Buriat dorsal epenthesis is not reproduced with novel morphemes

Peter Staroverov
Universität Leipzig
August 2015

Abstract
In Buriat, the consonant realized contextually as dorsal or uvular alternates with zero at stem-suffix boundaries (Poppe, 1938, 1960; Sanžeev, 1941; Sanžeev *et al.*, 1962; Čeremisov, 1973). This alternation has been analyzed as phonological epenthesis and has been known as a challenge to the existing theories of phonological markedness (Rice, 2008; Morley, 2015; Vaux & Samuels, 2015). The analysis of this alternation has also been debated (de Lacy, 2006; de Lacy & Kingston, 2013). This paper presents new fieldwork and experimental evidence showing that the reported epenthesis pattern fails to be generalized to new environments. The results go against the phonological insertion account of the alternation, and instead support the analysis of Buriat dorsal-zero alternation in terms of floating features, present only on the relevant native affixes. These results thus suggest that Buriat is not a counterexample to dorsal markedness. The fact that dorsal epenthesis is not generalized despite relatively robust native evidence is also consistent with a learning bias against unnatural alternations (White, 2014; Hayes & White, 2015).

Note: some examples in this draft contain references to the author's example database. These can be ignored for most purposes.

1 Introduction

In Buriat, the consonant realized contextually as dorsal [g] or uvular [ɢ, ʁ] alternates with zero at stem-suffix boundaries (Poppe, 1938, 1960; Sanžeev, 1941; Sanžeev *et al.*, 1962; Čeremisov, 1973). This alternation has been analyzed as phonological epenthesis and has been known as a challenge to the existing theories of phonological markedness (Rice, 2008; Morley, 2015; Vaux & Samuels, 2015). The analysis of the relevant alternation has also been debated (de Lacy, 2006; de Lacy & Kingston, 2013). This paper presents new fieldwork and experimental evidence showing that the reported epenthesis pattern fails to be generalized to new environments. The results support the analysis of Buriat dorsal-zero alternation in terms of floating features, present only on the relevant native affixes. The results are also consistent with other morphological accounts of the alternation (de Lacy, 2006; de Lacy & Kingston, 2013; Uffmann, 2014).

Reported dorsal epenthesis in Buriat is arguably an unnatural alternation. Indeed, intervocalic dorsal insertion involves a non-minimal perceptual change since vowel sequences are most similar to V-glide-V sequences (Delattre *et al.*, 1955; O'Connor *et al.*, 1957), and Buriat has glides. Thus a process inserting a dorsal consonant between any two vowels would be disfavored by a learning bias favoring phonetically natural alternations (Wilson, 2006; Zuraw, 2007; Hayes *et al.*, 2009; Baer-Henney & van de Vijver, 2012; White, 2014; Hayes & White, 2015). The present results, suggesting that the alternation is not represented as fully general despite the relatively robust evidence, are consistent with the existence of such a learning bias.

The rest of the paper is organized as follows. Section 2 presents the relevant background information on the studied dialect of Buriat. Section 3 describes the dorsal-zero alternation in

detail and reviews its theoretical implications. Section 4 argues that the purported dorsal insertion pattern is not generalized to a rare, but productive native suffix – the numeral distributive /-AːdAːr/. Section 5 describes an experiment where Buriat speakers were taught a novel affix /-AːbA/ which failed to trigger dorsal insertion for most speakers, although it would be expected to do so. Section 6 presents a theoretical model of the Buriat data within Optimality Theory (Prince & Smolensky, 2004), relying on Generalized Non-Linear Affixation (Trommer, 2011; Bermúdez-Otero, 2012). Section 7 concludes.

2 Buriat basics

The data in this article come from the author's field investigation of the Barguzin dialect of Buriat, as spoken in the village of Baragkhan. More details on the consultants can be found in section 5.1.3. The transcription used here adheres to IPA.

The segment inventory of the studied dialect presents only few substantial differences from that of Standard Buriat (Poppe, 1938, 1960; Sanžeev, 1941; Sanžeev *et al.*, 1962; Radnaeva, 2003a; b, 2006, 2008). The first syllable exhibits all vocalic contrasts in Buriat, and the relevant inventory is given in (1).

The system of historic diphthongs has undergone some changes (described below), and the transcription in (1) reflects the most common surface realization for each diphthong. In what follows, I analyze these vowels as underlying diphthongs since such an analysis presents an elegant account of Buriat vowel harmony (Poppe, 1938, 1960; Sanžeev, 1941; Sanžeev *et al.*, 1962). The underlying /ai ei/ most commonly appear as monophthongs /ai/ → [ɛː]; /ei/ → [eː]. On the other hand, /ui, ʉi/ surface as diphthongs [ui yi]. Finally, the underlying /oi/ commonly varies between [œɛ] and [œː], and in some items undergoes further raising to the close-mid region. The factors governing realization of /oi/ may require further investigation, and the surface transcription adopted here is standardized to the most common pronunciation.

(1) Buriat vowel inventory: first syllable

Underlying monophthongs			Underlying diphthongs
i iː	ʉ ʉː	u uː	/ai/ ɛː /oi/ œɛ /ui/ ui /ʉi/ yi /ei/ eː
ə əː	ɵː	o oː	
	a aː		

The vowel system in (1) is very similar to that of Standard Buriat (Radnaeva, 2003a; b, 2006, 2008), although there are a few phonetic discrepancies.[1] These differences are documented here based on my formant measurements. Minimal and near-minimal pairs of words contrasting for the relevant vowels in the first syllable were measured. The target vowel was always preceded by a non-palatalized consonant or a pause, and followed by a non-palatalized consonant. The present study does not aim at a detailed description of Barguzin Buriat vowel space, and the results here should be taken as preliminary.

In the studied dialect, the high central rounded vowels [ʉ ʉː] (orthographic 'ү, үү') differ from [u uː] (spelled 'y, yy') most notably in backness rather than height. The corresponding

[1] In addition, I use the symbols [o a] in keeping with most existing sources. Radnaeva (2003a,b; 2006; 2008) suggests that these vowels may be more accurately transcribed as IPA [ɔ ɑ] in Standard Buriat, but my data are not sufficient to firmly establish this for the Barguzin dialect. Nothing in what follows hinges on the exact realization of these vowels.

vowels in Standard Buriat have previously been transcribed as IPA [ʊ ʊː] (Radnaeva, 2003a; b, 2006, 2008). Using [ʊ ʊː] for these segments is not only phonetically less precise for the studied dialect, but additionally could lead to potential confusion with regard to vowel harmony patterns. Indeed, in closely related Mongolian [ʊ ʊː] pattern with [–ATR] vowels (Svantesson *et al.*, 2005), whereas Buriat [ᵻ ᵻː] pattern with the correspondents of Mongolian [+ATR] class, i.e. with /ɵː əː ə ᵻi ei/.

The orthographic 'э, ээ' is centralized in the Barguzin dialect, represented here as [ə əː]. The corresponding sounds in Standard Buriat have been transcribed as [e eː] (Radnaeva, 2003a; b, 2006, 2008).

The transcription adopted here abstracts away from the allophonic alternations in vowel frontness which varies with palatalization of a preceding consonant. For example underlying /iː/ is always represented as [iː] on the surface even though after non-palatalized consonants it may sound closer to [ɨː]. Observe however that short /i/, unlike its long counterpart, never occurs after non-palatalized consonants.

The non-first syllables present a reduced vocalic inventory lacking the short high rounded vowels [u ᵻ]. The vowels in non-first syllables are also subject to reduction and harmony restrictions. The duration of long vowels is reduced in non-initial syllables. Furthermore, the short /o ə a/ tend to be reduced to a schwa-like quality in this environment. The present study makes no assumptions as to whether vowel reduction leads to complete neutralization of /o ə a/. Following Poppe (1960) I will distinguish [o] vs. [ə] vs. [a] in non-first syllables. The rules of Buriat harmony are rather complex, and since they are directly relevant to the present experiment, they will be described in detail in a separate section below (section 2.1).

The Buriat consonant inventory is presented in (2). The segments in parentheses occur only in loanwords.

(2) Buriat consonants

p b	pʲ bʲ	t d	tʲ dʲ	(k) g/ɢ	gʲ	
(f v)	(fʲ vʲ)	s z	ʃ ʒ	x/χ	xʲ/χʲ	h
		(ts)	(tʃ)			
m	mʲ	n	nʲ			
		l	lʲ			
		r	rʲ			
(w)			j			

The voicing contrast may be more accurately described as a difference in aspiration (Poppe (1960); see also Svantesson et al. (2005) on Mongolian), although a detailed phonetic investigation remains to be undertaken. All voiced stops undergo at least partial devoicing word-finally. Preconsonantal devoicing is also reported (Poppe, 1960), although it is more variable, judging from my recordings. The phonetic realization of voiced dorsal /g/ (both underlying and 'epenthetic') varies with the vowel harmony class of the word. In front-vowel words this segment appears as [g], and sometimes undergoes lenition to [ɣ] intervocalically. In back-vowel words it appears as uvular [ɢ] and frequently lenites to [ʁ] between vowels. In what follows, this segment will be loosely referred to as 'dorsal'. The dorsal fricative /x/

varies according to similar principles, although the details of its positional allophones were not extensively studied. The coronal nasal appears as [ŋ] or vowel nasalization word-finally, and as [ŋ] and before dorsals.

All consonants occur word-initially and prevocalically, although /r/ only shows up word-initially in loanwords. /r/ also does not occur after consonants. Glottal fricative /h/ and glides /w j/ do not occur in the coda, i.e. word-finally or before a consonant. The non-palatalized consonants do not occur before short /i/, although both palatalized and non-patalalized consonants appear before long /iː/.

