The emergence of obstruents after high vowels: a maladaptive sound change

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Abstract

Sound changes in which obstruents emerge spontaneously after high vowels, while not widely discussed in the literature, are surprisingly common. In this article, I survey post-vocalic obstruent emergence (POE) processes in Maru, Huishu, Lom, Singhi, Fomopea, and Moghamo. I show that these sound changes are not well accounted for by functionally-oriented theories of sound change since they impose costs in terms of articulatory effort and systemic complexity without a consistent return in the form of markedness reduction, contrast preservation, or contrast enhancement. On the other hand, POE submits elegantly to a non-teleological analysis couched in terms of learning errors. Aerodynamic factors, I argue, result in the variable devoicing of high vowels and the fricative-like portions of the affected vowels are then misinterpreted by speakers as obstruent segments. These findings suggest that sound change is best viewed as transmission error rather than active adaptation.

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1 Introduction

In a surprising number of languages and language families, a sound change has occurred in which obstruents (most frequently, stops) have emerged after high vowels in open syllables. This is surprising not only because sound changes that insert buccal obstruents are relatively rare (glides, /h/, and /ʔ/ being the epenthetic consonants of choice) but also because of the very specific nature of the innovation, particularly the strong—almost complete—bias towards high vowels as a source for these emergent segments. While various scholars have noted the existence of this change in the history of individual languages and language families (Karlgren 1931:56; Benedict 1948; Burling 1966, 1967; Lyovin 1968; Stallcup 1978, Blust 1994) very little attention has been paid to examining these individual cases as part of a general phenomenon, to explaining the causes for this phenomenon, and determining its implications for the broader theory of sound change. The goals of the current paper are to resolve these lacunae in the literature.

I will survey six cases of obstruent emergence in three languages families and argue that these cases represent a single phenomenon with a single motivation. Working from the surveyed data, with a special emphasis on data from the Tibeto-Burman languages Huishu and Maru, I will present an account of post-vocalic obstruent emergence in which the intrusive segments appear as the result of an interaction between aerodynamic and perceptual/inferential factors. This hypothesis, I will show, accounts for aspects of the phenomena that other, more teleologically oriented, accounts cannot, giving support to a theory in which sound change is driven by mislearning ("innocent misapprehension") (Ohala 1974, 1981, 1993, 2003, Blevins and Garrett 1998, 2004, Kavitskaya 2002, Barnes 2002, Blevins 2004) rather than by systemic optimizations (Grammont 1950, Martinet 1952, Lindblom et al. 1995, Boersma 1998, Sanders 2003, Padget 2003, Ito and Mester 2003).

2 Six Cases of Post-Vocalic Obstruent Emergence

There are at least four cases of post-vocalic obstruent emergence (POE) mentioned in the literature. Two more cases are described here: one in the Tibeto-Burman language Huishu and another in a Grassfields Bantu language Fomopea. In

each case there is evidence, sometimes overwhelming, sometimes merely persuasive, that high vowels serve as the source of the vowel-obstruent sequences produced by POE. A survey of the known cases of this phenomenon shows that this is the case.

2.1 Maru (Langsu)

Of the four documented cases of POE, that of Maru (or Langsu) has inspired the longest literature. Maru is a Tibeto-Burman language of northern Burma (Kachin state) and contiguous parts of southern China (Yunnan province). While the speakers of Maru are part of the Jingpho nationality, Maru is more closely related to Burmese than to Jingpho and is even closer to Zaiwa (Atsi). It was first noted by Karlgren (1931:56ff), and later by Benedict (1948) that certain obstruent codas in Maru seemed to be a secondary development. However, it was not until Burling (1966) that it was shown that there was a regular sound change in the history of Maru in which final obstruents emerged after certain vowels. In comparing cognate sets from Modern Burmese (Rangoon dialect), Zaiwa, and Maru, Burling noted that certain instances of -/t/ and -/k/ in Maru corresponded to final stops in Modern Burmese and Zaiwa, but others did not. There were two sets of correspondences where these apparently non-etymological stops

appeared in Maru. Where Modern Burmese had -/ei/ and Zaiwa had -/i/, Burling's Maru had -/it/. Likewise, where Modern Burmese had -/ou/ and Zaiwa had -/au/ or -/ui/, Maru had -/uk/. These two correspondence sets belong with Written Burmese (WB) -/e/ and -/ui/ respectively, as summarized in Table 1.

Table 1 Written Burmese, Modern Burmese, Atsi, and Maru correspondences

WB	Modern Burmese	Zaiwa (Atsi)	Maru
-e	-ei	-i	-it
-ui	-ou	-au/-ui	-uk

In the speech of Burling's informants (called $Maru_1$ in Table 2), the rhyme /-it/ reflects the Proto-Tibeto-Burman (PTB) rhyme *-əy, while the rhyme /-uk/ reflects the Proto-Tibeto-Burman rhyme *-əw (following the system of PTB reconstruction developed by Benedict (1972) and Matisoff (2003)). Examples of these correspondences are shown in Table 2.

Table 2 Reflexes of PTB *-əy and *-əw in Burmish languages.

PTB	WB	Zaiwa	$Maru_1$	$Maru_2$	
*səy	se	šî	šıt	sık	'die'
*krəy	khre	khyí	khyìt	khyìk	'leg/foot'
*rəy	re	—	ɣìt	ɣək	'water'
*gyəy	kyê	ĵı	ĵıt	—	'parrot'
*kləy	khyê	khyì	khyít	khyík	'dung'
*krəw	khrui	khyúi	khyùk	khyùk	'horn'
*ŋəw	ŋui	ŋâu	ŋùk	ŋùk	'cry'

*məw	mûi	màu	mùk	mùk	‘sky’
*rəw	rûi	vùi	ɣùk	ɣùk	‘bone’
*kəw	-khûi	-khàu	-khúk	-khúk	‘smoke’
*r-kəw	khûi	kháu	khúk	khúk	‘steal’
*pəw	ʔəphûi	phàu	phúk	àphúk	‘grandfather’

It is useful to note that the PTB rhymes reconstructed as *-əy and *-əw may actually represent the long vowels [iː] and [uː] respectively (Matisoff 2003:159-160). In other words, it perfectly reasonable to propose that the vowel-stop sequences in Maru are derived from high vowels, a point which will be seen to tie this particular case of POE to the others. While in Written Burmese (WB) and Zaiwa, these vowels have undergone various changes in quality (but note that PTB *-ə̲y̲ > Zaiwa –i̲), in Maru, the second mora of the rhyme has been “replaced” by the intrusive obstruent. In another dialect of Maru (labeled Maru_2 in Table 2; data from Sun et al. (1991) and Dai and Huang (1992)) –/it/ has become –/ik/ as part of a general sound change in which all instances of coda /t/ following high vowels have been backed to /k/. Thus Maru_1 kýi̲t is cognate to Maru_2 kýi̲k ‘copper’, as a result of this innovation.

