiced obstruent sequence surfaces instead of a geminate. Even though candidate (a) violates AGREE, it is selected as the optimal candidate because candidate (b) violates the higher ranked constraint *DD. The constraints achieve the same effect in Selayarese.

(10)

/maC-busəʔ/	MAX-IO	*DD	AGREE
a. maʔbusəʔ			*
b. mabbusəʔ		*!	
c. mabusəʔ	*!		

Here the question arises why a glottal stop appears instead of the first half of a geminate voiced obstruent. I argue that this glottal replacement strategy can be explained on phonetic, phonological, and morphological grounds. Glottal stops are most commonly realized phonetically, at least in Buginese, as vocalic glottalization (Podesva 1998a, b). Vocalic glottalization is achieved with a slow and choppy release of air past the glottis, which conserves subglottal pressure. This conservation of subglottal pressure in turn maintains the pressure differential between sub- and supraglottal pressure, thus enabling the voicing of the obstruent that follows. To produce a glottal stop before a voiced obstruent, then, is a smart articulatory strategy.

The motivation for glottal replacement can also be found in phonology, as glottal stops commonly appear as default segments cross-linguistically. In Sierra Miwok, for example, glottal stops are inserted to fill in empty templatic consonant slots (e.g. Broselow 1995). Descriptively speaking, then, the Buginese and Selayarese pattern can be understood as the deletion

of the first half of a geminate voiced obstruent, followed by default glottal stop insertion. Alternatively, the first half of the geminate may be treated as debuccalized, losing its oral articulation altogether, followed by obligatory devoicing due to its glottal articulation.

Finally, the appearance of a glottal stop plus voiced obstruent sequence instead of a geminate voiced obstruent has a morphological explanation as well, at least in Buginese. The distribution of glottal stop in Buginese is limited to syllable codas, or more precisely, the ends of morphemes. Thus, the glottal stop can be viewed as a morpheme marker. This is not meant to suggest that all morphemes end in glottal stop, but rather that all glottal stops appear at the end of morphemes, with a very limited set of counterexamples. Many of the apparent counterexamples—such as *bu?bu?* ‘rice porridge’ and *bo?bo?* ‘book’—can be treated as bimorphemic, due to reduplication under the pressure of a minimal word constraint (content words in Buginese must be two syllables long). Though the morphological motivation works well for Buginese, it cannot be extended to Selayarese, since glottal stops commonly appear morpheme-medially, as in *se?la* ‘salt’, *je?ne?* ‘water’, and *la?ba?* ‘wide’.

Though AGREE and *DD crucially opposed each other in (10), they do not always stand in conflict with one another. In cases when they do not conflict—when *DD is irrelevant to the forms under consideration—AGREE encourages gemination. In Buginese, for example, roots beginning in voiceless obstruents or sonorants trigger assimilation; prefix-final consonants assimilate to root-initial consonants. As illustrated in the tableau for *mallebo* ‘to form into a ball’ in (11), both candidates (a) and (b) satisfy *DD, leaving the decision of the optimal form up to AGREE. Candidate (b) fatally violates AGREE, leaving *mallebo* as optimal.

(11)	/maC-lebo/	MAX-IO	*DD	AGREE
a.	^{ɛɸ} mallebo			
b.	ma?lebo			*
c.	malebo	*!		

Although the prefix-final consonant assimilates to the root-initial sonorant in Buginese, this is not the case in Selayarese. Surfacing instead of a geminate sonorant is a glottal stop plus sonorant sequence. The question is what constraint is responsible for the pattern. An articulatorily motivated constraint like *DD cannot be appealed to here, since sonorants are in fact quite easy to prolong, given that they either have relatively wide constrictions (and in case of glides, /l/, and /r/) which allow air to flow out the mouth (and therefore past the vocal folds, setting them into motion) or

an additional supralaryngeal cavity (the nasal cavity in the case of nasals) through which air can flow.

Goldsmith (1990) argues in a rule-based framework that sonorants and voiced obstruents pattern together in Selayarese because they are both marked by the feature [+voice]. Although I agree that it is the voicedness of the voiced obstruents that prevents geminate voiced obstruents from surfacing at the prefix-root boundary, there is nothing marked about voiced sonorants, since sonorants are by definition voiced. I argue that geminate sonorants are prevented from occurring at the prefix-root boundary not by a constraint grounded in articulation (as was the case for *DD), but by a perceptually motivated constraint.

