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Abstract Booklet

Lexical Tone Perception in Musicians and Non-musicians

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It has been suggested that music and speech maintain entirely dissociable mental processing systems. The current study, however, provides evidence that there is an overlap in the processing of certain shared aspects of the two. This study focuses on fundamental frequency (pitch), which is an essential component of melodic units in music and lexical and/or intonational units in speech. We hypothesize that extensive experience with the processing of musical pitch can transfer to a lexical pitch-processing domain. To that end, we asked nine English-speaking musicians and nine English-speaking non-musicians to identify and discriminate the four lexical tones of Mandarin Chinese. The subjects performed significantly differently on both tasks; the musicians identified the tones with 89% accuracy and discriminated them with 87% accuracy, while the non-musicians identified them with only 69% accuracy and discriminated them with 71% accuracy. These results provide counter-evidence to the theory of dissociation between music and speech processing.

Changes in the distribution of glottal stops in K'ichean languages

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This paper uses Optimality Theory to analyze diachronic changes involving glottal stops in K'ichean (Mayan) languages. Proto-Mayan *$CV_1?V_2C$ roots have a variety of modern correspondents including CV_1C, $CV_1?C$, $CV_2?C$, $C?V_1C$, and $CV_1?V_2C$. Modern K'ichean languages typically contain a variety of these forms, as shown below:

proto-K'ichean	Cantel K'iche'	Nahuala K'iche'	Sipakapense	Kaqchikel	gloss
*χo?oob'	χob'	χo?oob'	χ?ob'	χo?o?	five
*ti?iiχ	ti?χ	ti?iiχ	ti?	ti?iχ	meat
*ts'u?um	ts'um	ts'u?um	ts'uum	ts'um	skin
*ru+ts'u?um+al	uts'umal	uts'umal	rts'umil	ruts'umil	it's skin
*wa?im	wi?m	wa?im	wi?m	wa?im	meal

Historical linguists have treated this pattern as the result of a single sound change *CV?VC → K'iche' CV?C (Grimes 1968, Campbell 1977). However, if the pattern were the result of a traditional neo-Grammarian sound change, all of the languages involved would have undergone massive amounts of dialect borrowing and analogy. Using evidence from synchronic allomorphy in Colonial K'iche' manuscripts, an alternative analysis of this pattern is proposed within the framework of Optimality Theory. In 18th century K'iche', *CV?VC forms displayed three distinct allomorphs (CV?VC, $CV_1?C$, and CVC) depending on the position of the root within a word or a phonological phrase. For example, in the *Popol Wuuj* (~1700) the root [ts'u?um] "skin" shows the following alternations:

…tsu?um. (phrase-final)
…ri ts'u?m Pasilisib' ub'i? (phrase-medial) "the skin called "Pasilisib'"
…sa uts'umal chikop (under suffixation) "only the skin of an animal"

The changes in proto-Mayan *CV?VC roots in K'ichean languages did not typically involve neo-grammarian sound change (or constraint demotion). Rather, in OT terms, the constraints themselves changed from being restricted to a particular phonological context to being restricted to a specific lexical class. In terms of co-phonologies, one could argue that the phonologies themselves did not change but that phonologies associated with prosodic levels came to be associated with specific lexical classes.

A similar change in contemporary K'ichean languages is presented in which historically vowel-initial roots are separating into two distinct lexical classes depending on whether word-initial glottal stops are interpreted as epenthetic or underlying. The results suggest that, compared to traditional generative approaches, OT may be better able to model language changes involving interactions between morphology and phonology.

German Fricatives: Positional Faithfulness or Coda Devoicing?

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This paper addresses the question of whether there is syllable-final devoicing in German. Jessen & Ringen (2002) argue that the contrast in German *stops* is one of [spread] vs. no laryngeal specification. Hence, there *is* no syllable-final devoicing of stops: all stops are voiceless unless (variably) voiced by passive voicing when between sonorants. However, their analysis says nothing about fricatives. Unlike stops, German fricatives *do* contrast for voicing in word-initial position (***w****ir* [v] 'we', ***v****ier* [f] 'four'), and there is a clear voice contrast in intervocalic position as well (*Grä****s****-er* [z] 'grass PL', *Fü****ß****-e* [s] 'foot PL') (Jessen 1998). Hence, it might be suggested that although there is no coda devoicing of stops in German, there is coda devoicing of fricatives.

The research reported in this paper shows that although German fricatives clearly contrast for voice, there is no coda devoicing *per se* (cf. Ito & Mester 1998, Steriade 1997). Rather, fricatives (regardless of their syllabification) are faithful to their underlying voice specification in presonorant position (cf. Padgett 1995, Lombardi 1999, and Beckman 1998), and subject to markedness-driven devoicing elsewhere (see Jun 1995 for manner-sensitive faithfulness).

An analysis that bans [voice] for obstruents in coda position and one that preserves [voice] only in pre-sonorant position make similar predictions about devoicing of fricatives. For example, both accounts predict the devoicing of /z/ in *verlo****s****te* [s]'raffle 1SG/3SG PAST' < verlo/z+t/e (*cf. verlo****s****en* [z], INF) and devoicing of /v/ in *kur****v****te* [f] 'curve 1SG/3SG PAST' (*cf. kur****v****en* [v], INF). Specifically, the underlyingly voiced fricatives in these examples are devoiced by the coda devoicing analysis because they are in codas, and by the positional faithfulness account because they are not in presonorant position.

However, the two accounts differ in crucial cases where an underlying voiced fricative occurs before a sonorant consonant, as in *gru****s****lig* 'spooky' (*cf. gru****s****eln* [z] 'to spook') and *fa****s****rig* 'fibrous' (*cf. Fa****s****er* [z] 'fiber'), and where [zl] and [zr] are not possible onsets. Here, if speakers produce [z] rather than [s], we have evidence that there is no coda devoicing, because the syllabification must be *gru*[z.l]*ig*, *fa*[z.r]*ig*. The voiced pronunciation is predicted by an analysis with faithfulness to voicing in presonorant position, but not by an analysis with coda devoicing. (A possible pronunciation with a syllabic sonorant consonant is consistent with either analysis.)

36 native speakers of Standard German – both male and female – were recorded in a sound-treated room in Bielefeld, Germany. Subjects read a list of sentences, some containing words with the relevant structure (*fasrig*, etc.). Acoustic examination based on spectrograms and waveforms revealed variability across speakers and target words in the phonetic realization of the relevant phonologically voiced fricatives: both voiceless and voiced realizations of these fricatives occurred frequently, with voiced tokens occurring more frequently than voiceless ones.

The fact that we found many voiced realizations of fricatives in words like *fasrig*, regardless of the syllabicity of the following sonorant, can be explained by the analysis with presonorant faithfulness, but not coda devoicing. We suggest that the variability in voicing is a phonetic implementation effect: voicing in fricatives is inherently difficult.

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Variation in the Scottish Gaelic nasal mutation: Evidence from the Linguistic Survey of Scotland

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Like other Celtic languages, Scottish Gaelic demonstrates the phenomenon of initial consonant mutation, a morphosyntactic series of alternations which affect the initial consonants of words. The nasal mutation, known to celticists as eclipsis, historically applied following a nasal consonant. Interestingly, the nasal mutation affects word initial fortis and lenis stops differently, usually triggering some nasalizing effect on lenis consonants, while voicing the fortis consonants. (We note that, while Gaelic is normally considered to contrast aspirated vs. non-aspirated plosives, certain dialects are more appropriately represented by the voicing parameter). Crucially also, the nasal mutation may create novel segments that are nonetheless contrastive and quasi-phonemic; in Leurbost Gaelic, for example, an aspirated initial consonant, when subject to the nasal mutation, becomes an aspirated nasal (Oftedal).

Descriptive accounts of Gaelic dialects (e.g. Borgstrom 1937, Oftedal 1956, Ternes 1973) have noted significant regional variation in the surface description of nasal mutation; this paper brings previously unpublished data to bear on the full range of variation across the whole of Gaelic speaking Scotland.