Burling (1966) provided a tonal argument for the proposition that these stops were secondary. If the stops were primary, Burling showed, and had been lost in Burmese and Zaiwa, it would be difficult to explain the tonal correspondences between

the Maru forms and their cognates in these languages. Burling observed that there was a contrast between high and low tones in the Maru stopped syllables, but not in the stopped syllables of Zaiwa and Burmese. When these contrasting tones were compared with their cognates in Burmese and Zaiwa, it was apparent that they corresponded perfectly to the three way contrast found in the open syllables of these languages (with a tone split between high and low depending on the historical voicing of the syllable onset). By assuming that the Maru stops which lacked correspondents in Zaiwa and Burmese were a secondary development, it became possible to reconstruct a proto-Burmish tone system with no tonal contrasts in stopped syllables. In spite Burling's very clever argument, some Tibeto-Burmanists remained quite skeptical of Burling's claim, cautiously labeling it as "interesting" (Matisoff 1968) or adamantly insisting that stops could not appear by "spontaneous generation" (Miller 1970). Roy Andrew Miller further criticized Burling for failing to note that some of the forms in which Burling's putative secondary stops occurred seemed to be cognate to Old Chinese (=Archaic Chinese) forms that were reconstructed by Karlgren (1957) as having final stops, concluding—therefore—that these stops must have been a conservative feature of Maru. It was Karlgren (1931), however, who first suggested that the Maru stops were secondary and, arguing from parallels, contended that some of the Old Chinese stops to

which Miller made reference were the result of a parallel development. The body of scholarship on Tibeto-Burman historical phonology that has accumulated since 1966 has largely supported Burling's claim (Burling 1967; Lyovin;1968, Benedict 1972; Bradley 1979; Matisoff 2003).

In the case of Maru POE, no truly new structures were introduced into the language. Maru already allowed stop codas in three places of articulation (labial, coronal, and velar). While the comparative evidence is not adequate to make a definitive determination, it appears that the sequences /-uk/ and /-it/ existed in the language prior to POE, with evidence for /-it/ being particularly strong. That is to say, there is evidence to suggest that Maru POE was structure-preserving but contrast-neutralizing. Detailed evidence for this assertion, and arguments about its relevance to a theory of POE, are presented in §**Error! Reference source not found.** below.

2.2 Huishu

A somewhat different state of affairs holds in another Tibeto-Burman language, a member of the Tangkhul group called Huishu (Mortensen 2003a, Mortensen et al. 2004). Huishu is spoken in Huishu town, Ukhrul district, Manipur state, India by around

400 speakers. It bears no special affinity to any other documented language of the Tangkhul family (Mortensen 2003). In Huishu, POE occurred after an earlier sequence of changes in which stop codas in three places of articulation (*-p, *-t, and *-k) that were inherited from Proto-Tangkhul (PTk) merged as glottal stop except after (Huishu) mid vowels so that PTk *-cɐp > H –tsaʔ ‘weep’, PTk *-thɐt > H –thejʔ ‘kill’, and PTk *-khɐk > H –khoʔ ‘breath’, but PTk *-kup > H *-kɐp ‘finish’. After mid vowels, *-p was preserved but *-t and *-k became -/ʔ/. This left Huishu with a contrast in stop codas between *-p and *-ʔ, where *-p had a very limited distribution. In fact, *-p seems only to have contrasted with *-ʔ after *e, since there is no evidence for *-ɐp or *-op sequences in modern Huishu. It was at this point that POE occurred. PTk *-i, *-u, and *-uj became Huishu /ik/, /uk/, and /uk/ respectively (*-uj seems to have merged with *-u prior to POE, leading to the absence of contrast between the reflexes of *-u and *uj). As a result, Huishu /ik/ corresponds to Standard Tankghul /i/ and Huishu /uk/ corresponds to Standard Tangkhul /u/, as can be seen in Table 3.

Table 3 Correspondences with Huishu emergent stops

PTB	PTk	Tangkhul	Kachai	Huishu	
*s-hywəy	*-ʃi	ʔà-ʃi	ʔa-sɐ	ʔa-sik	‘blood’
*si	*rik-si	rik-si	rɐk-sɐ	ʔa-roʔ-sik	‘comb’
*səy	*-thi	kà-thì	—	kə-tik	‘die’
*kri	*-ŋə-ci	khà-ŋà-cì	khə-ŋə-tsɐ	kə-tsik	‘fear’

*b-ləy	*-phə-li	mə̀-tì	pə-tsɐ	mə-kik	‘four’
—	*-ŋə-ci	ʔà-ŋə̀-ci	ʔa-ŋə-tsɐ	ʔa-nə-tsik	‘horn’
*r-tsəy	*-ri	ʔà-ri	ʔa-rɐ	ʔa-rik	‘medicine’
—	*-ni	ʔà-ni	ʔa-nɐ	ʔa-nik	‘mother-in-law’
*tsyi	*mə-ci	mə̀-ci	mə-tsɐ	ʔ-mə-tsik	‘salt’
*s-nis	*ci-ni	ʃǐ-nɪ́	ʃi-nɐ	thi-nik	‘seven’
*g-nis	*khə-ni	khə́-ni	khə-nɐ	khə-nik	‘two’
*g-rus	*-ru	ʔà-rú-kúj	ʔa-rɐ	ʔa-ruk	‘bone’
*nəw	*-nu	ʔà-nù	nɐ-tɐ	ʔa-nə-nuk	‘breast’
—	*-ŋə-wu	khə̀-ŋə̀-vù	kə-hɐ	kə-nə-vuk	‘carry’
—	*-ru	ʔà-rù	i-ðɐ	ʔa-ruk-re	‘grandchild’
—	*-khu	ʔà-khu	ʔa-khɐ	ʔa-khuk-e	‘insect’
—	*-mə-su	khə̀-mə̀-sú	khə-mə-si	kə-mə-suk	‘tie’
*k^{w}əy	*huj	fu	ʔa-hwi	ʔa-huk	‘dog’
*har-rəy	*har-ruj	hɚ̀r-ru	har-ði	ʔa-ho-phə-ruk	‘egg’
*m-nwəy	*-mə-nuj	khə̀-mə̀-nù	khə-mə-ni	kə-mə-nuk	‘laugh’
—	*-ruj-cɐŋ	—	-ði-tɕa	-ruk-tso	‘thirsty’
*rəy	*-ruj	tɐ́-ru	tuŋ-ði	ʔa-ruk	‘water’

This process had the effect of (re)introducing into Huishu a structure that did not exist at the time POE applied (that is, rhymes ending in -/k/). The result was a rather odd phonotactic pattern, where /p/ and /k/, as codas, are in complementary distrubution, /k/ occuring only after high vowels, /p/ occurring only after mid vowels (if /ɐ/ is to be included in that category), and glottal stop occuring after high, mid, and low vowels (the sole low vowel being /a/). Owing to the rather tumultuous phonological history of