Buriat allows syllables to begin with a vowel only word-initially. Native Buriat words disallow onset clusters and only allow [ŋg] as a complex coda. The syllable structure for native words is thus CVCC word-medially and (C)VCC word-initially. Loanwords (mainly from Russian) allow larger consonant clusters in both onset and coda.

Buriat stress is attracted to bimoraic nuclei (long vowels or diphthongs). In words with more than one bimoraic nucleus, the penultimate one of those is stressed (Poppe, 1960). Finally in words with no bimoraic nuclei the first syllable is stressed (see also Walker, 1994). Stress is predictable, and it will not be marked in the examples.

2.1 Vowel harmony

Buriat vowels are subject to a pervasive set of vowel harmony alternations, targeting two kinds of features. All vowels within a word must agree in frontness (see also Poppe 1960: 21), hence every word may contain either the vowels from a relatively back set /a aː ai o oː oi u uː ui/ or the vowels from a relatively front set /ə əː ei ө ө̆ ө̆ː ө̆i/. The frontness value of the word is controlled by the first syllable vowel. The vowels /i iː/ act as neutral occurring in both kinds of words. The patterning of words with /i iː/ in the first syllable is somewhat controversially reflected in the literature. Thus, Sanžeev et al. (1962: 39-40) suggest that short /i/ may occur in first syllables of back-vowel words while Poppe (1960) does not mention this possibility. Both sources agree that words with fist-syllable /iː/ as well as words containing only neutral vowels act as front-vowel words. The patterning of fist-syllable /i iː/ will not be relevant for our purposes.

Buriat also has rounding harmony affecting non-high vowels and operating according to a rather complicated set of rules. The descriptions of Buriat rounding harmony vary in the amount of detail they provide, and the description below is largely based on a fairly detailed report of Poppe (1960: 21-24), while I also note the observations from other sources where appropriate. In general, the rounding of vowels in the suffixes is determined by the nearest long vowel or diphthong in the stem, or else by the vowel in the first syllable of the stem. Rounding harmony thus manifests itself in the suffix alternations, and Sanžeev et al. (1962: 41-42) also note the similar distributional restrictions on vowels in non-first syllables of stems. In what follows, I will illustrate the rounding harmony with suffix alternations.

Since Buriat inventory lacks short /ө/, the operation of rounding harmony will be first illustrated with long suffix vowels. The long alternating non-high vowel /Aː/ in the suffixes can show up with four different qualities on the surface: [aː, oː, əː, өː]. The suffix vowel /Aː/ appears as [aː] if the trigger vowel is non-mid and of the back harmony class, i.e. after /a aː ai u uː ui/; as [oː] after mid back rounded triggers /o oː oi/; as [əː] after triggering /ə, əː, ei, ө̆ː, ө̆i, i, iː/, and as [өː] after the trigger /өː/. In stems where short [ө̆] determines suffix rounding (i.e.

if the first syllable vowel is [ʉ], and there are no long vowels or diphthongs in the stem) the suffixes with underlying /Aː/ will normally appear round, i.e. as [ɵː]. However for some words first-syllable [ʉ] fails to trigger suffix rounding, thus suffix /A/ appears as [əː]. As reported by Poppe (1960: 23) all stems where first-syllable [ʉ] fails to trigger rounding have the last syllable beginning with a palatalized consonant.

Since Buriat lacks short /ɵ/, the suffixes with a short alternating vowel /A/ have fewer options for their realization. These suffixes appear with [o] if the trigger is /o oː oi/; with [a] if the trigger is /a aː ai u uː ui/; and with [ə] after all stems of the front harmony class.

The rounding and frontness alternations effectively limit the set of suffix vowels to only seven underlying options, which will be symbolized as follows in this article: /A/, /Ai/, /Aː/, /Uː/, /Ui/, /i/, /iː/. The rounding alternations of the suffix vowels are summarized in (3), based on the quality of the triggering vowel (i.e. the last long vowel or diphthong of the stem, or else the first vowel of the stem).

(3) Summary of Buriat rounding harmony

Trigger vowel	Suffix vowel						
	A	Ai	Aː	Uː	Ui	i	iː
/a, aː, ai, u, uː, ui/	a	ai	aː	uː	ui	i	iː
/o oː oi/	o	oi	oː	uː	ui	i	iː
/ə, əː, ei, ʉː, ʉi, i, iː/	ə	ei	əː	ʉː	ʉi	i	iː
/ɵː/	ə	ei	ɵː	ʉː	ʉi	i	iː
/ʉ/	ə	ei	ɵː/əː	ʉː	ʉi	i	iː

It should be pointed out that the phonetic basis of vowel harmony is obscured by the realization of diphthongs, e.g. /ai/ → [ɛː] and /oi/ → [œː]. Furthermore, several classes of morphemes systematically escape vowel harmony. The so-called particles have long been recognized for not undergoing harmony in Standard Buriat (Poppe 1960). Thus the negative particle /gʉi/ in (4a)[2] appears as [gyi] even after stems with back vowels. The studied dialect also has a number of non-harmonizing suffixes which are absent Standard Buriat. The dialectal ablative /-aːn/ is illustrated in (4b). The non-harmonizing dialectal suffixes will be written here with an underlying lower case vowel symbol. As we shall see, these morphemes behave just as Standard Buriat suffixes with respect to hiatus alternations they trigger (section 3).

(4) Barguzin Buriat morphemes escaping harmony

a. Paricles: /bajar-gʉi/ 'happiness-NEG' [bajargyi] 'unhappy'

b. Dialectal affix variants: ablative /aːn/ (pro Standard Buriat /hAː/)

/ʃono-aːn/ 'wolf-ABL.DIAL' [ʃonaːn], *[ʃonoːn] 'from a wolf'

/bʉrgəd-aːn/ 'eagle-ABL.DIAL' [bʉrgədaːn], *[bʉrgədɵːn] 'from an eagle'

[2] The following glosses are employed in the examples: ABL.DIAL(dialectal ablative), CAUS(ative), COMIT(ative), DAT(ive), FREQ(uentative), IMP(bare imperative), INSTR(umental), IPF(imperfective), NEG(ative particle), PASS(ive), PL(ural), PL.IMP(plural imperative), PST(past)

The status of non-harmonizing morphemes in the studied dialect may require further investigation. However the consultants are quite aware of and certain about the rules of Standard Buriat frontness harmony, perhaps owing to the fact that harmony is reflected in spelling.

3 Buriat dorsal-zero alternation

Buriat dorsal-zero alternation has been debated, since this alternation was raised as a possible challenge to certain theories of consonant place markedness (de Lacy, 2002, 2006; Morley, 2008, 2015; Rice, 2008; de Lacy & Kingston, 2013; Vaux & Samuels, 2015). Section 3.1 surveys the relevant data and gives a preview of the possible analyses. The theoretical implications of the dorsal-zero alternation are explored in more detail in section 3.2.

3.1 Possible interpretations of the data

Buriat allows no hiatus. The vowel sequences containing a short vowel (which only arise at a morpheme boundary) are always resolved via vowel deletion, as shown in (5).

(5) Buriat hiatus resolution via short vowel deletion

/nabʃa-Aːr/	[nabʃaːr] 'leaves-INSTR'	140819_OB_elct_09_1070
/ʃono-aːn/	[ʃonaːn] 'wolf-ABL.DIAL'	140820_B_elct_12_1157

When two bimoraic vowels (long vowels or diphthongs) come together, the reported repair is dorsal insertion. The core data on dorsal-zero alternation in Barguzin Buriat largely match the existing descriptions (Sanžeev, 1941; Poppe, 1960; Sanžeev *et al.*, 1962). The examples in (6a) document this alternation, with the underlying forms assumed by the traditional insertion analysis. The dorsal-zero alternation is recorded with both nominal and verbal suffixes as well as between suffixes (6a). Furthermore, the dialectal variant of the ablative suffix also triggers the dorsal-zero alternation (6b). Finally, the examples in (6c-d) show that no dorsal appears either on the stems or on the suffixes in other environments.

(6) Examples of Buriat dorsal-zero alternation (presented on the epenthesis analysis)

a. Dorsal-zero alternations with native morphemes

/buːA:r/	[buːʁaːr] 'rifle-INSTR'	140820_B_elct_01_1146
/xʉlʲeːA:/	[xʉlʲəːgəː] 'wait-IPF'	140809_EO_elct_23_66
/bajar-tAi-Aːr/	[bajartɛːʁaːr] 'pleasure-COMIT-INSTR'[3]	140822_OB_elct_14_1581

b. Dorsal-zero alternation with Barguzin Buriat morphemes

/taxʲaː-aːn/	[taxʲaːʁaːn] 'hen-ABL.DIAL'	140820_B_elct_10_1155

c. /g/ does not occur on the stems otherwise

/xʉlʲəː-dəg/	[xʉlʲəːdəg] 'wait-FREQ'	140811_NB_elct_39_207
/buː/	[buː] 'gun, rifle'	
/taxʲaː/	[taxʲaː] 'hen'	
/hurgaːl-tai/	[hurgaːltɛː] 'education-COMIT'	140809_EO_elct_09_38

[3] The combination of comitative and instrumental affixes also has a fast-speech dialectal variant /tʲAAr/ showing apparent vowel deletion, e.g. /noxoi-tAi-Aːr/ [noxœɛtʲoːr] 'with a dog'.