The strongest cues to the singleton/geminate distinction are the durations of the consonant itself and the preceding vowel, as found in Italian by Esposito & Di Benedetto (1999). These same phonetic parameters were found to be the strongest acoustic correlates of consonant length in Buginese, Madurese, and Toba Batak—all Austronesian languages of Indonesia—as well (Podesva 1998a, b; Cohn et al. 1999). Determining both the duration of the geminate consonant and the duration of the preceding vowel depends on locating the boundary between the two. However, sonorants exhibit formant structure and intensity levels comparable to the vowels that precede them, thus potentially making identification of a vowel's right edge and a geminate's left edge more difficult for geminate sonorants. As discussed by Kato et al. (1997), length contrasts are more easily perceived when accompanied by substantial jumps in intensity. This suggests that length contrasts are more difficult to perceive in sonorant consonants, which have high intensities relative to obstruents.

Due to the perceptual difficulty in perceiving sonorant length, I propose a constraint in prohibition of geminate sonorants, as in (12). Further support for this constraint can be found in typological patterns, as will be discussed in §4.

(12) *RR – Geminate sonorants are prohibited.

This constraint, along with *DD, must be ranked higher than AGREE, leaving us with the partial ranking shown in (13).

(13) Selayarese constraint ranking:
MAX-IO, *DD, *RR » AGREE

The tableau in (14) shows the constraint ranking at work in choosing the optimal forms for roots beginning in sonorants. The (b) candidate

taʔlesaj ‘to be removed’ is selected as the optimal candidate even though it violates AGREE because candidate (a) violates the higher ranked *RR.

(14)

/taʔlesaj/	MAX-IO	*DD	*RR	AGREE
a. taʔ tallesaj			*!	
b. taʔlesaj				*
c. talesaj	*!			

Although the markedness constraints on geminates (*DD and *RR) are motivated by phonetics, phonology has the ultimate say about their effectiveness. That is, no matter how phonetically well motivated a constraint is, the phonology can leave it powerless by ranking it low. A nice illustration of this comes from Buginese, in which the low ranking of *RR renders the constraint powerless. In contrast to the Selayarese constraint ranking, in which *RR is highly ranked, *RR sits at the bottom of the Buginese constraint hierarchy, given in (15). Since *RR ranks below AGREE, optimal candidates have geminate sonorants—rather than glottal stop plus sonorant sequences—spanning the prefix-root boundary.

- (15) Buginese constraint ranking:
MAX-IO, *DD » AGREE » *RR

To summarize thus far, the alternation between geminates and ʔC sequences has been analyzed as a result of the interaction between conflicting markedness constraints. AGREE stands at odds with *DD and *RR for voiced obstruent-initial and sonorant-initial roots. If AGREE is ranked higher, optimal forms contain geminates, as is the case with sonorant-initial roots in Buginese. On the other hand, if *DD or *RR is ranked higher, ʔC sequences surface instead. This is the case for roots beginning in voiced obstruents in Buginese and voiced obstruents and sonorants in Selayarese.

If AGREE ranks below *DD or *RR, we do not expect to find any voiced obstruent geminates or sonorant geminates, respectively. This expectation is not met within roots in either language, however. In Buginese, in which AGREE ranks below *DD, voiced obstruent geminates still appear in the monomorphemic forms in (1). Moreover, it is evident from the facts in (3) that geminate sonorants appear in Selayarese, even though AGREE ranks below *RR. An explanation of these facts is the focus of the next section.

3. Root-Internal Geminates versus Geminates at Morpheme Boundaries

Recall from §1 that geminate inventories within roots in both Buginese and Selayarese differ from those at the prefix-root boundary. In Buginese, *DD prevents geminate voiced obstruents from surfacing at the prefix-root boundary, yet they commonly appear morpheme-internally. Similarly in Selayarese, *RR militates against sonorant geminates at the prefix-root boundary, even though they appear within roots. In this section I present an analysis that appeals to root faithfulness, discussing its influence on consonant clusters at the prefix-root and root-suffix junctures.

McCarthy & Prince (1995) have proposed that faithfulness requirements are more strictly imposed within roots than in other types of morphemes, such as affixes. More recently, this issue has been taken up by Beckman (1998). Both argue that the cross-linguistic tendency for roots to contain more marked segment inventories and prosodic structures can be attributed to the high ranking of root faithfulness constraints. Under their reasoning, marked segments appear more commonly in roots because they need to be faithful to their root input correspondents, whereas affix segments have no corresponding root segments to be faithful to.

The geminate patterns of Buginese voiced obstruents and Selayarese sonorants provide support for the root faithfulness proposal. In Buginese, geminate voiced obstruents appear within roots because it is more essential to be faithful to root segments than to avoid geminate voiced obstruents. In other words, a constraint requiring that the value for the feature [Place] is the same in the output as in the input for root segments is responsible for the pattern. This same constraint, given in (16), captures the fact that geminate sonorants can appear within roots in Selayarese.