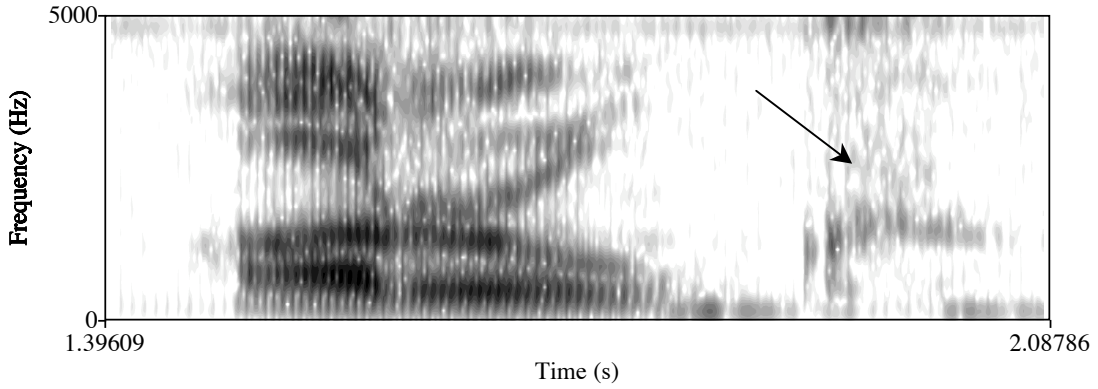
Huishu, the only obstruent coda which can now occur after /i/ in Huishu is /k/. Even more surprising is that fact that there is now no contrast between aspirated and unaspirated onsets in syllables ending with /k/, since this distinction was neutralized before high vowels prior to POE, all aspirates having lost their aspiration in that environment (Mortensen 2003, 2005).

For Maru, it seemed probable but not certain that POE applied after high, monophthongal vowels. In the case of Huishu, this observation is strongly confirmed. Not only are the vocalic nuclei of the affected syllables high, the corresponding vowels in Standard Tangkhul (and a two other Tangkhul languages mentioned in Mortensen (2005)) are high monophthongs as well. In §4 below, I will argue that this relationship between emergent stops and close vowels is not accidental. Rather, it is the result of aerodynamic properties of close vowels.

The velar stop codas of Huishu are phonetically unusual. While the codas of most Tibeto-Burman (indeed, most Southeast Asian) languages are unreleased, the Huishu coda /k/ is produced with a long (typically 10-15ms), strongly audible, fricated release. This is especially interesting in light of the fact that the Huishu coda /p/ is

usually unreleased. Below, I will argue that this frication is a relic of the stop's former identity as a fricative.

Figure 1 Spectogram of a-ruk 'bone'. Arrow indicates stop burst.



Huishu POE differs from the case in Maru in that it is contrast-preserving. No lexical contrasts were lost as a result of the development of the secondary obstruents. It also differs in the quality of the obstruents that develop. In Huishu, dorsal stops emerge after both front and back high vowels and these emergent stops have areally unusual phonetic properties. Despite these differences, it seems clear that the secondary obstruents in Maru and Huishu developed from the same historical source as a result of the same process.

2.3 Fomopea and Moghamo

POE is not a parochial tendency of Tibeto-Burman languages, or even of the Asia-Pacific area. It is also found in at least two Grassfields Bantu languages, Fomopea[1] and Moghamo (Stallcup 1978). In both of these languages, a velar stop has appeared after certain word-final vowels. That this is a secondary development can be confirmed by comparing these forms with the Proto-Grassfields Bantu (PGB) reconstructions for each of these sets of reflexes (Hyman 1979/1993).

PGB	Bafut	Fomopea	Moghamo	
*tù̱	àtú`	àtúk	á-tók`	'head'
*cùl`	ñcù	ñcūk	í-côk	'mouth'
*bù̱à	m̀bú`	m̀bʊ́k	bók`	'dog'
*gù̱a	—	—	gòk	'fall'
*lɨ̱́a	—	—	jɔ́k	'eat'
*mu-V	—	—	í-mɔ́k`	'moon'
*bé	—	—	fí-bék	'knife'
*tí´	—	—	aték`	'stone'
*tí´	àtì	àtík	—	'tree'

Table 4 POE in Fomopea and Moghamo

In these languages, it is less clear that high vowels provided the environment for POE than in the Huishu case. In Moghamo, unlike Maru and Huishu (and also Fomopea) the vowels preceding the non-etymological stops are all mid rather than high. Furthermore, very few of the afffected vowels reflect high vowels at the PGB level.

However, there are two pieces of evidence that these vowels were high at an earlier stage in the history of Fomopea and Moghamo. In certain related languages like Bafut (and also Fomopea) the cognate vowels are /u/ and /i/. In other closely related languages, the cognates of these vowels trigger aspiration of onsets (p.c. Larry Hyman). This is known to be a property of Grassfield Bantu super high vowels. These two facts confirm what must already when suspected when this case is compared with other instances of POE. In other words, we must suppose that, in the stage immediately preceding POE, there were three high vowels: *i, *ɨ, and *u. Subsequent to POE, /ik/, /ɨk/, and /uk/ were lowered to /ek/, /ək/, and /ok/ in Moghamo. In Fomopea, by contrast, /uk/ and /ik/ were retained. Moghamo and Fomopea, seen in this light, provide a rather strong parallel to the cases described so far.

2.4 Lom (Belom)

In Lom, an unclassified Austronesian language of Bangka (an island off the east cost of Sumatra, approximately 200 miles to the south of Singapore; Blust 1994), displays a pattern of POE is that, again, very similar to the patterns observed in Maru, Huishu, Fomopea, and Moghamo. In this language, obstruents have emerged after

Proto-Austronesian (PAN) high vowels, with the velar stop /k/ appearing in forms ending in PAN *u and the palatal stop /c/ appearing in forms ending in PAN /k/ (Blust 1994). Apparently *u has subsequently been lowered to a mid vowel when preceding /k/.[2] This is shown in Table 5:

Table 5 Postvocalic obstruent emergence in Lom (Blust 1994)

PAN	Lom	
*awRi	aric	'day'
*isi	isic	'flesh, meat'
*laki	lakeik	'husband; male'
*beli	melic	'to buy'
*Caqi	taic	'excrement'
*qabu	abek	'ash'
*au	aok	'yes'
*asu	asek	'dog'
*batu	batek	'stone'
*bubu	bubek	'tunnel trap'
*bulu	bulek	'body hair'
*taRu	tarok	'put, place'
*qulu	ulek	'headwaters'

As the examples *isi > isic, *bubu > bubek, and *bulu > bulek demonstrate, Lom POE only applied word-finally (and not in all open syllables, as in the case of Huishu). Despite the fact that PAN *-u > Lom -/ek/ instead of the -/uk/ that we might otherwise expect, this pattern seems very similar to those observed for Huishu, Maru, Moghamo, and Fomopea.

2.5 Singhi

Lom is not the only Austronesian language to display POE. In Lom, a Land Dyak language of Sarawak on Borneo, obstruents have also developed following high vowels (Blust 1994). As in Maru and Lom, these obstruents occur at two different places of articulation, depending upon the color of the source-vowel. Unlike those in the cases examined so far, though, the emergent obstruents in Lom are fricatives rather than stops, with /s/ occurring after /i/ and /x/ occuring after /u/.