d. Relevant suffixes after a consonant-final stem

/xatar-Aː/	[xataraː] 'dance-IPF'	140809_EO_elct_21_62
/bʊrgəd-Aːr/	[bʊrgədəːr] 'eagle-INSTR'	140820_KB_elct_01_1240
/hʊːl-Aːr/	[hʊːləːr] 'tail-INSTR'	140820_KB_elct_02_1241
/bʊrgəd-aːn/	[bʊrgədaːn] 'eagle-ABL.DIAL'	140820_KB_elct_09_1248

A phonological insertion process is not the only possible interpretation of the data in (6). De Lacy and colleagues argue that these data could equally stem from a pattern of phonologically-conditioned suppletion where the relevant affixes have two allomorphs whose selection is based on the last segment of the stem (de Lacy, 2006; de Lacy & Kingston, 2013). For example, the instrumental affix would have allomorphs /gAːr/ and /Aːr/, the former occurring after stems in long vowels, and the latter occurring elsewhere. The suppletion analysis is supported by the fact that a few Buriat affixes present a more complex allomorph distribution. Thus the accusative marker is /iːji/ after stems in a consonant or a short vowel, /ji/ after long vowels and diphthongs. The reflexive accusative is marked with /-jAA/ after short-vowel stems and with /-AA/ otherwise. Genitive/possessive is cited as another example of a clearly suppletive marker alternating between /Ai/ (after consonants and long vowels), /gAi/ (after long vowels), /n/ (after long /iː/ and diphthongs), and /iːn/ (after short vowels) (Poppe, 1960). However, new data from the studied dialect suggest that the genitive allomorphs /Ai/ and /(iː)n/ are not in a perfect complementary distribution, implying that these may be two separate affixes, whose distribution is yet to be documented in detail.

The suppletion analysis is based on an assumption that g-zero alternation is limited to only a few suffixes (de Lacy & Kingston 2013: 304). However, as Morley (2015) points out, the alternation is more general than this. In the studied dialect, the following suffixes appear with /g/ after long-vowel stems and with no /g/ otherwise: /Aːr/ 'instrumental'; /aːn/ 'ablative (dialectal)'; /Aːd/ 'approximative'; /Aː/ 'imperfective, imperfective participle'; /aːn/ 'perfective, perfective participle (dialectal)'; /AːʃA/ 'habitual participle'; /Aːd/ 'perfective gerund'; /AːrAi/ 'future imperative'; /iː/ 'non-future 2nd person imperative'; /UːʒAn/ 'non-future 3rd person imperative'.[4] The suppletion account would have to assume that all of these affixes accidentally match in their suppletive allomorphs as well as in the allomorph distribution.

Another variant of the morphological account would assume that all relevant affixes start with a floating /ᵍ/, or some set of floating features (Zoll, 1996). These features would be realized as [g/ʁ] between two long vowels (as in (6a-b)), but otherwise these features would not end up realized (as in (5)). On this account, the similar alternations of the suffixes are accounted for by their similar underlying forms. This analysis appears hard to tease apart from the suppletion account, and in what follows I will conflate these two hypotheses under the name 'morphological accounts'. One possible analysis along these lines is spelled out in detail in section 6.

[4] This list is similar to that compiled by Morley (2015) for Standard Buriat, but it includes a few dialectal morphemes and excludes the morphemes which are not used in the studied dialect. In addition to these, Poppe (1960) also lists a number of derivational suffixes which start with a long vowel but which are not recorded after stems ending in long vowels (see also Morley 2015: fn 10). These derivational affixes are of limited productivity: they do not attach to the relevant stems, and some are absent in the studied dialect altogether.

Lastly, it is important that Buriat has no general /g/-deletion process (pace Uffmann, 2014). The examples in (7a-b) illustrate the stems which end in /g/ as well as /g/-initial suffixes. For these morphemes, the underlying /g/ is not deleted (or left unrealized) next to a consonant. Buriat also has medial /Cg/ sequences, where /g/ is not deleted (7c).

(7) Buriat dorsal-initial stems and the suffixes

a. /g/-final stems: /beʃeg/ 'letter'; /zurag/ 'drawing'

/bəʃəg-tA/	[bəsəgtə] 'letter-DAT'	140822_OB_elct_36_1603
/zurag-tA/	[zuraʁta] 'drawing-DAT'	140822_OB_elct_40_1607

b. /g/-initial suffixes

/tanʲi-gdA-bA/	[tanʲigdaba] 'recognize-PASS-PST'	140821_OB_elct_05_1394
/jaba-gtiː/	[jabagtiː] 'walk-PL.IMP'	140809_EO_elct_34_89

c. Medial consonant + /g/ sequences

/ai-lgA-Aː/	[ɛːlgaː] 'fear-CAUS-IPF'	140820_B_elct_03_1148
/malgai/	[malgɛː] '(winter) cap'	
/xargiː/	[xargiː] 'road'	
/baːbgai/	[baːbgɛː] 'bear'	

Interestingly, no suffixes in the studied dialect start with a non-alternating /g/ before a long vowel. Such suffixes are equally predicted by the phonological insertion account and by the morphological accounts. Within the morphological approach it may be possible to assume that this gap is due to the fact that all suffix-initial /gVː/ sequences got reinterpreted as having a floating dorsal, although at a synchronic level, this gap is still accidental.

To summarize, the Buriat dorsal-zero alternation can be analyzed in at least two ways: as a general insertion process, and as a morphologized alternation (represented either as suppletion or as realization of a floating /^{g}/). Although the two accounts capture the core data equally well, they make different assumptions about how the speakers represent the relevant alternation. On the insertion account, the grammar of Buriat has a general insertion process that can be roughly stated as follows: /VːVː/ → [VːgVː], where /Vː/ stands for a bimoraic nucleus. The insertion account predicts that this rule should be generalized to novel items. On the other hand, on the morphological accounts the dorsal-zero alternation is represented as a property of affixes (either independently for each affix or generally for all of them), and therefore no productive dorsal insertion is expected. The rest of this article reports new evidence teasing these hypotheses apart.

3.2 Theoretical relevance of the Buriat dorsal-zero alternation

The analysis of the Buriat dorsal-zero alternation has significant theoretical consequences in at least three domains: treatment of consonant insertion, phonological markedness, and learning biases.

In some of the existing OT theories of insertion (de Lacy, 2002, 2006; Lombardi, 2002; de Lacy & Kingston, 2013), epenthetic quality can show the effects of the emergence of the unmarked, or TETU for short (McCarthy & Prince, 1994; Becker & Flack, 2011). In these accounts, the epenthetic segments do not have an underlying correspondent and their quality can be exclusively determined by the general markedness constraints, such the universal

place markedness hierarchy. Test cases for the TETU theory of epenthesis come from the patterns where the quality of an epenthetic segment does not depend on its surroundings, i.e. default consonant epenthesis. Thus in Buriat the quality of a (reportedly) inserted segment is the same regardless of the surrounding vowels (modulo the allophonic variation). The TETU theory predicts that a marked segment cannot appear in a default epenthesis pattern, if a language also has a less marked option available (Lombardi, 2002; de Lacy, 2006). Buriat dorsal-zero alternations present a potential challenge for the TETU theory, because dorsal and uvular segments are assumed to be universally more marked than coronals and glottals, and because Buriat also has coronals [t d]. Thus if the dorsal-zero alternations in Buriat are indeed an instance of phonological epenthesis then either the TETU theory of epenthesis or the associated markedness theory is wrong (Morley, 2008, 2015; Rice, 2008; Staroverov, 2014; Vaux & Samuels, 2015).

In a related set of approaches to markedness, it is assumed that certain phonological patterns are harder to learn than others because of a learning bias which may have a phonetic or a structural source. For example, a growing body of literature argues that phonetically natural alternations are easier to learn than the unnatural ones (Wilson, 2006; Zuraw, 2007; Baer-Henney & van de Vijver, 2012; White, 2014; Hayes & White, 2015), and that the typologically marked patterns may not be learned even in the presence of lexical statistical evidence (Becker *et al.*, 2011). A pattern inserting a dorsal consonant between any two long vowels is arguably not phonetically natural (as in fact most patterns of default consonant insertion). VV sequences are most phonetically similar to V-glide-V out of all potential VCV sequences (Delattre *et al.*, 1955; Liberman *et al.*, 1956; O'Connor *et al.*, 1957; Wright, 2004). Thus dorsal insertion involves a relatively large perceptual change, and it is therefore expected to be disfavored by a learning bias for perceptually minimal changes (Steriade, 2008; Hayes & White, 2015). On the other hand, the existing evidence of dorsal epenthesis is relatively robust in Buriat, as argued in section 3 (see also Morley, 2015). If Buriat has productive dorsal insertion, it would therefore constitute an interesting case of learning an unnatural alternation (Hayes *et al.*, 2009).

To summarize, both TETU theory of epenthesis and the existing evidence for a naturalness bias in learning lead us to expect that dorsal insertion may not be internalized as a general pattern, even in the presence of relatively robust evidence. This prediction is directly assessed in what follows.

3.3 Summary and the predictions of the two accounts

We have seen that there are two conflicting treatments of the dorsal-zero alternation in Buriat. According to the insertion account, Buriat has a general phonological alternation inserting a dorsal between two bimoraic vowels (Morley, 2015; Vaux & Samuels, 2015). On the other hand, according to the morphological accounts, the dorsal alternating with zero is part of the underlying specification of the relevant suffixes (de Lacy, 2002, 2006; de Lacy & Kingston, 2013; Uffmann, 2014).