In 1995-7, the transcribed questionnaires of the *Survey of the Gaelic Dialects of Scotland* (Ó Dochartaigh 1995-7) were published as a five-volume series, presenting narrow phonetic transcriptions of 200 speakers responding to a forty-page questionnaire. Interviews for this extensive project took place mainly between 1949 and 1962 across much of the Scottish mainland as well as the Western Isles. In many cases, some of the very last Gaelic speakers in a particular region were interviewed, and we thus have transcribed material of dialects that are now practically extinct. Naturally, the historic quality of these records renders them all the more valuable for close study.

However, only the "phonetic material" was included in the published volumes; morphophonological and morphological data, including data on initial mutations, remain unpublished, but available in the Survey archives. We employ data from the Survey archives to map out the actual range of variation in the nasal mutation across the *Gaidhealtachd*; using Mapmaker software we focus on three graded parameters: voicing, aspiration, and nasalization. We argue, first, that an accurate representation of regional variation requires parameters of both voicing and aspiration to account fully for radical (nonmutated) forms; we demonstrate, second, that the cross-dialectal variability represented by nasal mutation cannot be categorical in nature, but is gradient.

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Tone and Contrast in Consonants

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The notion of contrast has long been central to phonological theory. In this paper, I examine the role of contrast in determining whether a particular consonant can trigger tonal effects. The tonal effects triggered by consonants generally involve the insertion or spread of a L tone to a position immediately following the conditioning consonant. Thus, it has been proposed (Bradshaw 1999) that the phonological representation of this consonant-tone interaction involves the spreading of a feature [L/voice] that has the dual function of specifying voicing and low tone. The consonants which trigger these effects vary in a limited way from language to language. Invariably, the voiced obstruents are among the consonants which trigger tonal effects. But voiced obstruents in nasal-stop sequences may or may not participate in this consonant-tone interaction. Similarly, implosives are usually described as voiced obstruents and they do not necessarily interact with tone when other voiced obstruents do. Contrastiveness plays a crucial role in determining the consonants involved in this interaction. Voiced obstruents other than implosives are always contrastive with voiceless obstruents. Thus, in feature theory, they must be specified as bearing a voicing feature. Implosives are not contrastive for voicing and need not be so specified. Therefore, they need not participate in an interaction which is tied to the voicing feature. Nasal-stop sequences in some languages involve only voiced obstruents, while in others they can involve either voiced or voiceless obstruents. As expected by a theory that ties voicing to consonant-tone effects, the latter type of language (for example, Siswati) always include the nasal-stop sequences with voiced obstruents as participants in the tonal conditioning. In languages without such a contrast, there need be no such participation. While implosives and often nasal-stop sequences are not contrastive and are free not to interact in the consonant-tone effects, they are also free to participate. These consonants can bear a voicing feature without changing their basic phonological nature. In Kotoko, implosives trigger tonal effects; while in Suma, they do not. Voiceless obstruents, on the other hand, are not free to bear a voicing feature and never participate in consonant-tone effects. The importance of voiceless obstruents in consonant-tone effects is in the role of targets in languages in which tone conditions voicing in consonants. In the Austronesian language, Yabem, there is no contrast between voiced and voiceless stops except through the voicing effect of L tone.

Eastern Cham: the fine line between register and tone

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Eastern Cham (EC), an Austronesian language spoken in Vietnam, has a register system similar to those of many Mon-Khmer languages. Its syllables can be realized with a high pitch and a modal voice (high register) or with a low pitch and a breathy voice (low register). However, since the role of pitch is more important in EC than in most register languages, researchers have proposed that register has actually evolved into a tone language (Hoàng, 1987, Phú et al., 1992, Thurgood, 1999).

Word game data from native speakers suggest that register is a phonologically property of onset consonants. This conservative phonological behavior is not surprising as register derives from a former voicing contrast in onset stops. However, it results in a mismatch between phonological representation and phonetic realization: register is a phonological property of onset consonants, but it is acoustically realized on rimes. A closer look at the phonetic realization of register introduces another problem: two important acoustic correlates of register, voice quality and F1, are realized on the initial part of the vowel, a gradient behavior suggesting an onset-to-vowel phonetic transition. In contrast, the pitch of the two registers is clearly distinct throughout the rime, in a categorical pattern reminiscent of a phonological contrast.

It has been proposed that register developed from a lowering of the larynx that originally facilitated stop voicing (Ferlus, 1979). I argue that this lowering of the larynx is still present in the production of low register onsets, despite the neutralization of voicing. Therefore, there is no real phonetics/phonology mismatch: vertical laryngeal movement, the articulatory maneuver responsible for the register contrast occurs during onsets. However, since the acoustic effects of vertical laryngeal movement (pitch, voice quality and F1 variations) cannot be realized on onset stops, they are typically delayed to, and perceived on, the beginning of vowels. As for the categorical behavior of pitch, it resides in the non-quantal nature of larynx lowering (Stevens, 1972). I claim that the original register contrast was not salient enough and was therefore reinforced by redundant vocal fold activity. Originally, this additional mechanism must have been a gradient phonetic enhancement feature (Stevens et al., 1986), but I argue that it has since been phonologized (Hyman, 1977) into a redundant phonological tone. If this account is accurate, EC is neither typically registral, because of the role of tone in its phonology, nor tonal, because its tones are still redundant and subordinated to register.

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Chinese-English EFL Students' Use of Instruction: a Case Study on English Stress Pattern

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The present study investigates the validity of the "learning-acquisition hypothesis" proposed by Krashen and Terrell (1988), which states that early bilingual use mainly implicit acquisition while late bilinguals use explicit rule instructions. Three tasks of Chinese-English bilinguals learning English stress patterns were conducted, including English non-word reading, English stress rule induction, and English stress rule instruction. These tasks were to test if early bilinguals and late bilinguals differ in their use of learning styles (i.e. rule induction or direct instruction). A total of 16 participants, 8 early bilinguals who learn English before the age of nine (mean age of starting learning English: 5;9) and 8 late bilinguals who learn English after the age of thirteen (mean age of starting learning English: 13), were recruited for the study. The findings show that both early and late bilinguals benefit from explicit rule instruction in terms of learning of stress patterns. However, the results do not show sign of mastery of early bilinguals in rule induction. In fact the two groups perform equally in the induction task. The result suggests that late bilinguals benefit more from explicit rule instruction than early bilinguals. Further studies are suggested at the end.

Can the temporal unfolding of gradient lexical activation reveal the grain of phonological units?

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This paper asks two questions that are fundamental to speech perception, phonetics and phonology about the nature of sublexical perceptual units: their gradiency (categoricalness) and their grain or size (feature, phoneme, etc). Historically, assessing sublexical representations has been difficult because they are known to be susceptible to feedback from the lexicon (Magnuson et al, 2003), and because it is unclear how explicit decision processes alter phoneme decision tasks (Norris et al, 2000; McMurray et al, in preparation). However, *lexical* processes may be measured more straightforwardly using the visual world / eye-tracking paradigm (e.g. Allopenna et al, 1998), providing an indirect (but revealing) examination of sublexical processes.

Recent research has addressed gradiency in a lexical context using this paradigm (McMurray et al, 2002). Listeners identified tokens from a VOT continuum (e.g. *beach*/*peach*) by selecting a picture from an array of competitors. They looked more at competitors (e.g. *beach* when they chose *peach*) for VOTs close to the category boundary than for prototypical tokens, indicating that lexical activation is *continuously* related to phonetic detail. Using the same paradigm, the present study finds evidence of gradient sensitivity to formant transition cues indicating place, laterality and manner (d/g, r/l, and r/l). We argue that gradient lexical sensitivity entails gradient sublexical processing.

To investigate the grain of sublexical units we attempted to observe how two phonetic cues were combined during lexical access. Each cue could appear as a single effect on lexical activation *when it becomes available* in the signal, or cues could be integrated as a unit, before

lexical access, affecting activation once. Since the visual world paradigm measures lexical activation with high temporal precision (e.g. Allopenna et al, 1998), it may reveal the integration of cues occurring at different points in the signal.