- (16) ROOT IDENT-IO (PLACE) (after McCarthy & Prince 1995) – For all segments in the root, input and output correspondents must have identical feature values for the feature [Place].

In Buginese, ROOT IDENT-IO (PLACE) must outrank *DD since geminate voiced obstruents do not appear root-internally. An updated Buginese ranking appears in (17).

- (17) Buginese constraint ranking:
 ROOT IDENT-IO (PLACE) » MAX-IO, *DD » AGREE » *RR

The tableau in (18) shows how these constraints interact in the selection of the output form *tabba* ‘to fry’. Even though candidate (a) violates *DD, it is selected as the surface form since candidate (b)

containing a glottal stop plus voiced obstruent sequence (which is what surfaces at the prefix-root boundary), violates ROOT IDENT-IO (PLACE).

(18)

	/tabba/	ROOT IDENT	MAX-IO	*DD	AGREE	*RR
a.	tabba			*		
b.	taʔba	*!			*	
c.	taba		*!			

ROOT IDENT-IO (PLACE) has a similar effect in Selayarese, where it is also undominated. Even though *RR is relatively highly ranked (as compared to AGREE), ROOT IDENT-IO (PLACE) enforces faithfulness to input geminate sonorants. A revised Selayarese ranking is in (19).

- (19) Selayarese constraint ranking:
 ROOT IDENT-IO (PLACE), MAX-IO » *DD, *RR » AGREE

In both languages ROOT IDENT-IO (PLACE) loses its force at the prefix-root boundary. The constraint has no bearing on Buginese prefixed forms with voiced obstruent-initial roots, nor does it affect Selayarese forms with sonorant-initial roots, since affix segments (prefix-final consonants) vacuously satisfy root faithfulness constraints. However, ROOT IDENT-IO (PLACE) does influence the selection of optimal candidates in cases involving assimilation (prefixed forms with roots beginning in voiceless obstruents or sonorants in Buginese and voiceless obstruents in Selayarese). While AGREE requires that the final consonant of the prefix be the same as the initial consonant of the root, it makes no claim as to which consonant should assimilate to the other. Thus in the tableau in (20) both forms (a) and (c) are equally faithful with respect to AGREE.³ ROOT IDENT-IO (PLACE) chooses the root-initial consonant as the segment which is assimilated to.

(20)

	/maʔ-tapa/	ROOT IDENT	MAX-IO	*DD	AGREE	*RR
a.	mattapa					
b.	maʔtapa				*!	
c.	maʔʔapa	*!				

3. I have represented the prefix-final consonant in (20) with a glottal stop (rather than an underspecified consonant slot) for illustrative purposes only. The claim is not that the input prefix actually ends in a glottal stop, only that it could end in one, under Richness of the Base (Prince & Smolensky 1993).

To summarize thus far, an analysis in which ROOT IDENT-IO (PLACE) is undominated accounts for all the facts in (1)-(4). The constraint encourages glottal stops to assimilate to following consonants at the prefix-root boundary. If the root faithfulness analysis presented here is correct, we predict that the same constraint should preserve glottal articulations in the same type of consonant sequence at the root-suffix juncture.

This is exactly the case in Buginese, as illustrated by the data in (21). Instead of assimilating to the following voiceless obstruent (in the first person possessive) or sonorant (in the second and third person possessives), the root-final glottal stop remains faithful to its place specification in the input form.

(21) Buginese geminates at the root-suffix boundary (Podesva 1998b)

/pəttəʔ/	[pəttəʔ]		‘ax’
/pəttəʔ ku/	[pəttəʔku]	[pəttakku]	‘my ax’
/pəttəʔ mu/	[pəttəʔmu]	[pəttammu]	‘your ax’
/pəttəʔ na/	[pəttəʔna]	[pəttanna]	‘his/her ax’

Selayarese also supports the prediction that input root glottal stops will remain unchanged in the output. Though Mithun & Basri (1986) do not report on ʔC sequences at the prefix-root boundary, the pattern at word boundaries matches expectations; word-final glottal stops do not assimilate to following consonants.⁴

It should be noted that even though root faithfulness predicts the direction of assimilation in Buginese and Selayarese, it is a well known and unresolved issue that in some languages the direction of assimilation and related phenomena is determined not by morphological affiliation, but by segmental order. Such issues have been taken up by Casali (1997) in his discussion of which vowel elides in environments of hiatus and by Wilson (1999) in his analysis of which consonant neutralizes in intervocalic biconsonantal clusters. Since this issue is not directly relevant to the facts of Buginese and Selayarese, I do not pursue it further here.