Although the two analyses are able to capture the core data, they make different predictions. The insertion account predicts that the general process of dorsal epenthesis should apply with novel affixes. The morphological accounts present a very different picture of hiatus resolution in Buriat. According to these accounts, Buriat native data present little or no evidence of a general hiatus resolution strategy between bimoraic nuclei: the majority of the relevant sequences are handled by morphologized alternations. Therefore it is expected that speakers may diverge in their treatment of novel affixes. In particular, some speakers may generalize vowel deletion (the hiatus resolution strategy observed with short vowels) while others may try to guess a potential floating segment which may be part of a novel affix.

It should be noted that the two accounts do not differ in their predictions for novel stems. While the insertion account trivially predicts dorsal epenthesis in this case, the same prediction is yielded by the morphological accounts where the alternating dorsal is part of the representation of the affix, and hence native affixes are expected to trigger the alternation on novel stems.

The rest of this paper presents new evidence of how Buriat speakers treat new or unfamiliar suffixes. Section 4 is concerned with the suffix /-A:dA:r/ which attaches to numerals and carries an adverbial distributive meaning (e.g. 'in pairs', 'in bundles of three' etc). Section 5 reports on the results of an experiment with a made-up augmentative suffix /-A:bA/.

4 The numeral distributive

The numeral distributive /-A:dA:r/ presents a suitable test ground for the treatment of dorsal-zero alternations. The affix starts with a bimoraic vowel, and it can in principle be combined with any numeral, some of which also end in bimoraic vowels or in a /V:ⁿ/ sequence containing a floating /ⁿ/. The realization of floating /ⁿ/ is entirely morphologically-governed (thus /ⁿ/ is always realized in the nominative but never in the instrumental). With respect to the dorsal-zero alternations, the /V:ⁿ/ stems pattern exactly as the stems ending in a bimoraic nucleus in the cases where /ⁿ/ is not realized. A full account of the floating /ⁿ/, would lead us too far afield. Whenever possible, I use the stems clearly ending in a vowel to illustrate the relevant pattern. However, since numeral stems are a smaller class than nouns and many numerals end in /V:ⁿ/, such stems will also be cited as relevant.

Due to its meaning, the numeral distributive is expected to commonly occur with the numeral /xojor/ 'two' (in contexts of people working, walking etc. in pairs), and perhaps with the word /zu:ⁿ/ 'hundred' (in contexts like 'exchange a larger bill in bills of a hundred'). It is likely that the consultants never produced (and perhaps never heard) this affix with a variety of other numerals. On the morphological account, this would predict that the consultants might not have had enough exposure to postulate a floating /ᵍ/ on this affix. On the other hand, on the phonological insertion account, the amount of exposure to this particular affix should not matter, since Buriat dorsal insertion is a general phonological alternation affecting all sequences of bimoraic vowels.

Thus the insertion account predicts that this relatively rare affix will trigger dorsal epenthesis, while the morphological account leads us to expect that this affix is likely to exhibit idiosyncratic behavior. The latter prediction is confirmed, as illustrated by the data in (8), where all forms were verified with at least two consultants. The numeral distributive shows up with a dorsal only when attached to the numeral /zu:ⁿ/ 'hundred' while other numerals ending in a bimoraic nucleus trigger vowel deletion.[5]

[5] The same forms elicited from one additional consultant exhibited some variation: on one session the pattern in (8) was produced whereas on a later session, the numeral distributive triggered g-zero alternations with the words for *six* and *seven*.

(8) Numeral distributive with stems ending in a bimoraic nucleus

/zurgaː-AːdAːr/	[zurʁaːdaːr] 'in bundles of six'
/doloːⁿ-AːdAːr/	[doloːdoːr] 'in bundles of seven'
/zuːⁿ-AːdAːr/	[zuːʁaːdaːr] 'in bundles of a hundred'

The examples in (9) illustrate the point that both the numeral distributive and the stems in (8) have a long vowel at the appropriate edge. Thus the distributive surfaces with a long vowel after stems in a consonant or in a short vowel (9a). The stems in (8) attach the instrumental with a dorsal (9b).

(9) Numeral distributive and numeral stems contain a long vowel

a. Numeral distributive with consonant-final stems

/xojor-AːdAːr/	[xojoroːdoːr] 'in bundles of two'
/tabaⁿ-AːdAːr/	[tabaːdaːr] 'in bundles of five'

b. Numeral stems with other suffixes

/zurgaː-Aːr/	[zurʁaːʁaːr] 'six-INSTR'	140820_LD_elct_05_1325
/doloːⁿ-Aːr/	[doloːʁoːr] 'seven-INSTR'	140820_LD_elct_06_1326
/zuːⁿ-Aːr/	[zuːʁaːr] 'hundred-INSTR'	140820_LD_elct_07_1327

To summarize, the numeral distributive rarely occurs in the native data, but is entirely productive. The special behavior of this suffix is expected on the morphological accounts, whereas the absence of dorsal epenthesis with this suffix is problematic for the phonological insertion account.

5 Experimental evidence: the new augmentative

The experimental part of this study combines the wug test methodology (Berko, 1958) with novel affixes acquisition which has previously been used in artificial grammar learning (Tessier, 2012). The participants were taught a new affix /AːbA/ with an augmentative meaning. Phonologically similar affixes or native augmentatives are absent in Buriat. The phonological insertion account predicts that the new affix would trigger dorsal/uvular epenthesis when attached to native stems ending in a bimoraic nucleus. However, on the morphological accounts no dorsal epenthesis is predicted, because the participants are given no evidence to postulate a floating dorsal on the affix. According to the morphological accounts, the native data present no clear evidence of a general hiatus resolution strategy between two bimoraic nuclei. Hence the speakers are expected to either apply vowel deletion (the strategy applicable with short vowels) or perhaps to try and guess the floating segment that the new suffix might have. This section details the experimental methods (5.1) and results (5.2), and ends with some summarizing discussion (5.3).

5.1 Method

5.1.1 Stimuli

Prior to the experiment, about 50 nominal stems ending in either a consonant or a bimoraic nucleus were identified using the Buriat-Russian dictionary (Čeremisov, 1973). These stems were paired with appropriate pictures (obtained from Google picture search) and presented to the participants in a picture naming task, as slides on the screen of a 15-inch notebook

computer.[6] The participants were instructed to name the object they see in Buriat using the phrase [ənə __] 'This is ___'. The main experiment used the same pictures as those in the picture naming task. The stimulus set for each participant was designed to include only the words that he or she volunteered as a first reaction to the relevant picture. Although an effort was made to keep the stimulus set constant across participants, there were some inevitable differences. First, some of the participants occasionally failed to provide the intended Buriat word (usually replacing it with a Russian analog, or providing only a more general term such as *bird* for picture of an *eagle*). Second, some of the relevant words were found to have both a dialectal and a literary variant, e.g. *saw* /xʲʉrəː/ [xʲʉrəː] (literary); /xʉrei/ [xʉreː] (dialectal). In these cases, the form that the given consultant volunteered first was used in the experiment, provided that it was of the relevant phonological shape.

All stems used in the main experiment were between one and three syllables long. All stimuli were embedded in a carrier sentence [ənə __] 'This is ___'. The stimuli for the training phase were presented both auditorily and orthographically. The training set consisted of eight consonant-final stimuli for most participants. Due to occasional failure to produce the relevant words in the picture naming task, one participant (B) received seven training items, one received six (VV), and one – five (NV). The number of training items did not seem to affect the performance in the experiment.

All of the training stimuli were recorded from the same consultant, who did not participate in the main experiment, under the recording conditions described below in 5.1.2. The unmodified training stimuli were recorded in a picture naming task, and the modified stimuli bearing the novel affix were recorded from their orthographic representation. The vowels of the novel affix in modified stimuli varied according to the rules of vowel harmony (Poppe, 1960). Each stimulus was recorded in the carrier phrase and repeated three times. The resulting sound files were segmented using Praat (Boersma & Weenink, 2012), and the most suitable instance was embedded in the Powerpoint presentation for the experiment. All training stimuli were embedded with the maximal loudness setting of Powerpoint. The training stimuli always included stems of different frontness harmony classes.

In addition to the training stimuli, there were twelve test stems for each participant: five stems ending in a long vowel or a diphthong, and seven stems ending in a consonant. In total 108 test responses were obtained (12 responses from 9 participants), out of which 45 responses were potential cases of hiatus. The relatively small number of items per participant was motivated by the fact that pilot subjects exhibited visible signs of tiredness and started to modify the shape of the novel affix more and more when additional items were added. The vowel-final test stimuli always included items of different harmony classes as well as items ending in both long vowels and diphthongs.

The consonant-final stimuli in the experiment never ended in /g/ since including these stems could independently explain possible /g/-insertion answers. The Buriat nominal stems very often end in liquids /r l/, and this tendency was inevitably present in the data. However, the training stimuli always included items ending in non-liquids, such as /bʉrgəd/ 'eagle', /ʒəməs/ 'berry', and /nom/ 'book'. Whenever possible, consonant-final stems with a non-liquid ending were also included in the test set.

5.1.2 Procedure

At the time of the picture naming task, all participants were unaware of its goal. Before the experiment proper, the participants were told that the experimenter was designing a game for

[6] Due to power outages, an Ipad 2 was used for picture naming with two participants. All participants did the main experiment with the same notebook computer.

children, to see how they learn novel meanings of morphemes. The participants were instructed to guess the meaning from pictures in the training part, and to remember the shape of the new morpheme so that they can use the morpheme in the second part. The participants (many of whom were school teachers or kindergarten tutors) were also encouraged to give feedback on whether they thought the 'game' was appropriate and interesting for kids.