It is well known that vowel length contributes to voicing (b/p) and manner (b/w) decisions, along with VOT or Formant Transition Slope (FTSlope) (Summerfield, 1981; Miller & Liberman, 1979): early information (VOT and FTSlope) is dependant on later information (vowel length). Thus, listeners categorized tokens from VOT and FTSlope continua that also varied in vowel length by selecting the referent from a screen containing the target (e.g. *bell*), the competitor (*well*) and two unrelated items (*dune*, *goon*). Eye-movements were analyzed determine when listeners are sensitive to early and the late cues.

Preliminary results indicate that VOT and vowel length are integrated prior to lexical access as a single unit. FTslope and vowel length, on the other hand, affect lexical access sequentially and independently. These results suggest that sublexical processes, while fundamentally graded, may have a complex organization that is not obvious.

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Explanation in Phonetics and Phonology: Understanding Dorsey's Law in Hocank (Winnebago)

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Generally, phonological explanations are formal and phonetic explanations are functional. While these are usually viewed as competing, they sometimes can work in tandem. An interesting case demonstrating this is Dorsey's Law in Hocank (Siouan). Dorsey's Law is a synchronic process whereby a vowel is epenthesized into a sequence of a stop followed by a sonorant consonant; the epenthetic vowel is a copy of the vowel following the sonorant. Examples are given in (1) (Miner 1979, 1992, 1993).

1. a. /hipres/ - [hip<u>e</u>res] 'know' b. /krepnã/ -- [k<u>e</u>rep<u>ã</u>nã] 'unit of ten' c. [sgaa] 'white'

As seen in (1a-b), the epenthetic vowel splits up underlying obstruent-sonorant sequences. A plausible functional-phonetic account is mentioned by Blevins (2004,156). She suggests that the audible release of the obstruent before the sonorant is misperceived as a vowel; the misperceived release is colored by the post-sonorant vowel probably because of anticipatory articulation of vowel gestures. The vowel arising due to this misperception becomes phonologized since it counts for stress placement (Halle & Vergnaud 1987). While such an account is insightful, it is superficial since it cannot answer the question as to why epenthesis happens in Hocank, as opposed to English where it does not happen. In this paper we maintain that there is internal pressure from within the Hocank phonological system that prevents obstruent-sonorant consonant clusters from surfacing. Specifically, Baertsch (2002) and Davis & Baertsch (2005) show a formal relationship between onset clusters and clusters in syllable contact whereby the onset clusters must be a subset of the mirror-image clusters allowed in syllable contact. That is, if a language like English has [kr] as a possible onset (eg. "cry") then it must have [rk] occuring over a syllable boundary (eg. "arcade"). Since Hocank does not permit sonorant consonants in the coda, there is then internal pressure within the phonology for them not to surface as a second member of an onset. Thus, the release of the obstruent consonant before the sonorant in Hocank is susceptible to be misperceived as a vowel given the internal pressure not to have a sonorant surfacing as a second member of an onset. In sum, the occurrence of Dorsey's Law in Hocank can only be understood with reference to both the formal phonology and the phonetics; neither alone is sufficient as an explanation.

Data from Russian Speakers' Introspection as Evidence for a Human-oriented Phonological Theory

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The fact that phonology needs data considered extraphonological in structuralism is becoming more and more obvious since the structuralist framework provides a basis for multiple – and sometimes contradictory – phonological analyses of certain linguistic facts. Each structuralist analysis leaves some questions unanswered, with no theory clearly favored over the others. Russian reduction of unstressed vowels and assimilation of consonants are examples of phonological phenomena that have been getting various interpretations (see, e.g., Kodzasov, Krivnova 2001] for a review).

Making a linguistic theory human-oriented is one possible way to solve the theoretical contradictions and find the missing answers [cf. Bybee 2001:2-3]. Attempts are being made to create a human-oriented phonological description of Russian by incorporating phonetic data from spontaneous speech [Bondarko et al. 2000]. But it has been suggested that evidence not only from phonetics but also from psychological experiments, speakers' intuition, and introspection should be taken into account in phonology [Nathan 1996:107, Bybee 2001:7].

The present study is aimed at gaining evidence from psycholinguistic experiments and speakers' introspection to determine how the ambiguous phenomena in Russian phonology are represented in a native speaker's mind. We will report on one experiment using the introspection method. The subjects were orally presented with words containing reduced unstressed vowels and assimilated consonants and asked to identify those sounds (e.g., *What is the first sound of word X?* or *What is the last vowel of word Y?*).

We found that participants' judgements of sounds were influenced not only by phonetics but also by morphology and orthography (the influence of the latter two cannot always be separated since Russian orthography is morpheme-based). We also discovered that the influence of each factor was not uniform across words but depended on the sound assessed and on its position in the word.

Although the influence of orthography, well-documented in metalinguistic tasks (see, e.g., [Castles et al. 2003, Muneaux & Ziegler 2004] for reviews), is sometimes attributed to the strategies used by participants [Dijkstra et al. 1995], orthographic effects have also been found in non-metalinguistic tasks [Muneaux & Ziegler 2004]. Taking that fact into account and considering the findings of this and other experiments of ours, we suggest that the observed effects are not purely strategic but instead reflect in an indirect and complex way how phonological phenomena are represented in a speaker's mind. We believe that these findings should be accounted for in a human-oriented phonological theory.

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Tonal features in language and music: A proposal

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A longstanding debate in phonology concerns the nature of tonal features across languages. A central assumption of autosegmental theory (e.g., Goldsmith 1976) has been that tonal features are strictly paradigmatic, i.e., they define a relation solely between a tone and the speaker's pitch range. Another possibility is that the grammar admits not only paradigmatic tonal features, but also syntagmatic features, which define relative height relations between tones in sequence. Two considerations suggest the necessity of defining both syntagmatic, as well as paradigmatic, tonal features in the grammar. First, a number of languages attest not only contrastive use of lexical tone, but also constrastive use of downstep or upstep, suggesting the need for syntagmatic features. (See e.g., Williamson 1972 for Igbo, Pike and Wistrand 1974 for Acatlán Mixtec.) Second, theories which do not define sufficient syntagmatic restrictions on relative tone heights exhibit two types of problems: overgeneration of fundamental frequency (F0) contours from phonological representations, and indeterminacy of phonological representations for F0 contours. Current formulations of AM theory (e.g., Pierrehumbert 1980) are shown to exhibit these problems, leading to issues with descriptive adequacy.

How can these problems be addressed? One possibility is to borrow concepts from music theory, since music presents an attested means of integrating syntagmatic and paradigmatic "features". A proposal which takes this approach while also building on previous work in phonology and phonetics is *tone interval theory* (Dilley 2005). According to this theory, tonal features are represented in terms of abstractions of frequency ratios known as tone intervals (cf. musical intervals). A tone interval encodes the relative height and/or interval size either between two tones, or between a tone and a referent tonal level. It is assumed that all languages define syntagmatic tone intervals, while only a subset of languages define paradigmatic tone intervals. Two binary-valued features, [±same] and [±higher], define the relation between a tone and its referent, where the geometry of these features gives rise to three basic, universal relations: *higher* ([-same, +higher]), *lower* ([-same, -higher]), or *same* ([+same]). These categories define restricted ranges of tone interval values; additional, language-specific categories arise through further restrictions on ranges of tone interval values. The theory accounts for a range of phenomena encountered in lexical tone languages, while addressing problems of descriptive adequacy associated with AM theory.

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A PHONOLOGICAL ACCOUNT OF JAVANESE STOPS

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Many phoneticians agree that Javanese has a contrast between breathy voiced and voiceless, unaspirated stops (Adisasmito-Smith 2004). Others have suggested that the breathiness in Javanese is not like that found in Hindi, calling them instead slack voice versus stiff voice stops (Ladefoged & Maddieson 1996, Thurgood 2004). Regardless, whether slack or breathy, what is missing in the literature is a phonological account for the Javanese data.