Table 6 Postvocalic obstruent emergence in Singhi (Blust 1994)

PAN	Lom	
*qubi	bis	'yam'
*besi	bosis 'small axe'	'iron'
*iti	itis	'this'
*kali	karis	'dig'
*bili	miris	'buy'
*suligi	sirugis	'spear'
*qabu	abux	'ash, fireplace'
*batu	batux	'stone'
*baqeRu	baux	'new'
*kuCu	gitux	'louse'
*CuNu	ninux	'burn'
*CebuS	tobux	'sugarcane'

These fricative codas should bring to mind the fricated release of the emergent stops in Huishu. Below, I will argue that the Lom case represents an intermediate stage between vowels in open syllable and vowels followed by emergent stops (as in the other

langauges). Specifically, I will argue that fricatives in Lom appear after high vowels as a direct result of high vowel devoicing (HVD) and that this same process led to the appearance, phonetically, of a weak fricative in the other languages. This weak fricative, I contend, was reinterpreted by speakers as a stop, giving rise to the pattern seen in the other languages. In this way, Lom provides a crucial missing link between the initial state and the more common emergent stop-pattern.

2.6 Summary

It should be clear, at this point, that POE represents a unified phenomenon. In all cases, there is evidence that the process occurred in the environment of high vowels. All of the processes insert a dorsal consonant after /u/ and a coronal or dorsal obstruent after /i/. Since this pattern occurs across a wide array of unrelated languages (in the Tibeto-Burman, Grassfields Bantu, and Austronesian families) and appears to be an independent development in each of the languages surveyed, it appears that this is not an idiosyncratic areal feature, or the result of some predisposition of a particular language family, but rather the type of sound change that is universally possible. It is

therefore reasonable to give a single explanation for all six cases, stated in universal rather than parochial terms.

3 Competing accounts of POE

3.1 Desiderata

There are a number of possible accounts that could be offered of the phenomenon we have just surveyed. The account that should be accepted, I propose, is one that best explains three aspects of the phenomenon:

1. Motivation. Why this change, in which a "less-marked" structure was converted into a "more-marked", structure took place.

2. Environment. Why the change took place precisely in the environment of high vowels.

3. Substance. Why the inserted segments have the place an manner features that they do (e.g. dorsal after /u/, dorsal or coronal after /i/).

Given these criteria, it is now possible to perform a survey of the possible accounts of this phenomena and show that an account grounded in mislearning and driven by aspects of aerodynamics is superior to other explanations that could be offered for this phenomenon.

3.2 Diphthongization and glide fortition

There has been one explicit attempt to account for POE, which was offered by Blust (1994) and was directed towards accounting for the emergent obstruents Lom (but not Singhi). According to Blust, Lom POE was a two-step process. First, the high vowels diphthongized word-finally, yielding a vowel-glide sequence. The glides then underwent fortition to become obstruents. Of all of the accounts described here, this hypothesis comes closest to the articulatory/inferential account defended here. However, it fails to wholly meet the criteria we have established for judging accounts of POE.

On the one hand, this explanation does provide a plausible explanation for the mechanism by which the process could take place. This argument is bolstered by evidence from other Austronesian languages in which glides clearly are "strengthened" into stops, usually word-initially (Blust 1994). Furthermore, it provides a plausible

explanation for the change PAN *u > Lom /e/, which otherwise appears to be problematic. Under Blust's hypothesis, *u and *i diphthongized as *əw and *əy prior to the fortition of the glides. This allows Blust to say that there was a natural-loooking *ək > /ek/ change, rather than a more radical *uk > /ek/ change.

On the other hand, Blust does not attempt to account for the motivation behind this change. Furthermore, as Blust himself points out, this account cannot satisfactorily explain the facts of the Maru and Lom cases, which he asserts are clearly cases of obstruent epenthesis (to use his term) rather than glide fortition. In these two languages, and in the other languages in which POE has occurred, there is no independent evidence for diphthongization. Blust explicitly argues against glide-fortition as a soure of Singhi non-etymological -/s/ and -/x/, noting that medial glides in Singhi do not undergo fortition. He also suggests that positing diphthongization in the history of Singhi would imply the development of diphthongs like [ij] and [uw] which are "virtually unheard of in Austronesia languages." This would seem to leave Blust without a good explanation (in terms of glide-fortition) for PAN *-i > Lom -/ic/, where the most reasonable intermediate step would be -[ij].[3]

In the case of Huishu, also, it is necessary to reconstruct monophthongs as the antecedent of those vowels after which POE applies. Appealing to diphthongization in that case would force us to appeal to an intermediate stage which would be otherwise unmotivated. This same criticism, though, could be leveled against the hypothesis defended below, in which there is an unattested phase between the open syllable- and obstruent final-stages in which the latter portion of the vowel is phonetically devoiced. A more damning criticism is the failure of Blust's hypothesis to account for the fact that high vowels always seem to be involved in POE (even in the Lom case). It would seem strange to argue that word-final glide fortition can occur in exactly those cases when that glide is historically derived from a monophthongal high vowel. A more satisfactory account of the phenomenon would explain why this connection between vowel height and POE exists. However, as we will see, Blust's account fares far better than most other possible accounts of POE. Indeed, there is a sense in which the "terminal devoicing" hypothesis which I offer involves diphthongization (according to its broadest definition) followed by fortition, consistent with the spirit of Blust's proposal.

3.3 Excrescence

It is known that one source of word-final obstruents is the type of excrescence that has lead to the development of informal English nope [nop] from earlier English no [no] (Hock 1991:124). This phenomenon may be attributed to the fact that glottal stops often occur at prosodic boundaries (see, for example, the case of Dagbani as described by Hyman (1988)), especially in emphatic utterances. Acoustically, a sequence like [oʔ] shares many properties with the sequence [op], and this perception may result in the reinterpretation of the emphatic phrase-final glottal stop as a word-final oral stop (but see Hock (1991:124) for an alternative account; indeed, the phenomenon may equally well be attributed to the closed position of the articulators at the end of utterances). It is clear, however, that this type of process cannot be responsible for POE. Excrescence is, in all known cases, a sporadic process that applies to words usually occuring in prosodically prominent positions, typically utternance finally (see also English oh! > [ow] ~ [owʔ] ~ [owp]). POE, on the other hand, is a regular sound change that occurs after all vowels of a certain quality. If POE was explained as excrescence of this type, there would be no way of explaining the limited distribution of the emergent segments—it should not preferentially target a single class of vowels. Just as significantly, the final /k/ in Huishu could not have been derived from glottal stop

because the rhymes /uʔ/ existed in Huishu prior to POE, and if the glottal stops arising from prosodic boundaries had become /k/, we would expect the same change to have applied to the pre-existing glottal stops. Furthermore, this account (even if there is no need to posit an intermediate /Vʔ/ phase, provides no insight regarding the existence of the word-medial stops that emerge in Huishu (but in none of the other languages mentioned here). Indeed, the fact that verb roots are effected by POE, even though they only occur utterance-finally in one of two citation forms suggests that POE is a process distinct from better-known types of excrescence. In other words, excrescence must be solidly rejected as an explanation for this type of innovation.

3.4 Constraint against word-final vowels

If the emergence of final obstruents in the six languages enumerated above is not to be attributed to either diphthongization or to excrescence, it might be tempting to attribute it to some functional factor. One possible factor is the pressure to have a final consonant, made incarnate in the Optimality Theory constraint Final-C (McCarthy and Prince 1994). This constraint penalizes prosodic words that end in a vowel. The insertion of word-final obstruents to close previously open syllables could be seen as a

kind of markedness reduction: a marked structure (the epenthetic obstruent coda) is introduced in order to eliminate a more marked structure (a word ending in a vowel). This account has the great advantage of providing an explanation for the observed phenomenon in terms of a phonological constraint that can be motivated on other grounds.