At the training phase, the participants were presented eight pairs of pictures where the first picture (normal object) corresponded to a training item in unmodified form while the second picture (big object) corresponded to a training item with the novel affix. The training items were presented both orthographically (on a computer screen) and auditorily (through Sennheiser HD 202 headphones), and the participants were asked to repeat what they heard three times for each slide.

After the training phase, the participants took a short break and were asked what they thought was the meaning of the new item, and whether they thought the kids could do the exercise. The test stimuli were presented to the participants only orthographically. At the test phase, the participants were presented with pairs of pictures where the first picture (normal object) was paired with the corresponding unmodified stem while the second picture (big object) appeared with a gapped phrase [ənə __] 'This is ___'. The participants were instructed to fill the gap and to repeat the resulting phrase three times.

The test phase always started with five consonant-final items in order to give the participants some practice in attaching the new affix. The remaining two consonant-final test items were randomly interspersed with vowel-final test items in the final part of the test phase.

The experiment lasted between ten and twenty minutes and was performed in a quiet room. The participants' responses were recorded using an AKG C-1000S microphone (cardioid) and a Zoom H4N portable solid-state recorder. The participants were asked to repeat each response three times. In cases of occasional stutterings, self-corrections, or interruptions, further repetitions were prompted.

The results were segmented using Praat (Boersma & Weenink, 2012). Each of the test responses was coded for whether it reflects frontness harmony and rounding harmony (the latter was assessed according to the rules presented in Poppe, 1960). The responses to vowel-final test items were additionally coded for the hiatus resolution strategy they employed. Additional modifications to the novel affix were also noted, although they rarely occurred.

5.1.3 Participants

Nine speakers of Barguzin Buriat from the Baragkhan village took part in the experiment. One of the speakers (CDSh) spent their childhood in Southern Buriatia (close to Mongolian border), but was living in the area for more than forty years. Data from two additional speakers were discarded since these participants did not use the intended affix, and instead used a completely new morpheme or the Russian augmentative.

For sociolinguistic reasons eight out of nine participants were female, aged between 37 and 65. The one remaining participant (B) was a man aged 17. The consultant's job was not considered socially appropriate for older men.

5.2 Results

Each of the test responses was consistent across the three repetitions. In rare cases of self-correction, the participants clearly insisted on just one response. The participants understood the instructions and were using the novel affix (except for two additional subjects).

5.2.1 Frontness harmony

The participants correctly applied frontness harmony to the novel suffix in all cases. In total, the long vowel of the novel suffix correctly appeared as [ɔː/ɵː] after front-vowel stems in 32 responses, each participant provided at least three such responses. The long vowel of the suffix correctly appeared as [aː/oː] after back-vowel stems in 54 responses. These counts exclude the cases where the long vowel of the suffix was shortened (see 5.2.4), or where the first vowel of the suffix was deleted, in which case only a short suffixal vowel remained. Short vowels in non-first syllables are subject to qualitative reduction, making the harmony class of the vowel hard to judge.

5.2.2 Rounding and other harmony

Unlike the frontness harmony, the expected rounding harmony was often not found in the data. Occasionally rounding harmony was also overapplied, but only if it led to total harmony. Recall that the rules of Buriat rounding harmony are rather complex. According to Poppe (1960) mid vowels /o oː ɵː/ always trigger roundness of the suffix /A Aː Ai/, high /ʉ/ lexically varies in whether it does so, and high /uː u ʉː/ never trigger suffix roundness. The trigger for suffix rounding is reported to be the last bimoraic vowel of the stem or else the first vowel of the stem.

The table in (10) summarizes rounding harmony observed in the data (based only on the responses where the long vowel of the suffix was realized and appeared as long).

(10) Rounding harmony on the novel augmentative suffix

Expected	Observed [+rnd]	Observed [–rnd]	Total	% as expected
[+rnd]	5	6	11	45%
[–rnd]	4	71	75	95%

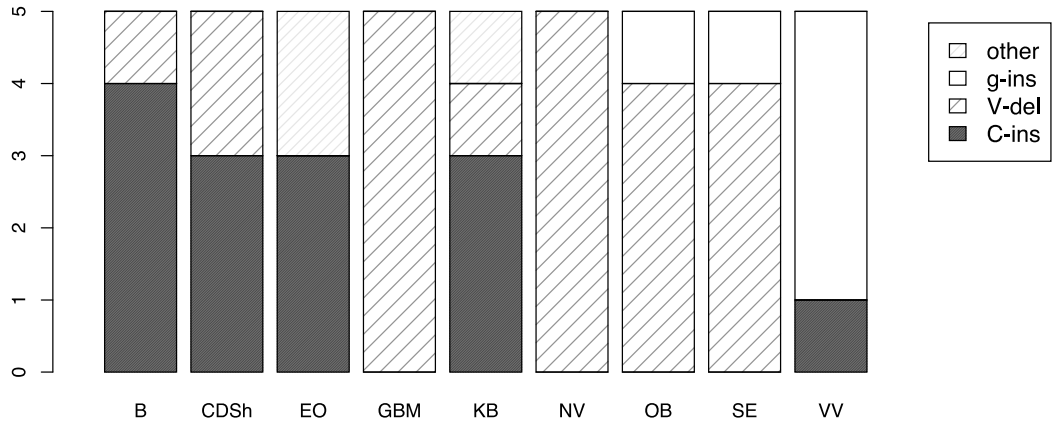
It can be observed that the participants almost never used a round vowel where an unround one is expected. In fact the four cases of 'overrounding' all come from one consultant (NV), and in all of these cases the height of the suffix vowel was also unexpectedly modified. In other words, these four responses changed the intended /Aː/ of the novel augmentative /AːbA/ to [uː/ʉː] after stems with a high rounded vowel in the first syllable. These four responses thus exhibit total harmony – a pattern not found in native Buriat data.

Importantly however, for cases where a round vowel is expected, rounding was actually produced only 45% of the time. Although the amount of data is small in this case, the observations are rather evenly distributed among consultants. This can be a preliminary indication of the fact that rounding harmony in Barguzin Buriat is either not active at all or operative according to a special set of rules.

5.2.3 Hiatus resolution

The potential hiatus between a stem-final bimoraic nucleus and a long vowel of the novel suffix was always resolved. The strategies employed for hiatus resolution are summarized in (11) for each speaker.

(11) Buriat hiatus resolution with the novel affix



It can be observed that hiatus was resolved fairly consistently within each speaker. Three of the speakers (CDSh, EO, KB) employed the same strategy in three out of five responses, and the remaining speakers gave either four or five responses using the same hiatus resolution strategy.

/g/-insertion was used as a hiatus strategy more or less reliably by only one speaker (VV, four out of five responses). The remaining speakers together produced only two /g/-insertion responses (one for each OB and SE), and the overall number of /g/-responses for these remaining speakers was not significantly different from zero (Fisher's exact test, $p = 0.25$). The /g/-responses for both OB and SE were produced with the same stem /buː/ 'gun, rifle', yielding the novel augmentative [buːʁaːba].

Four speakers consistently employed vowel deletion in hiatus (GBM, NV, OB, SE). Vowel deletion was also commonly observed as an alternative response strategy for participants who overwhelmingly did insertion of a consonant other than /g/ (B, CDSh, EO, KB). This latter group of participants is in fact rather heterogeneous. For one thing, the participant responses were less consistent within this group (three out of four group members gave only three of the same response). Furthermore, the inserted consonant was different for different participants. Two participants employed insertion of /r/, one participant inserted /l/, and one participant inserted /b/. The insertion of liquids is consistent with the fact that many training and filler consonant-final stems ended in /r l/ in the experiment (see section 5.3 for further discussion). /b/-insertion suggests that the participant attempted reusing the consonant which was already present in the novel affix. Similarly, the consultant VV, who overwhelmingly did /g/-insertion employed /r/-epenthesis with one item where the stem already contained an /r/: /zarʲaː/ 'hedgehog' giving [zarʲaːraːba]. Interestingly, /r/-insertion responses for both participants B and KB also incurred shortening of the first vowel of the novel suffix, e.g. /taxʲaː/ 'hen' → [taxʲaːraba] (see section 5.2.4 for further discussion of shortening).

The responses coded as 'other' in (11) were as follows. The participant EO (who typically inserted /l/ before the suffix in hiatus contexts) produced two items with an inserted CVC sequence [lul], e.g. /baːbgai/ 'bear' → [baːbgɛːlulaːba]. The participant KB (who typically inserted /r/) produced one item with both /g/ and /r/ insertion: /buː/ 'gun, rifle' → [buːʁaːraba]. Coding this response as /g/-insertion would not alter the results.

5.2.4 Shortening and other modifications

In addition to hiatus repairs and harmony, the participants occasionally also applied other modifications to the novel affix. Shortening is perhaps most notable. The first vowel of the novel augmentative /A:bA/ was shortened in /r/-insertion repairs for participants B and KB (7 responses total). The suffix was realized as /rAbA/ in these cases. Shortening did not occur in any other responses. Shortening may have to do with the fact that the relevant vowel was always preceded by a stressed bimoraic nucleus, since stress falls on penultimate bimoraic nuclei in Buriat (Poppe, 1960). The duration of the shortened vowel was nonetheless quite substantial and hardly interpretable as an instantiation of /r/ release: mean 74,66ms, sd 21.7ms for consultant B (24 tokens); mean 61,37ms, sd 13,4ms for consultant KB (18 tokens).