How does this sort of stop contrast fit in with cross-linguistic typological accounts? The fact of the matter is that it does not fit, at least not into the laryngeal typology proposed by Iverson & Salmons (1995). According to their typology, a language with a two way laryngeal contrast has a stop with no laryngeal specification and another specified as [voice], [spread] or [constricted]. But a combination of features such as Hindi's [voice/spread] breathy stops is not available in a language with a two way contrast. If we then assume the slack/stiff voice contrast, both of which include some vocal cord vibration by definition and thus both have [voice] as a feature, we have no stops with no laryngeal specificaton in Javanese.

This paper addresses the question: What is the *phonological* contrast in Javanese? A native speaker of Javanese was recorded in a sound proof booth. The speaker read a series of verbs using a "conjugation frame". Acoustic examination based on spectrograms and waveforms revealed that there was no vocal fold vibration present during the closure of any word initial stops. This can be seen in the spectrogram for the intervocalic production of the slack voiced 'b' in fig. (1), and again for the stiff voiced 'p' in fig. (2). This is consistent with Fagan's (1988) claim that there is no difference in the voicing duration between the two series of stops. Thus based upon the phonetic analysis of the data, it becomes apparent that the slack/stiff voice distinction is not accurate.

We suggest that the "breathy" phonation of the following vowel is a product of a contrast involving aspiration ([spread]). This aspiration is different from the aspiration such as that found in English in that there is a slow, partial adduction of the vocal folds into the following vowel. This slow adduction then produces the "breathiness" in the following vowel in much the same way that the pre-aspiration in Swedish, as described by Helgason 2002, produces breathiness in the preceding vowel. This results in the aperiodic noise and delayed formant formation present in the following vowel in fig. (1) which is not present in fig. (2).

Fig. (1) Spectrogram of ‘dibakar’ – intervocalic slack voiced bilabial stop

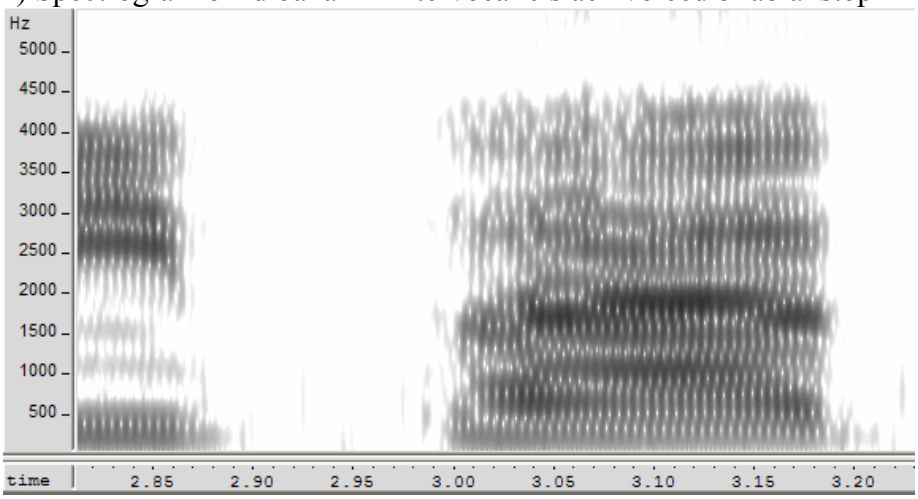
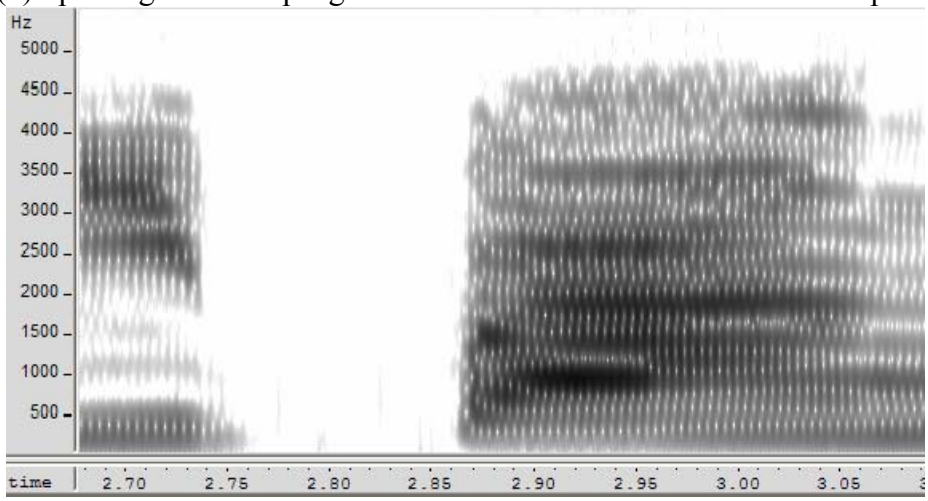


Fig. (2) Spectrogram of ‘dipangan’ – intervocalic stiff voiced bilabial stop



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The Effects of Race on Speech Perception

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It is generally believed that while there is a great deal of phonetic variation in the production of speech sounds, the contrastive nature of phonemic units is retained, and listeners are able to discriminate between phonemes in their native language despite such variation in the acoustic signal. However, recent research has shown that the perception of phonemes is influenced by non-linguistic factors such as gender (Johnson et al. 1999, Strand 2000) and geographic location (Niedzielski 1997). If it is possible to shift listeners' perceptions of speech sounds based on such social factors, then phonemes may not be as ideally contrastive as has been previously believed in the realm of speech perception. The goal of the current investigation is to explore whether other social factors, specifically race, also come into play in the perception of phonemes.

This study focuses on the English phonemes /f/ and /θ/. In African American Vernacular English (AAVE) [f] frequently replaces 'standard' English [θ], particularly word-finally (see e.g. Rickford 1999). If listeners use social information in the perception of these speech sounds, preconceived notions of how an African American or White speaker "ought to" sound may have a greater effect than the raw acoustic information in the processing of the speech signal. In this study, participants were asked to perform two phoneme discrimination tasks. In the first task, listeners participants were played a single word and were shown two options from which to choose on the computer screen based on the word they believed had been played before. (For instance, listeners heard 'wreath' and saw 'reef' and 'wreath', and had to choose which of the two words they heard.) In the second task, listeners were given two consecutive VC segments (created from the words in the first task) and asked to judge whether the two sounds were the same or different in relation to each other. The test items and filler items were composed of minimal pairs contrastive at the end of the word (e.g. wreath/reef).

The influence of social information was operationalized using three different conditions—one control group, in which no information was given regarding the race of the speaker, one in which participants were told that the speaker was White, and finally, one in which participants were told that he was African American. In this talk, I will show comparisons across the three groups, and discuss implications for phonological theory.

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An Autosegmental Examination of Floating Tones in Ekegusii

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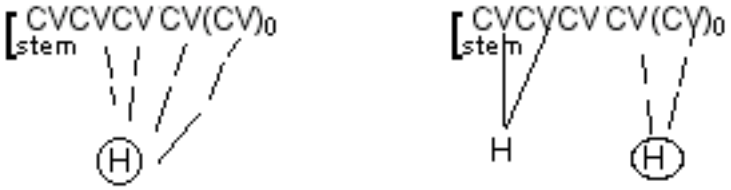
Ekegusii is a Lacustran Bantu language (E.10 in Guthrie's Classification System) which uses tone in a variety of ways. On top of following many of the traditional manifestations of Bantu tonality, it utilizes tone in a semantic manner unlike most of its related languages. Nurse and Philippson (2005) cite it as one of only five Bantu languages out of over a hundred surveyed with a tonally contrastive morpheme for past tense (recent á versus remote à).

Using my own field work from two native speakers and precedents from Bickmore (1997), I have identified several points of linguistic interest which bear discussion, following a brief discussion of the more basic functions of Ekegusii tone and phonology.