On the surface, modeling POE with Final-C does not seem to make the right prediction about the kind of segment that is introduced. Other things being equal, an epenthetic segment should be the least marked segment that will satisfy some phonotactic requirement. It seems unlikely that /k/ should ever be such a segment, yet it is the segment most commonly appended in POE. In fact, the Optimality Theory literature on markedness widely suggests that dorsal obstruents are universally more marked than coronal, labial, and glottal obstruents (de Lacy 2002). To understand why this is a problem, and also how it might be addressed, take the example of Huishu. Prior to POE, Huishu had both /p/ and /ʔ/ as codas but enforced a ban on the coda /k/. Suppose, then, that Final-C was reranked so as to force all words to have a final consonant. It is most reasonable to assume that that consonant would be either /p/ or /ʔ/, unless there was some specific constraint against /p/ and /ʔ/ in the environment in which

the new consonant is inserted. We can assume that there was a constraint against /p/ after high vowels, since high vowel-labial consonant sequences did not occur. We must also assume the existence of a constraint against /ʔ/ after high vowels and posit that it was dominated Max, since underlying glottal stops were preserved (after high vowels) but new glottal stops were not inserted. This constraint (and Final-C) would also have to be ranked above any constraint against high vowel-velar stop sequences. In other words, we are forced to make the under-motivated assumption that glottals are worse after high vowels than velars. If we intend to model the phonotactics of various stages of Huishu in terms of OT, however, we probably have to assume the existence of freely-rerankable constraints of exactly this type.

There is an additional problem with a Final-C analysis of POE, namely that the emergent obstruents are not always word-final. The best example of this comes from compounds in Huishu. Thus, PTk *-ruj-cɐŋ becomes Huishu /–ruk-tso/ 'thirsty'. This could be rationalized, though, either by treating this as a paradigmatic effect (where the PTk root *-ruj 'water' becomes H. /ʔə-ruk/ so all instances of the 'water' morpheme have the form /ruk/ as well) or by asserting that compounds like /ruk-tso/ contain two prosodic words (one for each root). Without one or the other of these two mechanisms,

the distribution of /k/ in Huishu cannot be accounted for. As long as one of them is assumed, however, the model can be made to work. Thus, the Final-C analysis seems plausible, if awkward, up to this point.

Without additional stipulations, however, this model falsely predicts that POE should apply after all word-final vowels. This fact can be remedied, but the fix introduces as many problems as it repairs. If one admits local constraint conjunction (Smolensky 1993) into the grammar, then it would be possible to conjoin Final-C with *[high] within the domain of the syllable. The resulting constraint would be violated only by output candidates having word-final high vowels. POE could then be modeled as the change that takes place when $(\text{Final-C} \;\&\; *[\text{high}])_{\sigma}$ comes to dominate Dep and NoCoda. This is problematic, though, because it simply restates the generalization observed in the POE phenomenon without explaining why it should exist. In the same vein, proposing a constraint such as $(\text{Final-C} \;\&\; *[\text{high}])_{\sigma}$ seems to predict the existence of another constraint, $(\text{Final-C} \;\&\; *[\text{low}])_{\sigma}$, which would trigger consonant epenthesis only after low vowels. That sound change is apparently unattested. A theory of POE relying upon Final-C has no way of explaining why this sound change should occur in one post-vocalic environment and not the other. It also requires either adding a

controversial mechanism into the Optimality Theory formalism in the form of local constraint conjunction, or else admitting to the grammar a class of ad hoc constraints that penalize word-final vowels having a certain featural makeup. Allowing either move would greatly dilute the restrictiveness of the theory.

Despite its initial attractiveness, an account of POE in terms of a constraint against word-final vowels is neither insightful nor explanatory. In order to make such a model work, it is essential to restate the whole series of generalizations, except for the fact that the emergent stops appear at the ends of prosodic words, in terms of unprincipled stipulations about possible constraint types. There is nothing in the theory itself that predicts why the inserted segments have the properties that they do and why they emerge in the environment that they do. While it is perfectly possible to model the process in terms of such constraints, doing so requires the introduction of constraint types a factorial typology of which would predict a whole range of unattested epenthetic process such as the epenthesis of /χ/ after /a/. This analysis, then seems to be on the wrong track, neither providing insight into the phenomenon nor making the correct predictions about it.

3.5 Push chains and contrast maintenance

Reaching farther back into the history of linguistic ideas, we might attribute POE to a drive to retain phonological contrasts (Martinet 1952) or—in a more recent incarnation of the same idea—to create an inventory in which the drive to maximize the number of contrasts is balanced with the drive to maximize the distinctness of the its constituent contrasts and the ease of articulation of its members (Sanders 2003, Padgett 2003, Ito and Mester 2003). Taking Huishu and Maru as examples, since their history is relatively well understood, it can be shown that a contrast-maintenance approach to POE has several compelling aspects but ultimately fails to account for its empirical details.

It is well know that phonetically long vowels tend to rise in the vowel space (Labov 1994), particularly in systems with both "tense" and "lax" vowels (Kiparsky 1995). As mid vowels, under pressure of this mysterious but irresistible force, gradually creep higher and higher in the vowel space, they will ultimately approach the high vowels, impinging on their "margin of safety" (Martinet 1952). The insertion of coda consonants could be seen as a way of enhancing the contrasts that would otherwise be eradicated by the merger of the mid vowels with the high vowels. In truth, it is clearly

the case in Huishu that the former mid vowel *o (and perhaps *e as well) has been raised in the top of the vowel space, suggesting that it could had been moving in that direction all along.

This push-chain analysis of POE has the advantage of explaining why high vowels are always involved: while the other vowels are free to rise in the vowel space, the high vowels have, as it were, no place to run. POE would then be a radical response to the threat of merger. A contrast that formerly existed between two vowels would be transferred to a contrast between a mid vowel and a high vowel-obstruent sequence. Unfortunately, this hypothesis has no way of explaining why the new segment is inserted after the mid vowels rather than the high vowels. It also shares with the Final-C proposal the inability to predict the substance of the segment that is inserted without additional stipulations that are otherwise unmotivated.

A more damning problem is presented by Maru. In this language, it appears that the rhymes *-it and *-uk were already licit when POE occurred. In other words, POE actually eliminated a contrast rather than preserving it. For example, the contrast that is preserved in Zaiwa between pyí 'give' and pyít 'break' has been erased by POE in Maru so that both forms are pronounced as pyít ($Maru_1$) or pyík ($Maru_2$). Economy

constraints us to reconstruct *pyít for break in the immediate ancestor of Zaiwa and Maru. Likewise, the contrast that is preserved in Zaiwa between –vóʔ ‘ant’ and –vùi ‘bone’ has been erased in Maru, where the cognates to these morphemes are both pronounced as -ɣùk. The instances of -/uk/ in Maru that do not result from POE are from the PTB (Proto-Tibeto-Burman) and PLB (Proto-Lolo-Burmese) rhyme *-wak, as shown in Table 7.