Occasionally other modifications were applied to the novel affix with consonant-final stems (recall that each consultant gave seven responses for consonant-final stems). Two responses contained the affix /tAbA/: /hʉ:l/ 'tail' → [hʉ:ltəbə] and /ural/ 'lips' → [uraltaba], both from consultant KB. Four responses from consultant VV contained the affix /VlA:bA/, where the first vowel copied the vowel of the stem: /ʒəməs/ 'berry' → [ʒəməsələ:bə]; /buxal/ 'haystack' → [buxalala:ba]; /xʉl/ 'foot' → [xʉlʉlə:bə]; /hʉ:l/ 'tail' → [hʉ:lʉ:lə:bə]. In one response from consultant B the novel augmentative appeared as [ba]: /ural/ 'lips' → [uralba].

5.3 Discussion

The consultants understood the task, most of them correctly identified the meaning of the novel suffix in the feedback, and the participants used the novel augmentative (with the exception of two speakers whose data was excluded). For the most part, the participants also remembered and correctly reproduced the phonological form of the affix: the unexpected changes with consonant-final stems were relatively rare (only 7 responses out of 63). At the same time, the participants were not simply using the same string of segments all the time: they correctly varied the form of the affix according to the frontness harmony class of the stem. These observations suggest that the hiatus repair strategies as well as the relatively frequent failure to produce expected patterns of rounding harmony are indicative of the grammar of Barguzin Buriat.

With respect to rounding harmony, the present results preliminarily suggest that its rules may be different from those reported by Poppe (1960), or that it may be non-productive in the studied dialect. Recall that other descriptions of Standard Buriat vowel harmony also tend to mention only a part of the patterns discussed by Poppe (Sanžeev, 1941; Sanžeev *et al.*, 1962). Thus although there is no explicit disagreement in the sources, the existence of different descriptions suggests that there may be dialectal differences applicable to Buriat rounding harmony.

The hiatus resolution strategies applied by the participants are highly suggestive of the morphological accounts for Buriat dorsal-zero alternations. /g/-insertion was consistently used by only one subject (VV). The remaining instances of /g/-insertion were rare (only two responses), and always occurred with the same stem /bu:/ 'gun, rifle', suggesting that hiatus resolution may be driven by properties of individual morphemes. The overall rare application of /g/-insertion with the novel affix goes against the predictions of the phonological insertion analysis.

Importantly, the non-/g/ responses produced in the experiment match the predictions of the morphological accounts very closely. Recall that on these accounts Buriat presents no evidence of a general hiatus resolution strategy with bimoraic vowels. It is therefore expected that some speakers would generalize vowel deletion applicable with short vowels while other

speakers may attempt to guess the floating segment which is part of the novel affix. Four consultants (GBM, NV, OB, SE) used vowel deletion fairly consistently, thus apparently generalizing the hiatus strategy applicable with short vowels.

Four other consultants (B, CDSh, EO, KB) usually resolved hiatus via consonant insertion, consistent with postulating a floating segment that is part of the affix. The inserted consonants produced by this latter group of consultants further corroborate this interpretation. Three of the four relevant consultants (B, EO, KB) inserted a liquid /l, r/ in hiatus. Postulating a floating liquid on the suffix could account for a lot of the training data: the majority of the consonant-final stems ended in a liquid, and liquid clusters are very limited in Buriat – only [rl] is attested (Poppe 1960: 15-18). If the novel suffix had a floating liquid at the beginning, the floater would likely be unrealized after liquid-final stems. Thus postulating a floating liquid on the affix correctly explains the shape of most training items. The behavior of participants B, EO, and KB is thus consistent with the hypothesis that they were attempting to guess the floating segment present on the affix that would best match the training data. Finally, the participant CDSh used /b/-insertion relatively consistently – perhaps because this segment was part of the novel affix /A:bA/.

The account sketched above assumes that the participants were postulating an underlying representation and morphophonological rules that govern hiatus resolution between the stem and the novel affix. However the participants' responses could be accounted for equally well by the analogy models where the assumption would be that the participants store entire forms and the form of the affix in hiatus is governed by analogy to the stored forms (Bybee, 1985, 2001; Rumelhart & McClelland, 1986; Köpcke, 1988; Skousen, 1989; Dąbrowska, 2008 a. o.). Teasing apart the different predictions of the two models is not our goal here (see e.g. Albright & Hayes, 2003). Importantly, the data clearly suggest that there is no general pattern of dorsal insertion in Buriat, at least for eight out of nine speakers.

To summarize, the results of an experiment with the novel augmentative /A:bA/ go against the view that Buriat has phonological dorsal epenthesis, and instead support the idea that the dorsal-zero alternations are represented as properties of particular suffixal morphemes. These results thus eliminate a potential counterexample to the view that dorsal consonants are relatively marked (Lombardi, 2002; de Lacy, 2006). The fact that one participant did produce dorsal epenthesis is consistent with the view of markedness as a bias on learning rather than a hard constraint on possible grammars (Pierrehumbert, 2006; Hayes *et al.*, 2009). The present results are also consistent with a naturalness bias for learning and generalizing phonological alternations (Wilson, 2006; Zuraw, 2007; Baer-Henney & van de Vijver, 2012; White, 2014; Hayes & White, 2015): despite the relatively robust evidence, the arguably unnatural dorsal epenthesis pattern is only rarely represented as a general alternation.

Finally, one aspect of the hiatus data that might require further investigation is the fact that /r/-insertion co-occurred with shortening of the first vowel of the suffix (speakers B, KB). One would hope that a broader study would discover cases of shortening unrelated to hiatus resolution.

6 Analysis

The aim of this section is to spell out a possible morphological analysis of the Buriat dorsal-zero alternation. The proposed account captures the general alternation pattern while abstracting away from a couple of affixes which are clearly suppletive (see section 3.1). The approach presented here is casted within Optimality Theory (Prince & Smolensky, 2004) and relies on the assumptions of Generalized Non-linear Affixation (Trommer, 2011; Bermúdez-Otero, 2012), although similar generalizations can be encoded in other morphophonological

frameworks such as indexed constraints (e.g. Pater, 2000, 2006), sublexicon grammars (Allen & Becker, 2015; Becker & Gouskova, 2015), or cophonologies (Inkelas *et al.*, 1997; Inkelas & Zoll, 2007 a.o.).

I will assume that all affixes that trigger dorsal-zero alternations come with a floating feature DORSAL at the beginning, which will be written /ᵍ/ in underlying forms. Thus the application of the relevant alternation is encoded as part of the representation of the particular morphemes. The exact realization of Buriat /g/ depends on the quality of the vowels in the word: dorsal in front-vowel words and uvular in back-vowel words, with a possibility of intervocalic lenition. These alternations equally apply to all underlying dorsals, floating or not. In what follows I will abstract away from these alternations. Although they could be analyzed by some ad-hoc constraint requiring VC feature sharing, analogous to the spreading rule proposed for Mongolian by Svantesson et al. (2005), these alternations are somewhat unique in the typology of harmony processes since they present a case of an arguably non-local vowel-consonant place feature interaction (Padgett, 2011; Rose & Walker, 2011). Thus providing a theoretically-informed analysis of these alternations would lead us too far afield.

In Buriat, the floating dorsal can only be realized by inserting a root node,[7] in violation of the constraint DEP, as defined in (12) (McCarthy & Prince, 1995, 1999).

(12) DEP: assign a violation mark for every surface segmental root node which does not have a correspondent in the input

This analysis treats the Buriat dorsal-zero alternation as epenthesis, but epenthesis of an empty root node, rather than of a dorsal consonant.

Segmental insertion is generally disallowed in Buriat, and therefore the floating DORSAL normally remains unassociated in violation of the constraint *FLOAT.

(13) *FLOAT: assign a violation mark for every feature that is not associated to a segmental root node

This is illustrated in the tableau (14) showing attachment of the instrumental suffix /ᵍAːr/ to a consonant-final stem /hʉːl/ 'tail' (6d). This paper combines the comparative tableau format of Prince (2002) with numbers showing violation marks.

(14) Floating dorsal is normally left unrealized

	[hʉːl-ᵍAːr]	DEP	*FLOAT
☞ a.	hʉːl(ᵍ)əːr		1
b.	hʉːlgəːr	W1	L

The winning candidate (14a) has a floating dorsal, shown in parentheses. These floating features remain unassociated, and hence not phonetically realized. The losing candidate (14b) represents an attempt to realize the floater which fatally violates DEP.

A more interesting case of floating dorsal non-realization comes from hiatus environments with a short vowel, e.g. /nabʃa-ᵍAːr/ → [nabʃaːr] 'leaves-INSTR' (5). In these cases inserting a root node could help to avoid a violation of ONSET (Prince & Smolensky,

[7] Alternatively, the realization of floating dorsal could be analyzed as splitting, i.e. creation of a root node corresponding to an underlying vowel (Staroverov, 2014). The difference between the two approaches to epenthesis is irrelevant here.

2004). Nevertheless, vowel deletion is preferred in this environment, because MAX is ranked below DEP. The relevant constraints are defined in (15-16).

(15) ONSET: assign a violation mark for every surface syllable without an onset consonant

(16) MAX: assign a violation mark for every underlying segmental root node which does not have a correspondent in the output

The analysis of Buriat vowel deletion in hiatus is presented in (17). Here and below the dots show syllabification.

(17) Hiatus resolution via vowel deletion with short vowels

	[nabʃa-ᵍAːr]	ONSET	DEP	MAX	*FLOAT
☞ a.	nab.ʃ(ᵍ)aːr			1	1
b.	nab.ʃa.ʁaːr		W1	L	L
c.	nab.ʃa(ᵍ).aːr	W1		L	L

Buriat does not tolerate word-medial onsetless syllables, and therefore when two vowels come together at a morpheme boundary hiatus has to be resolved, (17c) cannot win. However, it is better to delete a stem-final short vowel and leave the /ᵍ/ floating than to insert a root node (DEP >> MAX). Therefore the deletion candidate (17a) beats the insertion candidate (17b).