Melodic High Docking: In Ekegusii, a tone may only be linked to the first syllable of a verbal root. However, there are certain tenses which include a floating high tone, the tonality of which follows predictable rules for docking and spreading. Take for example, the present tense, which consists of a null marker and a floating high tone. Provided are a tonal and toneless verb for comparison:

	ko-bún-á	'to break'	kó-yugor-a	'to open'
1sg	m-bún-á	'I break'	n-yugór-á	'I open'
2sg	o-bún-á	'You break'	o-yugór-á	'You open'
3sg	a-bún-á	'He/She/It breaks'	a-yugór-á	'He/She/It opens'
1pl	to-bún-á	'We break'	to-yugór-á	'We open'
2pl	mo-bún-á	'You pl. break'	mo-yugór-á	'You pl. open'
3pl	ba-bún-á	'They break'	ba-yugór-á	'They open'

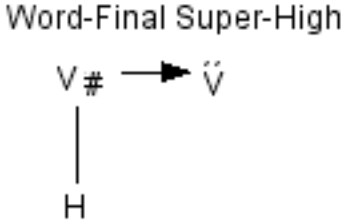
Melodic High Docking Rule:



Tonal Habitual and Ultimate-Syllable Super-High: When discussing habituality, a super-high tone occurs on the final vowel of the verb:

Word	Gloss	Word	Gloss
m-bún-á	'I break'	n-yugór-á	'I open'
m-bún-ấ	'I break habitually'	n-yugor-ấ	'I open habitually'

As it is a language which can be simplified through default low insertion, with this being the only case of a perceivable super-high (other than in certain occurences of down-stepping in the noun), it is prudent to analyze it as follows:

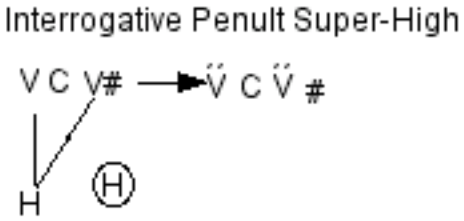


This simply leaves the question as to whether the habitual is a lexical *-á* in the final vowel verbal position – which does have strong impact on the tense, aspect, and mood – or occurs on some form of a semantic autosegmental level.

Interrogative Floating High: The interrogative can be found as a floating high tone as well. When floating high tones from a finite verb interact, or when tones from a tonal verb and the interrogative mood interact, certain phonetic shapes occur:

Word	Gloss	Word	Gloss
m-bún-á	'I break'	n-yugór-á	'I open'
m-bűn-ő	'I break?'	n-yugőr-ő	'I open?'
kó-minyok-a	'to run	kó-minyók-á	to run?
kó-ror-a	'to see'	kó!-ror-á	'to see?'
ko-ráager-a	'to eat'	ko-ráagér-á	'to eat?'
gó-teeng-a	'to dance'	gó-teéng-á	'to dance?'

To account for this, the following rule would have to apply; considering the rarity of two floating high tones in the same word, it may be possible to make this generally applicable:



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Gapped acquisition of harmonically complete inventories:
An analysis of children's cluster acquisition

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Claims about markedness hierarchies have pervaded all contemporary theories of both phonology and acquisition. Implicational markedness hierarchies suggest that languages will have harmonically complete inventories (Prince & Smolensky, 1993/2004). In fully developed languages, this is not always the case. Gapped inventories, which include marked and unmarked items but lack items of intermediate markedness, are predicted not to occur, but despite the claims of markedness, such inventories exist (e.g., de Lacy, 2002). From an acquisition perspective, the continuity hypothesis (Pinker, 1984) predicts that children should have access to the same phonological processes or patterns that adults do. A question that follows naturally is whether children produce gapped inventories as they learn languages with harmonically complete inventories. The current paper addresses this question by exploring children's acquisition of onset s-clusters. It is shown that, though the target English s-cluster inventory is harmonically complete, gapped inventories are actually quite common in children's early stages of acquisition. These results force a reconceptualization of markedness and its role in acquisition.

Data from 110 children (3;0-7;4) were examined in order to determine each child's s-cluster inventory. Results showed that of the 32 children who produced some s-cluster, over one third evidenced a gapped inventory. These results appear to challenge the validity of s-cluster acquisition based on sonority. To account for the apparent exceptions in the descriptive study, an optimality theoretic account of s-cluster acquisition is offered that appeals to sonority, but is based on a stringent ranking of constraints (Prince, 1997; de Lacy, 2002) rather than fixed rankings based on constraint hierarchies. The existence of stringently-formed constraints help account for why gapped inventories are not as uncommon as expected in child acquisition. The constraints necessary for an account of the facts of s-cluster acquisition (a sample tableau is in (1)), as well as the initial state and possible demotion strategies children may use in the acquisition of target English, are discussed.

These results are particularly interesting for a number of reasons. The results discussed here force us to rethink our definition of markedness; perhaps a definition of markedness based on sonority is not sufficient in this instance. Second, gapped inventories have been shown to exist for singletons in fully developed languages, but the issue has previously not been addressed relative to clusters or other more complex constituents. Finally, these results offer strong support for stringency in the ongoing theoretical debate between stringent constraints and fixed rankings. [NIH DC00012 and 001694]

(1) Sample gapped inventory: child acquired unmarked [sw] and marked [sn], but not intermediate [sl]

/snæk/ 'snack'	ID(sn)	*sn-sl	ID(sn-sl-sw)	*sn	*sn-sl-sw	ID(sn-sl)
a. ☞ snæk		*		*	*	
b. slæk	*!	*	*		*	*
c. swæk	*!		*		*	*
/slip/ 'sleep'	ID(sn)	*sn-sl	ID(sn-sl-sw)	*sn	*sn-sl-sw	ID(sn-sl)
a. slip		*!			*	
b. snip		*!		*	*	*
c. ☞ swip			*		*	*
/swit/ 'sweet'	ID(sn)	*sn-sl	ID(sn-sl-sw)	*sn	*sn-sl-sw	ID(sn-sl)
a. ☞ swit					*	
b. snit		*!	*	*	*	
c. slit		*!	*		*	

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Asymmetries in patterns of confusion of American English vowels

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Listeners identified American English phonemes in noise at signal-to-noise ratios ranging from 0 to -12 dB. Stimuli consisted of three different types, CV and VC syllables with all phonotactically possible English consonants and vowels [a i u] by California speakers (Shannon et al., 1999), and hVd stimuli by Michigan speakers (Hillenbrand et al. 1995). This presentation will focus on the vowel results.

Our results show some asymmetries between confusions, particularly in the vowels. As expected, [ɑ] and [ɔ] were highly confusable at all S/N ratios, consistent with the [ɑ]-[ɔ] merger which has been going on for quite some time in the majority of the United States. Thus even though the speakers distinguished between these two phonemes, the listeners did not. However, patterns of confusion between [ɑ] and [æ] were asymmetric, in that [ɑ] was frequently heard as [æ], but not vice-versa, as measured by a signal detection theory analysis.

We draw the following conclusions from these results: (1) Listeners are not treating the speakers as having the Northern Cities Shift (see e.g. Gordon, 1997). If they were, we would expect to see a symmetrical pattern of confusion between [ɑ] and [æ] - that is, listeners would adjust their phonological categories to fit those of the speaker. Instead, the listeners are treating the fronted [ɑ] tokens simply as poor instantiations of [æ]. (2) The acoustic difference between [ɑ] and [ɔ] is not sufficient for listeners to discriminate between the two, but it is sufficient to create different patterns of confusion between [ɑ]-[æ] and [ɔ]-[æ]. Further acoustic and sociolinguistic explanations of the confusions and asymmetries will also be explored.

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Lexical Exceptions in Vowel Harmony

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Two methods for accounting for variation in vowel harmony are considered: lexically indexed rankings (Anttila 2000) and lexically indexed constraints (Pater 2000). Lexically indexed constraints predict that long distance processes will localize to the exceptional morpheme, while lexically indexed rankings predict no localization effects. We present a typology of exceptions in vowel harmony that supports the predictions made by lexically indexed constraints.