Table 7 Reflexes of PTB *-wak

PTB	WB	Atsi	Maru	
*p-rwak	pərwak	pâu-vóʔ	phə̀-ɣùk	‘ant’
*kwak	khwak	khóʔ	khúk	‘bowl’
*s-twak	thwak	thóʔ	thúk	‘exit, emerge’
*k-r-wak	krwak	—	ɣùk-nòʔ	‘rat’

This sequence seems to have become *-ok in the common ancestor of Atsi and Maru, and to have subsequently become -/uk/ in Maru. Whether POE was directly responsible for the elimination of the contrast between ‘ant’ and ‘bone’ in Maru depends wholly on whether the raising of *o to /u/ before /k/ occurred before or after POE. In either case, the final outcome was the same. A theory in which sound changes are driven by the need to maintain contrasts between lexical items is hardly helpful in a case where a fairly radical sound change occurs which does not save a contrast, but rather eliminates one. We might attempt to save this hypothesis by an appeal to functional load, but given

the relatively poor empirical track-record of this concept (Labov 1994), and the fact that reflexes of earlier Maru *e and *o do not appear to have been appreciably more common that *it and *uk, this appeal seems unconvincing. However, other analytic options are available.

A newer, very nuanced approach to contrast maintenance/enhancement is that developed within the Dispersion Theory variant of Optimality Theory (Sanders 2003, Padgett 2003, Ito and Mester 2003). In this theory, as in OT Dispersion Theory generally (Flemming 1995), phonology is seen as a competition between constraints enforcing the maintenance of underlying contrasts (systemic faithfulness), constraints enforcing the distinctness of contrasts (systemic markedness), and constraints against articulatory complexity (elementary markedness). Under such a theory, phonological innovations occur when they improve the resulting output inventory along one of these dimensions. For example, Ito and Mester (2003) explain the depalatalization of consonants before Japanese /e/ as a means of enhancing their contrast between /Ce/ and /Ci/ sequences (where /i/ triggers the palatalization of preceding consonants). This change results in a system that is better in terms of systemic markedness than one in which consonants were palatalized—or allowed to be palatal—before /e/. In this case,

the Dispersion Theory approach to contrast maintenance and enhancement seems to account for a difficult piece of data quite effectively and it does so without introducing any special diachronic mechanism: sound changes are the simple result of constraint re-ranking.

This theory makes the interesting (and superficially paradoxical) prediction that mergers may occur in order to enhance contrasts. That is, when systemic markedness comes to dominate systemic faithfulness, contrasts that existed previously will be eradicated precisely because they are not phonetically robust enough. Likewise, markedness-increasing sound changes may occur when they lead to greater distinctiveness among elements in an inventory. It follows from these facts that markedness increasing mergers may occur in order to maximize the strength of phonetic contrasts within the system. This might appear to make the Maru problem—where POE erases lexical distinctions between words which formerly had a high vowel in an open syllable and those which had a high vowel in a syllable closed by /t/ or /k/—tractable. It could be argued that the epenthesis occurred so that a vowel system with three degrees of height in open syllables (as in Proto-Burmish; Burling (1967)) could be reduced to a vowel system with two degrees of height (in open syllables) without adding an

additional constrast to the system. This argument is problematic for two reasons. First, the same end could have been achieved at a lower cost (in terms of faithfulness) by simply merging the mid vowels and the high vowels. Second, Maru returned quite swiftly to a three-degree vowel system, as shown by the inventories provided by Burling (1967) and Namkung (1996), indicating that any pressure to maintain only two degrees of height must have been extremely transitory.

Figure 2 Maru vowel inventory

i u

e o

a

This type of model might be applied more plausibly to Huishu, where no neutralization of contrast occurs as a result of POE. Again, we might attribute the emergence of obstruents as a mechanism to increase the distinctiveness of contrasts. Substituting rhymes for the CV inventories employed by Ito and Mester (2003) and Padgett (2003), we might conceive of the scenario as follows: the rhymes *-i and *-u are relatively indistinct from the rhymes *-e and *-o. There are no rhymes of the type *-iC and *-uC except for *-uʔ. The rhymes -/ik/ and -/uk/ are added to the inventory because they are maximally distinct from both the open rhymes /e/ and /a/ and the other stopped

rhymes, such as -/ɐp/, -/ep/, etc. The relatively indistinct -/i/ and -/u/ are eliminated from the system. At the same time, the underlying system of contrasts is preserved in the output. Unfortunately, this explanation rests upon the assumption that -Vk rhymes are more distant from -Vp rhymes than -Vt rhymes. Otherwise, we would expect the insertion of /t/ rather than /k/. This problem could be skirted by positing a constraint against high vowel + /t/ sequences, as was mentioned in §3.4 above and by adding such stipulations to our proposal, we could undoubtedly model the specific change found in Huishu. What is problematic about such possible accounts, though, is that they capture only the generalization that a contrast has been preserved, but require that the means by which the contrast is saved be stipulated. They, like the Final-C analysis have no means of accommodating the kind of change seen in actually attested POE without predicting the existence of unattested processes of consonant epenthesis. This specific problem in the analysis of POE is part of a general problem with contrast optimization theories, namely that when they are given sufficient power to account for attested phenomena, they predict the existence of types of contrast repairs that are unknown in the histories of actual languages.

3.6 Inventory optimization and pull chains

The same objection must be raised against any account that treats POE as the result of a pull-chain, filling a gap in the phonological inventory. While from some theoretical perspectives (e.g. Dispersion Theory) gap-filling is simply a manifestation of

contrast optimization, I will discuss it separately. It is true that, in Huishu, POE does make the phonological inventory more symmetrical as long as we assume that the underlying contrast between stop codas in this language is simply one between buccal and non-buccal stops. The insertion of a buccal stop after high vowels fills a gap in the rhyme inventory by extending the buccal/non-buccal contrast to a new environment. However, this hypothesis raises as many questions as it answers. There seems to be no way, within the context of this model, to explain why it is specifically high vowels that get this treatment, rather than the low vowel (after which the buccal/non-buccal contrast is not present). If there is no underlying contrast between buccal stops in coda position, this theory provides no general account of why they surface as [k] after high vowels but [p] after mid vowels. And if the [p] and [k] codas are treated as distinct underlyingly, then POE has actually made the phonological inventory of Huishu worse (less symmetrical). That is to say, such an account is not particularly insightful either in terms of form or substance, even when applied to Huishu, the easy case.

Applied to Maru, such a hypothesis seems even less insightful, since—as we have discussed above—it is almost certain that the rhyme *-it (and possibly *-uk) existed in Maru prior to POE. In this case, the change would not have resolved a gap in

the inventory. Rather, it would have created a gap (at the top of the vowel space) which had not existed previously. Against such data, a pull-chain analysis of POE seems uninformative.

The upshot of this discussion is the insight that POE, as a class of phenomena, is neither ameliorative nor optimizing. Not only does it create "marked structures" (referring here to structures which are typically disfavored cross-linguistically and destroyed by historical changes) where no marked structures existed before, it does so in a way that fails to improve phonological systems. As a class of phenomena, it cannot be said to preserve contrasts or maximize their distinctiveness. Its effect upon phonological inventories is mixed, but as often as not decreases the orderliness of such systems. All of these teleological/systemic theories of sound change fail to predict the existence of sound changes of the sort like POE without ad hoc stipulations, yet it is clear that POE exists as a broadly attested cross-linguistic pattern and—as a universal phonological possibility—requires a universal motivation. This motivation is to be found in two principle factors: speech aerodynamics and speech perception. The phonotactic knowledge of speakers seems also to play a role. Using these facts alone, it

is possible to construct a non-teleological model of POE that satisfies all of the desiderata defined above.