When two bimoraic nuclei come together, deletion is not applicable in Buriat. The special behavior of long vowels in hiatus environments is well-documented cross-linguistically (Casali, 1998; Staroverov, 2014). In Buriat, the set of 'long vowels' is further extended to include all bimoraic nuclei, i.e. long vowels and diphthongs. As we have seen, the diphthongs pattern together with long vowels in other respects as well (vowel harmony, stress assignment). Here I follow Casali (1998) and Beckman (1998) in assuming that bimoraic nuclei are protected by a special family of positional faithfulness constraints. In particular, MAX-BIMORAIC (18) protects bimoraic vowels from deletion.

(18) MAX-BIMOR(aic): assign a violation mark for every underlying bimoraic segment which does not have a correspondent in the output

The high ranked MAX-BIMORAIC protects long vowels from deletion in hiatus environments. In this case, lower-ranked DEP is violated instead: a consonant root node is inserted, providing a docking site for the floating /ᵍ/. This is illustrated in (19) with the analysis of the mapping /buː-ᵍAːr/ → [buːʁaːr] 'rifle-INSTR' (6a).

(19) Hiatus resolution via root node insertion between two long vowels

	[buː-ᵍAːr]	ONSET	MAX-BIMOR	DEP	MAX	*FLOAT
☞ a.	buː.ʁaːr			1		
b.	buː(ᵍ)r		W1	L	W1	W1
c.	buː(ᵍ).aːr	W1		L		W1

The winning candidate (19a) keeps both input long vowels and avoids the potential ONSET violation through floating /ᵍ/ realization. The competitors on the other hand either delete a bimoraic nucleus (19b) or have a violation of ONSET (19c).

Of course, a bare root node together with dorsal place does not yield a full specification of a dorsal. It may be that some of the other features are left unspecified and filled in by phonetics. Alternatively some of the relevant features may be inserted together with the root node. Finally, at least one other part of the floating /ᵍ/ is marked, and therefore it has to be underlying – that is the specification for [+voice].[8]

On this account of Buriat, native data present no evidence of a general hiatus resolution strategy for sequences of two bimoraic vowels. As we have seen from the behavior of the numeral distributive and from the experimental data in section 5, such sequences are typically resolved either via vowel deletion or via postulating some floating consonant. Crucially however, bimoraic vowel deletion is attested with the numeral distributive and in the experiment. These examples could be used as evidence for further refining our grammatical model of Buriat. The responses with long vowel deletion evidently do violate MAX-BIMORAIC, which we were assuming to be top ranked so far. However, in the absence of a floating /ᵍ/, consonant epenthesis would always involve insertion of place features. We can therefore assume that Buriat prohibits place insertion via a ranking DEP-PLACE >> MAX-BIMORAIC, relevant at least for the speakers who produced long vowel deletion in the absence of a floater.

Finally, the proposed grammar of Buriat hiatus correctly predicts that the floating /ᵍ/ should be highly restricted in its distribution: it should only be found in a suffix-initial position before a bimoraic nucleus. According to Richness of the Base, we have to consider inputs where floating /ᵍ/ would occur in other environments, but none of these inputs would give surface evidence of dorsal-zero alternation. Indeed, if /ᵍ/ occurred next to a short vowel or next to a consonant, it would not have a chance to be realized, since its realization is always triggered by MAX-BIMORAIC. On the other hand, if /ᵍ/ occurred morpheme-internally between two bimoraic nuclei it would always be realized, and thus equivalent to a fully specified /g/. In both of these cases, the learner would fail to postulate a floating segment because input optimization would crucially rely on the constraint prohibiting floating material, namely *FLOAT (Prince & Smolensky, 2004). The only environment where a floating /ᵍ/ can be reasonably postulated is at an edge of a morpheme, next to a bimoraic nucleus. Since Buriat has no prefixes and very limited compounding and reduplication, this is equivalent to the environment where /ᵍ/ actually occurs.

To summarize, this section has provided an autosegmental account of the Buriat dorsal-zero alternation within the framework of Generalized Non-linear Affixation (Trommer, 2011; Bermúdez-Otero, 2012). This account does not postulate a general dorsal insertion process, it is compatible with the evidence in sections 4 – 5, and it correctly derives the distribution of the floating /ᵍ/.

7 Conclusion

This paper has provided a detailed examination of the Buriat dorsal-zero alternation, based on new fieldwork and experimental data from the Barguzin dialect. It was argued that most speakers of Buriat do not have a productive phonological dorsal insertion pattern, based on two kinds of new evidence. First, the relatively infrequent but productive numeral distributive /-A:dA:r/ does not trigger dorsal epenthesis with stems with which it was probably never seen before by the consultants. For this affix, the speakers have not encountered enough evidence

[8] Thus the floating /ᵍ/ should probably be more precisely represented as two floating features, not as one. However, it seems unnecessary to assume that the two floating features are underlyingly linked together (cf. Zoll, 1996): their association to the inserted root node can be entirely independent. In fact, in many models of feature geometry there is no node lower than the root node which could bring together place and [voice]

to postulate a floating dorsal, and therefore they systematically apply vowel deletion (the strategy applicable with short vowels) instead of the purported dorsal insertion.

Second, when Buriat speakers were taught a novel augmentative suffix /-AːbA/, they systematically failed to generalize dorsal insertion to this suffix. Instead their experimental responses matched the predictions of the morphological accounts of the alternation: several speakers resolved hiatus via vowel deletion while other speakers attempted to guess the floating segment that may be present on the affix. Finally, the experimental results suggest that rounding harmony in Buriat may require further investigation.

A theoretical model of the Buriat dorsal-zero alternation was proposed in section 6. This model encodes the quality of the alternating segment as an underlying property of the relevant affixes. The proposed account assumes that the relevant affixes start with a floating /^{g}/ whose realization is governed by the general properties of Buriat phonology. The model is compatible with the experimental results, and it correctly accounts for the context of dorsal-zero alternation.

The findings of this paper are consistent with the theories of phonological markedness assuming that dorsal and uvular consonants are marked (Lombardi, 2002; de Lacy, 2006). Furthermore, our experimental findings are also reminiscent of the view that phonetically unnatural processes are disfavored by a learning bias, but not unlearnable (Wilson, 2006; Zuraw, 2007; Hayes *et al.*, 2009; Becker *et al.*, 2011; Baer-Henney & van de Vijver, 2012; White, 2014; Hayes & White, 2015). In fact, one of the experimental participants did appear to reproduce the /g/-insertion pattern, suggesting that for that speaker a dorsal insertion grammar may be internalized.

Acknowledgements

I wish to thank my Buriat consultants for their eager engagement, patience, and hospitality. Many thanks to Sergei Tatevosov both for his astute comments on Buriat, and for organizing the Buriat field trips which he kindly let me take part in. I am grateful to Sven Grawunder for sharing his fieldwork and recording experience, and for his comments on Buriat phonological system. I am indebted to Andrew Nevins and Paul de Lacy for our encouraging and challenging discussions of the Buriat data. For their comments and expertise I wish to thank all my fellow fieldworkers, especially Pavel Koval, Ilya Kuryanov, Dmitry Privoznov, Galina Sim, Maria Vassilyeva, and Dmitry Zelensky. For their feedback on various aspects of the paper I am grateful to Asya Achimova, Michael Becker, Will Bennett, Sara Finley, Jochen Trommer, Colin Wilson, and Kie Zuraw. I am grateful to Leipzig University and the German Research Foundation (DFG Research Training Group GRK 2011) for financial support.

References

Albright, A. & Hayes, B. (2003). Rules vs. analogy in English past tenses: a computational/experimental study. *Cognition*, 90(2), pp 119–161.

Allen, B. & Becker, M. (2015). Learning alternations from surface forms with sublexical phonology. Ms, UBC and Stony Brook University.

Baer-Henney, D. & van de Vijver, R. (2012). On the role of substance, locality, and amount of exposure in the acquisition of morphophonemic alternations. *Laboratory Phonology*, 3(2), pp 221–249.

Becker, M. & Flack, K. (2011). The emergence of the unmarked. In: Van Oostendorp, M., Ewen, C. J., Hume, E., & Rice, K. (Eds) *The Blackwell Companion to Phonology*. Malden, MA: Blackwell.

Becker, M. & Gouskova, M. (2015). Source-oriented generalizations as grammar inference in Russian vowel deletion. *Linguistic Inquiry*,.

Becker, M., Ketrez, N. & Nevins, A. (2011). The Surfeit of the Stimulus: Analytic Biases Filter Lexical Statistics in Turkish Laryngeal Alternations. *Language*, 87(1), pp 84–125.

Beckman, J. (1998). *Positional Faithfulness*. PhD dissertation, Umass Amherst.

Berko, J. (1958). The child's learning of English morphology. *Word*, 14, pp 150 – 177.

Bermúdez-Otero, R. (2012). The architecture of grammar and the division of labour in exponence. In: Trommer, J. (Ed) *The phonology and morphology of exponence*. pp 8–83. Oxford: OUP.

Blevins, J. (2008). Consonant epenthesis: natural and unnatural histories. In: Good, J. (Ed) *Linguistic Universals and Language Change*. pp 79–107. Oxford: OUP.

Boersma, P. & Weenink, D. (2012). *Praat: doing phonetics by computer* [online]. Available from: www.praat.org.