Exceptional morphemes may be either exceptional undergoers or exceptional non-undergoers. Undergoers occur in languages in which vowel harmony is not a regular process. For example, the Korean verbal morpheme alternates between [ə] and [a]; when the preceding vowel is [o] or [a], [a] surfaces, otherwise [ə] (e.g. [məgə] 'eat', [nokˌa] 'melt'), but harmony is not spread beyond the affected morpheme ([məg-ə-tˀa]). Other languages with exceptional undergoers include Ibibio, Ainu and Yucatec Maya.

Exceptional Non-undergoers occur when a vowel harmony language contains a set of morphemes that are not affected by the harmony process; for example, Nandi-Kipsigis Kalenjin, is a Southern Nilotic language that exhibits [+ATR] dominant harmony. In [ka-ɣa:-ɣo-ɣe:r-æ], [+ATR] [o] has no influence on [–ATR] [a] in the opaque morpheme (underlined), blocking [+ATR] from spreading to syllable-initial [a]. These non-participating vowels are not phonologically opaque ([æ], the [+ATR] counterpart to [a] surfaces freely throughout the language). Exceptional non-undergoers also show locality effects; harmony will always occur outside the immediate context of the opaque morpheme (*[ka-ɣa:-ɣɔ-ɣe:r-æ]). Other languages that show similar effects include Old Turkic and Mayak. There are no cases of exceptional undergoers or non-undergoers that exhibit non-local effects.

A lexically indexed rankings account uses one ranking for regular items and a separate ranking for exceptional items. This poses a problem for capturing the effects discussed above because the entire input is affected by the presence of an exceptional morpheme. An exceptional undergoer should trigger a harmony-inducing ranking such as AGREE >> ID for the whole lexical item, predicting long distance effects. Stratal OT (Kiparsky 2000) encounters problems because there is no way to undo the long distance effects without undoing harmony in the exceptional undergoer.

The lexically indexed constraint approach introduces a separate class of constraints for exceptional morphemes. These constraints are high-ranked relative to the corresponding general constraint. For Nandi-Kipsigis Kalenjin, this ranking would be: ID[ATR]-OPAQUE >> AGREE[ATR] >> ID[ATR]-GENERAL. Because the locus of violation for lexically indexed constraints is limited to the morpheme that triggers it (Pater, 2005), locality effects are predicted.

Aspects of the phonology pitch accents in JC reduplication

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Jamaican Creole has two reduplication processes that produce segmentally identical outputs, intensive and distributive. These processes exhibit a stress contrast by which speakers are able to differentiate between the two. Specifically, there are two types of pitch accents H* and H+L* which can potentially be anchored to the head-foot of reduplicated words. While intensive reduplications are doubly accented and can bear both pitch accents, distributive reduplications are accented only once. These along with several constraints on segmental wellformedness constrained the output of reduplication. I present an integrated OT analysis which incorporates phonetically grounded constraints. I show that satisfying constraints on both the phonological and phonetic form of the output are equally important in predicting the correct the surface form of the words. In addition, I show that the H+L* pitch accent is associated with a falling F0 while the H* pitch accent is associated with a rising/high F0.

Stress assignment in Jamaican Creole

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University of Pittsburgh

The prosodic identity of Caribbean Creoles like Jamaican Creole (JC) has been subject to much debate over the years (Voorhoeve, 1961; Lawton, 1963; Wells, 1973; Carter, 1987; Devonish, 1989; Good, 2003; Gooden, 2003, among others). In fact, JC has been in the past variably characterised as having a tonal system and a stress system. Drawing on data from Wells (1973), Cassidy and LePage (1967) and Gooden (2003), I show that stress in JC is distinctive and predictable which is manifested phonetically by a falling F0 onto that syllable. I provide an Optimality Theoretic analysis showing that JC forms trochaic feet with a preference for left-aligned heavy syllables. The analysis is compared to Alderete's (1993) earlier analysis of JC stress. Through coverage of a wider range of data, I show that the moraic trochee approach assumed in the earlier analysis is not necessary to account for the data and cannot adequately account for the JC stress facts.

Abstract Title: Minimal word length in Hungarian
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Affiliation: Indiana University, Linguistics Department (Ph.D. student)

This talk examines the development of a minimal word requirement in modern Hungarian, a language with binary length distinctions for vowels and consonants (geminates). While monosyllabic words in Hungarian are ubiquitous, nearly all content words obey a minimal bimoraic requirement (cf. Siptár and Törkenczy, 2000; Törkenczy, 1994).

In monosyllabic CVC word forms, the vowel is found to be long surprisingly frequently – depending on the final consonant, CVC forms with a long vowel are anywhere from two to ten times more frequent than their short vowel counterparts. I will present type and token frequency statistics to support this from online corpora (Halácsy et al., 2004). This asymmetry has been observed previously without explanation. The purpose of this talk is to suggest that the phenomenon is not unrelated to the minimal word requirement. It can be explained by suggesting that a word final consonant is extrametrical and is not parsed into a syllable, therefore not contributing to syllable weight. Hence CVC word forms require a long vowel under the minimal word requirement.

I develop independent support for an extrametricality analysis. Ham (2001) contrasts closed syllable duration word finally and word internally in Hungarian. Kerek (1971) gives evidence from variable secondary stress, showing that word internal CVC syllables pattern with other heavy syllables in being stress attracting. However word final CVC syllables pattern with CV syllables and do not attract secondary stress. The maximum size of a syllable also supports extrametricality – in Table 1 below, we see the seven short and long vowel pairs of Hungarian in VC#, VCC#, and VC.C contexts. Setting aside the exceptional vowels /e:/ and /a:/, the data illustrate that a maximum of two moras may appear in the syllable rhyme, if a final consonant is not parsed.

Having argued for extrametricality, I will conclude by addressing why the minimal word requirement applies categorically to enforce CV forms to have long vowels, but allows for CVC forms to have short vowels (despite a tendency toward long vowels). Evidence from loanword phonology suggests that borrowings from German in the early part of the 20^{th} century adhered rather strictly to the minimal word condition by requiring a consonant cluster or geminate following a short vowel in monosyllabic words. In recent English and German borrowings this does not appear to be the case. I conclude that the present-day lexicon may reflect a former synchronic state of the language's phonology.

Table 1. After Siptár and Törkenczy 2001.

	VC#	VCC#	VC.C
i	hit ‘belief’	ring ‘sway’	inger ‘stimulus’
ü	sün ‘hedgehog	csüng ‘hang’	kürto ‘funnel’
ö	sör ‘beer’	gyöngy ‘pearl’	ördög ‘devil’
e	nem ‘gender’	szent ‘saint’	persze ‘of course’
u	fut ‘run’	must ‘grape juice’	undor ‘digust’
o	lop ‘steal’	gyros ‘fast’	boglya ‘stack of hay’
a	hat ‘six’	tart ‘hold’	apró ‘tiny’
i:	sír ‘grave’	----	----
ü:	bun ‘sin’	----	----
ö:	bor ‘skin’	----	----
e:	kém ‘spy’	érc ‘ore’	érték ‘value’
u:	rút ‘ugly’	----	----
o:	kór ‘disease’	----	----
a:	láp ‘marsh’	mart ‘dip’	árpa ‘barley’

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Segmental Behavior of Suprasegmental Tone

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Tones interact with segments' laryngeal features in problematic ways for the view that tone associates exclusively with prosodic units (e.g., Zec 1988, Hyman 1985, Hayes 1989, also Goldsmith 1976). In Zulu, syllables with voiced obstruents must be extra-low (L) toned (1). These "depressor consonants" also block high tone (H) spreading. Voiced obstruents seemingly come prelinked to L. The Line Crossing Prohibition would then explain the blocking effect. But this is impossible if the mora is Zulu's tone-bearing unit (TBU), as Laughren argues. Similarly, in Bade, non-glottalized voiced obstruents block H spreading (2). Again, prelinked low tones (L) would explain the blocking. These solutions are unavailable if we take seriously the proposal that TBUs are necessarily prosodic.