4 Post-vocalic Obstruent Emergence and High Vowel Devoicing

This discussion must start with an assertion, namely that language change is the result of mistaken inferences, that is, imperfect learning. By extension, phonological change of many types may be seen as the result of misperception, a point made repeatedly by Ohala (1981, 1993, 2003) and recently taken up by other investigators (e.g. Blevins and Garrett 1998, 2004, Kavitskaya 2002, Barnes 2002, Blevins 2004). Under such a theory, sound change does not occur because speakers "want" to improve their grammar, or because of unmotivated mechanical changes in articulation. Rather, sound change results when phonetic factors interfere with a listener's ability to properly recover the intents of speakers from the speech signal. If speakers fail to correct for perturbations in the speech signal, then the effects of those perturbations will be incorporated into the lexical representations of the speaker. This Ohala labels "hypocorrection." If speakers overzealously correct for a perturbation where none exists, a change—usually dissimilatory—also occurs, which Ohala labels

"hypercorrection." In other words, sound change results because of "innocent misapprehensions" on the part of language users.

Such an analytic tool invites us to investigate the possible phonetic sources for the obstruents inserted by POE, specifically why it would occur (apparently) only after high vowels. It is well known that high vowels are more prone to devoicing that lower vowels, for reasons that are detailed in Jaeger (1978). In brief, phonation requires a relatively large pressure drop across the glottis. Such a pressure differential is dependant not only upon the subglottal pressure maintained pulmonic airstream mechanism, but also upon the properties of the oral tract above the glottis. For high vowels, the oral cavity is more constricted than for low vowels. As a result, the superglottal pressure for high vowels should be slightly higher than that for lower vowels, meaning that phonation is slightly more difficult. It is not surprising, then, that high vowel devoicing should be—far and away—the most common type of vowel devoicing pattern, a fact also demonstrated convincingly by Greenberg (1969) and Jaeger (1978). From these facts follows the prediction that the latter portions of a phonetically long high vowel may be unintentionally devoiced at some with a non-zero frequency of occurrence. As summarized by Ohala (1997b) "these segments, by virtue of their high close

constriction, impede the flow of air more and thus constitute 'almost' obstruents. In conjunction with other factors, they can help to reduce ΔP_{glot} [the pressure drop across the glottis] enough to extinguish voicing." It is by the phonologization of these "almost obstruents" that POE begins.

4.1 From vowels to fricatives

A devoiced vowel is very close—in its articulatory properties—to a weak fricative. A slight adjustment in the position of the tongue for a voiceless /i̥/ will produce a palatal fricative [ç]. Likewise, a slight adjustment in the configuration of the articulators used to produce /u̥/ will result in the production of a velar fricative [x]. The devoiced terminus of a high vowel, misinterpreted by listeners as a separate segment, can result in the emergence of voiceless fricative codas. It is a related type of process that seems to be responsible for the pronunciation of French oui as [wi̥] where the voiceless vowel often sounds remarkably like a voice palatal fricative (Laver 1994)[4].

I propose that much the same thing happened in Singhi. The emergence of non-etymological obstruents in this language results from the phonologization of this high vowel devoicing (HVD) accompanied by a slight "strengthening" of the devoiced

vowel, yielding a fricative. This strengthening is easily explicable as a mistaken inference on the part of listeners who, hearing the weak friction accompanying the voiceless vowel, assume that the speakers actually intended to produce a fricative. Given a few basic assumptions about sound change and speech aerodynamics—the assumptions I have just reviewed—the existence of phenomena of this kind is predicted (without additional stipulations).

4.2 Perception and phonological inventories

It is still puzzling, though, that a coronal [s] rather than a palatal [ç] should be inserted after /i/ in Singhi (especially since the palatal /c/ is the consonant that emerges after /i/ in Lom). This outcome could have been influenced by the fact that the phonemic inventory of Singhi includes no palatal (or alevopalatal) fricatives, but does include /s/ (Blust 1994). Bringing this phonotactic knowledge to bear in making phonological inferences, speakers may have assumed that speakers were actually attempting to produce a coronal fricative.[5] In brief, then, the word-final fricatives of Lom result from the phonologization of an aerodynamically motivated phonetic perturbation. Their place features result from an interaction between the phonetic

characteristics of the epiphenomenal fricatives resulting from HVD and speakers' knowledge of the phonological system of their language.

4.3 From fricatives to stops

It is less clear how HVD would lead to the emergence of stops. The short answer to this question is that final fricatives resulting from the misinterpretation of HVD undergo fortition. This is not particularly satisfying, since it labels the process without explaining it, but it is worth noting that this type of "fortition" is not unprecedented. A useful point of comparison is the phenomenon found in certain dialects of Danish (found in Jutland) in which high vowels have become vowel-fricative sequences and these fricatives have "hardened" to stops in some of the dialects while remaining fricatives in others. Thus, bi [biç], syl [syç], and lun [lux^{w}n] have become [bic], [syc], and [luk^{w}n] respectively (Andersen 1972). In light of this example, the kind of fortition that must be posited in the Maru, Huishu, Lom, Fomopea, and Moghamo cases is clearly possible. What remains is to provide mechanisms through which the change could take place.

One such mechanism suggests itself very strongly in the case of Huishu: that the epiphenomenal fricative resulting from HVD was mistaken for a stop release. Both fricatives and stop releases are characterized by a great deal of acoustic noise resulting from turbulence, and the noise produced during a stop release is similar to that produced by a fricative at the same place of articulation. In the Huishu case, it seems that the fricative present in the phonetic implementation of the high vowels was mistaken for a released stop with an unusually long burst. This high-energy noise is preserved in the phonetic implementation of the emergent /k/ segments. One cannot help but ask why this particular misinterpretation of the phonetic signal would take place. After all, it is not immediately clear why Huishu emergent obstruents would necessarily emerge when the option of interpreting the whisper (the voiceless portion of the vowel) as a fricative was open, for example, to speakers of Singhi. The best answer may lie, again, in the bias imposed by listeners' knowledge of the phonotactic and segment inventory of their language.

The perceptions of speakers of Huishu were biased by the fact that their language allowed the (optionally released) stop coda /p/ but no fricative codas. Likewise, the phonological inventory of Huishu includes /k/, but does not include velar

or palatal fricatives. Thus, invoking a principle similar to that which was used to motivate the development of -/s/ in Lom, I posit that the phonotatic knowledge of Huishu speakers was brought to bear upon this perceptual task with the result that phonetic [x] and [ç] were misconstrued as dorsal stops. It must further be explained why the stop after /i/ is a velar rather than a palatal stop (as in Lom). This is not as large a problem as transcriptions make it appear, since /k/ is (not surprisingly) realized with a closure somewhat farther forward than /k/ after /u/ so that phonemic /ik/ is in fact pronounced very similarly to [ic].