Bybee, J. L. (1985). *Morphology: a study of the relation between meaning and form*. Amsterdam: Benjamins. (Typological studies in language; 9).

Bybee, J. L. (2001). *Phonology and language use*. Cambridge: Cambridge University Press.

Casali, R. (1998). *Resolving Hiatus*. New York: Taylor & Francis.

Čeremisov, K. M. (1973). *Buriatsko-Russkii Slovar'*. Moskva: Sovetskaya Entsiklopediya.

Dąbrowska, E. (2008). The effects of frequency and neighbourhood density on adult speakers' productivity with Polish case inflections: An empirical test of usage-based approaches to morphology. *Journal of Memory and Language*, (4), pp 931–951.

Delattre, P. C., Liberman, A. M. & Cooper, F. S. (1955). Acoustic loci and transitional cues for consonants. *The Journal of the Acoustical Society of America*, 27(4), pp 769–773.

Hayes, B., Siptár, P., Zuraw, K. & Londe, Z. (2009). Natural and Unnatural Constraints in Hungarian Vowel Harmony. *Language*, 85(4), pp 822–863.

Hayes, B. & White, J. (2015). Saltation and the P-map. *Phonology*,.

Inkelas, S., Orgun, C. O. & Zoll, C. (1997). The implications of lexical exceptions for the nature of grammar. In: Roca, I. (Ed) *Derivations and constraints in phonology*. pp 393–418. Oxford: Oxford University Press.

Inkelas, S. & Zoll, C. (2007). Is grammar dependence real? A comparison between cophonological and indexed constraint approaches to morphologically conditioned phonology. *Linguistics*, 45, pp 133–171.

Köpcke, K.-M. (1988). Schemas in German plural formation. *Lingua*, 74(4), pp 303–335.

De Lacy, P. (2002). *The Formal Expression of Markedness*. PhD dissertation, Umass Amherst.

De Lacy, P. (2006). *Markedness: Reduction and Preservation in Phonology*. Cambridge: CUP.

De Lacy, P. & Kingston, J. (2013). Synchronic explanation. *NLLT*, 31(2), pp 287–355.

Liberman, A. M., Delattre, P. C., Gertsman, L. J. & Cooper, F. S. (1956). Tempo of frequency change as a cue for distinguishing classes of speech sounds. *Journal of Experimental Psychology*, 52(2), pp 127 – 137.

Lombardi, L. (2002). Coronal epenthesis and markedness. *Phonology*, 19(2), pp 219–251.

McCarthy, J. J. & Prince, A. (1994). The Emergence of the Unmarked: Optimality in Prosodic Morphology. Ms, UMass Amherst and Rutgers University.

McCarthy, J. J. & Prince, A. (1995). Faithfulness and Reduplicative Identity. Ms, UMass Amherst and Rutgers University.

McCarthy, J. J. & Prince, A. (1999). Faithfulness and identity in Prosodic Morphology. In: Kager, R., van der Hulst, H., & Zonneveld, W. (Eds) *Prosody-morphology interface*. Cambridge: CUP.

Morley, R. (2008). *Generalization, lexical statistics, and typologically rare systems*. PhD dissertation, Johns Hopkins University.

Morley, R. (2011). From phonetics to phonology: learning epenthesis. *Proceedings of CLS 47*.
Morley, R. (2012). The emergence of epenthesis: an incremental model of grammar change. *Language Dynamics and Change*, 2(1), pp 59–97.
Morley, R. (2015). Deletion or epenthesis? On the falsifiability of phonological universals. *Lingua*, 154, pp 1–26.
O'Connor, J. D., Gertsman, L. J., Liberman, A. M., Delattre, P. C. & Cooper, F. S. (1957). Acoustic cues for the perception of initial /w,j,r,l/ in English. *Word*, 13, pp 24 – 43.
Padgett, J. (2011). Consonant-vowel place feature interactions. In: Van Oostendorp, M., Ewen, C. J., Hume, E., & Rice, K. (Eds) *The Blackwell Companion to Phonology*. Malden, MA: Blackwell.
Pater, J. (2000). Non-uniformity in English secondary stress: the role of ranked and lexically specific constraints. *Phonology*, 17(02), pp 237–274.
Pater, J. (2006). The locus of exceptionality: Morpheme-specific phonology as constraint indexation. In: Bateman, L., O'Keefe, M., Reilly, E., & Werle, A. (Eds) *Papers in Optimality Theory III*. pp 259–296. Amherst, Mass: GLSA.
Pierrehumbert, J. B. (2006). The statistical basis of an unnatural alternation. In: Goldstein, L. M., Whalen, D. H., & Best, C. T. (Eds) *Laboratory Phonology 8*. pp 81–107. Berlin: Mouton de Gruyter.
Poppe, N. N. (1938). *Grammatika Buriat-Mongol'skogo iazyka*. Moskva, Leningrad: Izdatel'stvo AN SSSR.
Poppe, N. N. (1960). *Buriat grammar*. Bloomington: Indiana University.
Prince, A. (2002). Arguing optimality. In: Coetzee, A., Carpenter, A., & De Lacy, P. (Eds) *UMOP 26. Papers in Optimality Theory II*. Amherst, Mass: GLSA.
Prince, A. & Smolensky, P. (2004). *Optimality Theory. Constraint Interaction in Generative Grammar*. Malden, Mass: Blackwell.
Radnaeva, L. D. (2003a). The two types of transcription (the Buryat Language Database). *Proceedings of ICPhS 15*. pp 2737–2740. Barcelona.
Radnaeva, L. D. (2003b). *Zvukovaja forma sovremennogo buriatskogo jazyka. Teoreticheskije i prakticheskije aspekty kachestvennogo i kolichestvennogo analiza*. Doctoral Dissertation, Saint Petersburg State University.
Radnaeva, L. D. (2006). Phonetic research of the sound form of Modern Buryat language. *Proceedings of the XIth International Conference "Speech and Computer".* pp 577–582. Saint-Petersburg.
Radnaeva, L. D. (2008). Issledovanie zvukovoi formy sovremennogo buriatskogo jazyka. *Proceedings of the 36th International Conference "Problemy Izucheniya, sokhraneniya i prepodavaniya jazykov narodov Rossii".* Saint-Petersburg.
Rice, K. (2008). Review of de Lacy (2006). *Phonology*, 25(2), pp 361–371.
Rose, S. & Walker, R. (2011). Harmony systems. In: Goldsmith, J., Riggle, J., & Yu, A. C. L. (Eds) *The Handbook of Phonological Theory, Second Edition*. pp 240–290. Oxford: Blackwell.
Rumelhart, D. E. & McClelland, J. L. (1986). On learning the past tenses of English verbs. In: Rumelhart, D. E., McClelland, J. L., & The PDP Research Group (Eds) *Parallel distributed processing: explorations in the microstructure of cognition*. pp 216–271. Cambridge, Mass: MIT Press.
Sanžeev, G. D. (1941). *Grammatika Buriat-Mongol'skogo iazyka*. Moskva, Leningrad: Izdatel'stvo AN SSSR.
Sanžeev, G. D., Bertagaev, T. A. & Tsidendambaev, T. B. (Eds) (1962). *Grammatika buriatskogo iazyka*. Moskva: Izdatel'stvo Vostochtoi Literatury.

Skousen, R. (1989). *Analogical Modeling of Language* [online]. Dordrecht: Kluwer. Available from: http://dx.doi.org/10.1007/978-94-009-1906-8. [Accessed 2015-07-10].

Staroverov, P. (2014). *Splitting theory and consonant epenthesis*. PhD dissertation, Rutgers University.

Steriade, D. (2008). The Phonology of Perceptibility Effects: the P-map and its consequences for constraint organization. In: Hanson, K. & Inkelas, S. (Eds) *The Nature of the Word: Essays in Honor of Paul Kiparsky*. pp 151–180. Cambridge, Mass: MIT Press.

Svantesson, J.-O., Tsendina, A., Karlsson, A. & Franzén, V. (2005). *The phonology of Mongolian*. Oxford; New York: Oxford University Press.

Tessier, A.-M. (2012). Testing for OO-Faithfulness in the Acquisition of Consonant Clusters. *Language Acquisition: A Journal of Developmental Linguistics*, 19(2), pp 144–173.

Trommer, J. (2011). *Phonological aspects of Western Nilotic mutation morphology*. Habilitation thesis, University of Leipzig.

Uffmann, C. (2014). Possible epenthetic segments: the role of faithfulness. Handout from a talk presented at Manchester Phonology Meeting.

Vaux, B. & Samuels, B. (2015). Consonant epenthesis and markedness. Ms, University of Cambridge and USC.

Walker, R. (1994). Buriat syllable weight and head prominence. *Phonology at Santa Cruz vol. 3*. pp 99–110. Santa Cruz, CA.

White, J. (2014). Evidence for a learning bias against saltatory phonological alternations. *Cognition*, 130(1), pp 96–115.

Wilson, C. (2006). Learning phonology with substantive bias: an experimental and computational study of velar palatalization. *Cognitive Science*, 30(5), pp 945–982.

Wright, R. (2004). A review of perceptual cues and cue robustness. In: Hayes, B., Kirchner, R., & Steriade, D. (Eds) *Phonetically based phonology*. pp 34–57. Cambridge: CUP.

Zoll, C. (1996). *Parsing below the segment in a constraint based framework*. PhD dissertation, UC Berkeley.

Zuraw, K. (2007). The Role of Phonetic Knowledge in Phonological Patterning: Corpus and Survey Evidence from Tagalog Infixation. *Language*, 83(2), pp 277–316.