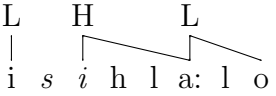
To capture these facts in Optimality Theory (Prince & Smolensky 1993), this paper augments the generally successful approach of prosodically associated tone with independent segmental pitch features (Ladefoged 1989, Duanmu 1991). Constraints can penalize marked pitch/tone configurations ("Realize-T(one)"; e.g., Realize-H: "Segments dominated by a high-toned TBU must not have non-high pitch features"), producing tone's apparent segmental qualities. To account for depressor consonants, *D[high pitch] prohibits high-pitched voiced obstruents on articulatory grounds (Maddieson 1997). With Realize-H, it blocks H spreading when ranked above spreading constraints. Segmentally linked tones are eliminated. Low-pitched consonants, through *D[high pitch] and Realize-T, can force their syllables to be (extra-)low-toned. The Realize-T constraints ensure that when features affect pitch, they also affect tone.

These constraints also account for tonal reduplication (Downing 2003). In OT, only segments stand in correspondence (McCarthy & Prince 1995). But prosodic TBUs apparently must also stand in correspondence to ensure successful tone copying in Chichewa (3). In eliminating **támbala-tambalá* (cf. (3a)), TBUs must stand in correspondence to ensure identical tone on "matching" TBUs.

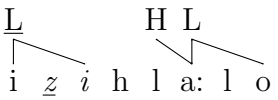
In this paper, though, the reduplicated segments are faithful to the base segments in terms of pitch features, requiring only Ident-BR(pitch). A high-ranking Realize-T requires H on the TBUs dominating the high-pitched reduplicated segments and L on the TBUs dominating the low-pitched segments. Pitch identity yields tonal identity.

This paper presents a theory of the interaction of pitch features and prosodically associated tone that simultaneously accounts for tone's prosodic and segmental properties. These interactions account for phenomena like depressor consonants without resorting to exceptional segmental TBUs and let us limit correspondence to segments while accounting for apparent prosodic faithfulness.

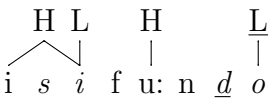
(1) Depressor Consonants in Zulu (Laughren 1984)

a. (i) 

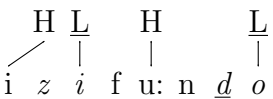
'seat'

(ii) 

'seats'

b. (i) 

'lesson'

(ii) 

'lessons'

(2) H Spreading in Bade (Schuh 1978)

a. /nən kàtáw/ → nən ká'táw 'I returned'
b. /nən ɗàmáw/ → nən ɗá'máw 'I submerged'
c. /nən làwáw/ → nəl lá'wáw 'I ran'
d. /nən gàfáw/ → nən gàfáw 'I caught' (*gáfáw*)

(3) Chichewa Verbal Reduplication (Myers & Carleton 1996:49–50)

a. tambalá 'stretch out your legs!'
tambalá-tambalá 'stretch out your legs repeatedly!'

b. phikitsá 'really cook!'
phikitsá-phikitsá 'really cook repeatedly!'

c. ndíma-sangalátsa 'I please'
ndíma-sangalátsa-sangalátsa 'I please repeatedly'

d. ti-sangalatsé 'let's please'
ti-sangalatsé-sangalatsé 'let's please repeatedly'

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DOUBLE accent in loanwords of North Kyungsang Korean and Variable Syllable Weight

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This paper provides an analysis of the loanword tone patterns in North Kyungsang Korean (NKK), especially focused on the issue of contextual syllable weight in disyllabic words. The tone pattern of loanwords in NKK is predictable by syllable weight, unlike native words which have a lexical tone pattern. In particular, according to Kenstowicz and Sohn's (2001) generalization for NKK loanwords, if the initial syllable of the output is heavy, the word falls into the DOUBLE accent class (e.g. rEndEn 'London'), with a sequence of high tones. But this fails to explain the realization of INITIAL accent (e.g. t^hemp^{h}o, with one high tone) occurring against DOUBLE accent in spite of the presence of an initial heavy syllable. The data are illustrated below. ('E'=schwa)

(1) DOUBLE vs. INITIAL accent with initial closed syllable
a. DOUBLE accent: rEndEn 'London', engin 'engine'
b. INITIAL accent: t^hemp^{h}o 'tempo', t^heksi 'taxi'

In disyllabic-words, if the initial syllable is closed, the word falls into the DOUBLE accent class when the second syllable is heavy as in (1a), whereas it falls in the INITIAL accent class when it is light, (1b). The examples in (1) imply that the weight of the initial closed syllable varies depending on context. It is heavy comprising an entire foot in (1a), but light in (1b) where it is the initial syllable of the foot

This paper proposes that variable weight of closed syllable occurs as a consequence of the conflict between metrical constraints and the constraints determining the weight of the coda (Rosenthall & Van der Hulst 1999). First, in DOUBLE versus INITIAL accent with an initial closed syllable, the realization of a moraic coda with DOUBLE accent (e.g. rEndEn 'London') and non-moraic coda with INITIAL accent (e.g. t^hemp^{h}o 'tempo') is captured by the constraint WEIGHT-BY-POSITION requiring coda consonants to be moraic. In rEndEn 'London' there are two bimoraic feet. The coda /m/ in t^hemp^{h}o 'tempo' is not moraic to satisfy foot binarity. Second, in DOUBLE versus INITIAL accent with an initial long vowel, DOUBLE accent is found in foot structure like roma 'Rome'. Since weight identity is respected, the initial long vowel cannot shorten (e.g.*roma); trimoraic feet (e.g.*roma) are also not allowed. As for the initial accent on t^hi:mi 'team'. HEAD MAX I-O requires a head-identity between the input and output.

In conclusion, Kenstowicz and Sohn fail to capture the appearance of double accent. The weight of closed syllable varies within NKK.

Phonological or phonetic: the case of "intrusive" nasal consonants in Ottawa

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Ottawa, a dialect of Ojibwe belonging to the Algic family, has both contrastive and non-contrastive vowel nasalization. One example of the contrastive nasalized vowels can be found in words that form the diminutive with nasal vowel plus /s/. Piggott (1980) claims these nasalized vowels are derived phonologically by the following rule:

$$[\ V + \text{tense}\ ] \rightarrow [\ +\text{nasal}\ ] / \_\_\ [\ C + \text{nasal}] [- \text{son} + \text{cont}]$$

The nasalization rule is then followed by another rule that deletes the nasal consonant. In the present study, the status of nasalized vowels in diminutives was further complicated by the discovery of variation between speakers and words in their production. All speakers but one produced some words with a nasal consonant following the vowel. Which words were produced with the nasal consonant varied by speaker. While one explanation for this phenomenon is a simple variation in register, a number of factors indicate that the nasal consonants could be a phonetic by-product of the heavily nasalized vowels. 1) The "intrusive" nasals mostly appear following the vowel [i:], which has the most oral impedance and therefore potentially the most nasalized airflow to begin with. 2) The nasal consonant is always homorganic with the following oral consonant, which indicates that the primary articulator is close to its target by the end of the nasalized vowel, and reaches closure before oral airflow begins. 3) The "intrusive" nasals also follow other nasalized vowels in non-diminutive contexts in rapid speech, albeit much more rarely. Therefore, the phenomenon is also explainable in phonetic terms. Which leads to the question: are the nasal consonants new or old? In other words, are the nasal consonants truly intrusive, or do they represent the phoneme /n/ of Piggott's rule and therefore sound change in progress? In light of the acoustic evidence presented here, I will argue in favor of the phonetic explanation.

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Perceived Linkage of English Pitch Accents with Syllables

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In autosegmental-metrical theories of intonation, the text of speech is linked phonologically to the tune by the association of pitch accents with stressed syllables. How is the perceived linkage of pitch accents to syllables affected by their timing?

Speech sounds were modified in a computer so that the timing of pitch accents could be varied while leaving the formants fixed. Sixteen native American English speakers were tested.