Superficially, at least, the Lom case parallels the Huishu case quite closely. The segment inventory of Lom includes neither a palatal nor a velar fricatives. On the other hand, it includes both palatal and velar stops, which occur both initially and finally. Lom inherits word-final velars (that are not a result of POE) and these have become palatals after high vowels so that Malay baik is cognate to Lom beic and Malay tarik is cognate to Lom taric (Blust 1994). As a result, the distribution of the velar and palatal codas arising from POE mirrors that of the inherited velars/palatals. Given an initial state in which palatal and velar stop codas existed but palatal and velar fricative codas

did not, it is reasonably easy to see why the fricative off-glide of high vowels could be misinterpreted as /c/ and /k/, rather than [ç] and [x].

The real challenge of the Lom case (and, for that matter, the case in Maru) is explaining why the stops resulting from POE are not released, a fact which Blust (1994:126) notes explicitly. One possibility is a two-step scenario: First, released stops developed from the devoiced portion of the vowels. However, this contrast, based solely upon the nature of the release, was impossible to maintain so the distinction was erased by an almost immediate merger of these novel released stops and the historical unreleased stops. However, this hypothesis is at odds with the earlier proposal that the interpretation of the epiphenomenal fricatives as stops was partly driven by the speakers' knowledge that stops occur as codas but fricatives do not. If we are to maintain that phonotactic knowledge is a critical factor in determining whether POE produces stops or fricatives it might be necessary to maintain that, in at least some cases, it was not the presence of noise in the terminus of the vowel but rather some other cue (formant transitions, cessation of voicing) that led earlier fricatives to become stops. In other words, listeners may have misapprehended emergent fricatives as weakly articulated stops and corrected for this apparent deficiency in their own speech.

The final complication of the Lom case is the *u > /e/ change. Blust takes this as prima facie evidence that the source of the emergent stops in Lom is glide fortition rather than "obstruent epenthesis" (that is to say, POE). He points out two problems facing any analysis that posits epenthesis in this case: a *-u > /e/ change is rather unusual and there is no evidence for its application word-internally.

On the first count, Blust (1994:127-128) also observes that Smedal (1987) (from whom Blust takes the Lom data) reports that "/e/ is backed before /-k/" and that reflexes of *-u are sometimes transcribed by Smedal as -/ok/. This being the case, it appears that the sound change which must actually be posited is somewhat less radical (viewed on a phonetic level) than transcriptions would lead us to believe. While a bit out of the ordinary, it is by no means inconceivable. In fact, it is quite similar to one of the changes that must be posited for Moghamo following POE (i.e. *-uk > -/ok/). The second problem is also soluble, since all of the affected vowels share not simply their proximity to /k/ but also their position in a closed syllable. All word-medial reflexes of *u would be in open syllables (given the CVCVC pattern common in Austronesian roots). Once these facts are accounted for, the HVD hypothesis for POE explains the

Lom development nicely, without the necessity of appealing to an intermediate diphthongization phase.

Having solved the problems presented by Huishu and Lom, the remaining cases are relatively simple. While the data available for Moghamo and Fomopea are limited, the developments in these languages seem to parallel (in large part) POE in Huishu and Lom. In both cases, velar stops were appended after what were (at the time) high vowels. The dorsal articulation of these stops follows from the configuration of the articulators in the production of the preceding high vowels, probably influenced—again—by facts about the segmental inventories and phonotactic constraints associated with each of these languages.

5 Conclusion

Post-vocalic obstruent emergence is an example of what might be called a maladaptive sound change. It takes a simple, "unmarked" structure—an open syllable—and transforms it into a more complex structure. It does this, most frequently, by inserting not an unmarked "default" segment but a buccal obstruent at a relatively marked place of articulation. Importantly, the evidence overwhelmingly supports the

proposition that this development is a regular sound change of the Neogrammarian variety rather than the outcome of some set of analogical processes or other special mechanisms. It is widely attested enough that it must be taken seriously as a universally possible type of sound change, yet this development seems to incur significant costs for the phonological system of a language without conferring any obvious benefits. It may create less symmetrical inventories (Huishu), may complicate phonotactics (Singhi), and may neutralize contrasts (Maru, Lom). There is no general evidence that this kind of change generally results in a more distinct inventory of contrasts and it clearly does not reduce the articulatory effort needed to produce the affected words and sounds.

In light of any ideology that sees language change as a process of amelioration and optimization, this development looks curious. It seems rather unlikely that any functional teleology can be discovered to motivate this change. It seems even less likely that such a teleology could predict the attested range of environments and outputs of this process without badly over-generating, that is, predicting related but unattested—and historically improbable—processes, or positing additional (otherwise unmotivated) constraints on possible changes.

While this development does not seem to follow from any functional teleology, it is predicted by a theory of language change driven my misperception and mistaken inference or, in other words, "innocent misapprehension." Taking only the assumptions that people learn the phonological patterns of their languages based upon imperfectly produced and transmitted data and by employing imperfect principles of inference, we predict that the variability and noise in the primary data to which a learner is exposed will manifest itself as innovations in the lexicon and grammar she posits. Since the facts of speech production and perception inevitably result in the presence of such noise, they must necessarily contribute to the sound pattern acquired by learners. If we add to this set of assumptions the additional observation that speakers' inferences about linguistic stimuli are strongly biased by their knowledge of the patterns in their own language, the patterns of obstruent emergence that have been described here follow quite naturally, with no need to resort to a functional teleology (or broader systemic motivation) of any kind. Thus, we find in POE a pattern that is easily explained by a parsimonious, non-teleological theory of sound change but which evades explanation in goal-oriented terms.

This fact does not prove that no sound change is teleological. If, like Martinet (1952) we are will to admit multiple motivations for sound change—some teleological, some automatic—there is no sense in which a maladaptive sound change like POE prevents us from employing functional models to explain other sound changes. What it does suggest, and very strongly so, is that there must be a mechanism in the theory of linguistic change for accounting for maladaptive sound changes that may only serve to make a language "worse." To the extent that this same mechanism can explain the attested range of developments in historical phonology, even those that appear to be optimizing or ameliorative, models which appeal to motivations such as the need to maintain contrasts, maximize perceptual distinctness, or minimize articulatory difficulty are unnecessary.

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[1] The Fomopea data given here are taken from unpublished field notes graciously provided by Larry Hyman.

[2] Blust actually provides a different interpretation of these facts, as will be seen below in Section XYZ. He proposes that *u broke to become -/əy/ after which the off-glide

was fortified to become /k/. He dismisses as unlikely the possibility that the *u > e change occurred after the appearance of /k/.

[3] Apparently, Blust is proposing a series of changes such that *-i > *-əy > *-əc > -ic.

[4] See, however, Smith (2003) who shows that all French vowels devoice at some frequency of occurrence in the appropriate prosodic contexts.

[5] Of course, it cannot be argued (from ideological position adhered to in this paper) that there is a deterministic relationship between the perception of phonetic categories and the composition of the phonemic inventory of a language. Otherwise, sound changes that introduce new categories into the sound system of a language could never occur. The effect of phonological grammar upon speech perception, then, is conceived of here as a bias rather than a hard constraint.