4. A notable exception to this pattern is when following words begin in voiceless obstruents, in which case the glottal stop assimilates to the voiceless obstruent. This pattern, however, is independent of morphology. The glottal stop in Selayarese may appear in any environment except before voiceless obstruents (Mithun & Basri 1986), irrespective of morphological affiliation. In this case, instead of dealing with a morphological phenomenon, we are dealing with a global prohibition of a specific type of cluster (glottal stop plus voiceless obstruent), presumably motivated by an insufficient perceptual distinction between the two segments in the sequence.

4. Typological Implications of *DD and *RR

Having accounted for the geminate patterns of Buginese and Selayarese, I turn now to a discussion of the cross-linguistic patterns predicted by *DD and *RR.

Let us begin with *DD, which singles out voiced obstruent geminates as marked. Implicit in the formulation of this constraint is that geminate voiceless obstruents are unmarked. Indeed, given that no constraint against voiceless obstruent geminates has been proposed, it is impossible for a language to ban voiceless obstruent geminates while permitting voiced obstruent geminates, no matter how low *DD ranks. Thus, any language allowing voiced obstruent geminates should also allow voiceless obstruent geminates. This prediction, a descriptive typological generalization mentioned by Blevins (1999), is empirically supported by the results of a cross-linguistic survey of approximately forty languages containing geminate consonants (see Podesva in progress for details of the survey). The only exception to the prediction is Somali (also pointed out by Blevins 1999), which is described as permitting voiced obstruents—but not voiceless obstruents—to geminate, though there is reason to call this pattern into question. According to phonetic descriptions of Somali (Puglielli 1997), voiced stops are almost devoiced in initial position and voiceless stops are strongly aspirated, suggesting that the voiced/voiceless distinction is in fact an unaspirated/aspirated contrast. Thus what is traditionally described as a geminate voiced stop may in fact be a geminate voiceless (unaspirated) stop.

*RR also makes a typological prediction, specifically about the frequency with which particular sonorant consonants appear as geminates cross-linguistically. *RR maintains that it is undesirable for sonorants to appear as geminates. If it is the case that within the class of sonorant consonants some segments are more sonorous than others, then it is reasonable to expect *RR to more heavily penalize those sonorant consonants that have high sonority levels (i.e. geminate glides are worse than geminate liquids, which are worse than geminate nasals). In fact, the Sonority Scale argues for just this sort of treatment, dividing the class of sonorants into glides, liquids, and nasals, according to Clements' (1990) hierarchy. Essentially this means that *RR is in reality three constraints—one against geminate glides, one against geminate liquids, and one against geminate nasals—which may be universally ranked with respect to one another according to the sonority hierarchy. This ranking predicts that the more sonorous a sonorant, the less likely it should appear in geminate inventories cross-linguistically.

The same cross-linguistic expectation can be arrived at if *RR is understood in terms of its phonetic motivation rather than the sonority hierarchy. As was suggested in §2, the relatively small intensity difference

between a geminate sonorant and the vowel that precedes it makes difficult the perception of the sonorant's phonemic length. Following this reasoning, glides should appear least commonly, since their intensity values are very close to those of vowels. Nasals, with the lowest intensity of the sonorants, should appear most commonly, and liquids should fall in between.

In the absence of evidence favoring one explanation over the other (phonological Sonority Scale account vs. phonetic intensity difference account), I do not identify either as more theoretically or empirically attractive. It may turn out that the explanations are two sides of the same coin. Regardless of the explanation appealed to, we expect to find nasals more commonly than liquids, which should occur more commonly than glides. The results of the survey confirm the expectation.

In summary, we have seen how the effects of constraints proposed to account for geminate patterns in individual languages can be observed in cross-linguistic patterns. Geminate inventories are thus not randomly configured, but rather must adhere to the implicational universals predicted by segmental constraints on geminates. See Podesva (in progress) for a discussion of additional segmental constraints on geminates and a more extensive set of the typological implications that they predict.

5. Concluding Remarks

The analysis presented here argues that the phonological behavior of geminates cannot be understood solely in terms of prosody, but must additionally take into account the segmental content of geminate consonants. The proposed constraints on geminates (*DD and *RR) not only account for the language-internal geminate patterns in Buginese and Selayarese, but also work to constrain permissible geminate inventories cross-linguistically. Thus formal status is granted to implicational universals which until now have been descriptive generalizations.

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