By changing the timing of a pitch accent, the noun ‘re.ject can be changed to the verb re.’ject, or the sentence “this permit’s nothing but trouble” (permit = noun) can be changed to “this permits nothing but trouble” (permits = verb). For some listeners, a change as small as 10 msec. is effective. Perception appears to be categorical – there is an abrupt change when a pitch accent crosses a boundary, but subjects are insensitive to timing shifts between boundaries. With some exceptions, subjects generally agreed on the location of the boundary where the accent shifted from one syllable to the other. Well-defined boundaries were perceived in a nonsense word and an artificial sound that could not be produced by the human voice – subjects did not make much use of lexical or syntactical knowledge in assigning boundaries. In some cases, a pitch accent was linked to a syllable that it did not overlap. No single feature of the pitch contour consistently crossed the boundary when the accent shifted from one syllable to another.

When asked to categorize a sound as having emphasis on one syllable or another, subjects exhibited a wide range of signal-to-noise ratios, as measured by the d’ statistic. For each subject, d’ was consistent across different types of pitch accents and different texts. The seven subjects with high values of d’ (1.79 to 3.07) gave reproducible responses to repeated presentations of the same sound. The nine subjects with low values of d’ (0.63 to 1.31) gave varying responses to repeated presentations of the same sound and appeared to be guessing much of the time. One source of noise for some subjects was response perseveration when test sounds were presented in random order.

Patterns of Consonant Cluster Reduction in Child Phonology:
An articulatory and perceptual Account

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It is well established that young children tend to omit one of the consonants in a consonant cluster. Many existing studies have accounted for the patterns of cluster reduction in terms of relative sonority of adjacent consonants: onset clusters are more likely to be reduced to the less sonorous member of the onset (e.g., Barlow 1997; Gnanadesikan 2004; Ohala 1999 among others).

However, these previous studies miss an important variation which occurs in a cluster of /s/ + sonorant in their analysis: /s/ + sonorant clusters are either reduced to /s/ or a sonorant. In fact, Jongstra (2003) and Goad & Rose (2004) take up this issue and postulate two different stages of syllable representation (sonority pattern vs. head pattern) to account for this variation. Both Jongstra and Goad & Rose assume that the children elaborate their input based on "distributional evidence" to move from the sonority pattern stage to the head pattern stage, but it is not clear in their studies what kind of "distributional evidence" children may use and how.

In this paper, I develop an alternative analysis of consonant cluster reduction in child phonology, while drawing on the insights from Articulatory Phonology (Browman & Goldstein 1986, et seq.) and a line of research underscoring the role of perceptual factors in segmental process (e.g., Hume 2004; Steriade 2001b) to determine how articulatory and perceptual factors affect child's production of consonant clusters.

In particular, I propose that perceptual contrast of adjacent segments plays a key role in children's mapping of consonant clusters, which accordingly influences the deletion patterns. For instance, this study reanalyzes existing data in /s/ + C clusters (C = consonant) by assuming that /s/ is perceived as a weak syllable by children. Under this assumption, a word such as *spoon* is perceived as /sVpun/ by children, and the first weak syllable /sV/ is deleted due to weak syllable deletion. As a result, *spoon* is realized as [pun] in child phonology. On the other hand, when it comes to the cluster of /s/ + sonorant, when /sV/ and /sonorant + V/ are given to children as possible choices, the advantage of /sonorant + V/ over /sV/ is not as prominent as that of /stop + V/ over /sV/ since a sonorant is not a preferred onset in a child phonology. Accordingly, the competition between /sV/ and /sonorant + V/ sometimes renders /sV/ as a winner and other times /sonorant + V/ as a winner. This explains why variation exists in the reduction pattern of /s/ + sonorant clusters. I provide theoretical and empirical justifications for these analyses by making reference to the relation between the degree of gestural overlap and syllabification in Articulatory Phonology and Devers' study (1999) on the patterns of weak syllable deletion in child phonology.

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Weight-sensitive tone patterns in loan words of South Kyungsang Korean

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The purpose of this paper is to provide an explicit formal account for the tone patterns of loan words in the South Kyungsang (SK) Korean within the framework of Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993, 1995). Based on my own data collection (2265 words), I will first show that unlike SK native lexical tones, SK loan word tone patterns are, in general, predictable; more specifically, syllable weight plays a crucial role in the high tone assignment. I will then propose a constraint-based account for such weight-sensitive tone patterns, employing constraints whose validity has been already justified in the formal literature.

The data of the present study mostly consist of two, three and four syllable words. In two syllable words, if there are heavy syllables (signaled by the presence of a long vowel or coda consonant) in the word, only the heavy syllables are realized with a H (1a-c).

(1) a. tʰɛk s□(taxi) b. k□tʰa: (guitar) c. æk □□n (action) d. s□tʰ□(city)
H L L H H H H L

If there is no heavy syllable in the word, the word-initial (and, at the same time, penultimate) syllable receives a H (1d). To account for these generalizations, we adopt the following constraints and ranking.

(2) Ranking: One-H-Pw, Weight-to-Tone > NON_FINALITY, *DOUBLE_H_LINK
a. One-H-Pw (A H is present in a prosodic word)
b. Weight-to-Tone (Heavy syllables have a H)
c. NON_FINALITY (Final mora is extra metrical)
d. Foot Form: Iambic: High tone goes on the head syllable of an Iambic foot.

Tone patterns of three syllable words are more complicated. Several interesting generalizations can be derived from the following observations:

(3) a. If the first syllable is heavy, both first and second syllables receive a H, regardless of whether the second or final syllable is heavy or not:
e.g. kʰ□m.pju.tʰ□. HHL, ‘computer’; d□□n.tʰ□.m□n. HHL, ‘gentleman’.
b. If only the final syllable is heavy, both final and penultimate syllables receive a H: e.g. tʰ□.□b□. LHH, ‘table’.
c. Otherwise, only the penultimate syllable receives H: e.g. p□.□p□ LHL, ‘baby’.

Tone patterns of four syllable words are generalized as below.

(4) a. If the first syllable is heavy, each of the first three syllables receives a H:
e.g. sæn.dɑwɑ.ʧɑ HHHL, ‘sandwich’
b. If the final syllable is heavy, final, penultimate and ante-penultimate syllables receive a H: e.g. pa.ɑɑl.lɑn. LHHH ’violin’
c. otherwise, the penultimate and ante-penultimate syllables receive a H:
e.g. sɑna.rɑɑ. LHHL ‘scenario’

The weight sensitivity effect, which can be seen in two syllable words, is also exhibited in three and four syllable words, but in a more complex way. First, if either the word-initial or final syllable has a H, the penultimate one also has a H in three syllable words (3a, b) and the penultimate and ante-penultimate has a H in four syllable words (4a, b). To explain this tone spreading, I adopt a constraint requiring that H is aligned with the right edge of the prosodic words (Align R). Second, even when all three or four syllables are heavy, H is not assigned to all of them (3a, 4a). This observation can be captured by a constraint prohibiting a sequence of three syllables with Monotone (No Monotone). Third, other wise, H goes on the second syllable. To explain this, I adopt a Foot structure constraint requiring that H is imposed on the head syllable of initial iambic foot (Foot Form: Iambic). These constraints, ranked as in (5), explain all the relevant tone patterns in SK loan words.

(5) *Monotone, One-H-Pw >> W-t-T, Non_finality >> Iambic >> Align R

Acoustic Effects of Prosodic Boundary on Vowels in American English

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The current study provides evidence of prosodic boundary-induced effects on vowels in American English, with measurements of F1, F2, and vowel duration. Prior work finds that a prosodic phrase boundary is correlated with final lengthening (Edwards, Beckman & Fletcher, 1991; Beckman, Edwards & Fletcher, 1992; Whitman et al, 1992) and articulatory strengthening (Fougeron & Keating 1997; Cho & Keating, 2001; Tabain, 2003b; Cho, 2005). Most of the earlier studies were conducted on articulatory features, with a limited number of discussions of acoustic effects (Tabain, 2003a; Cho, 2005), and the focus has been more on consonants than on vowels. In addition, the data was mostly obtained from controlled laboratory speech and the vowel studies have looked only at a limited subset of vowels, [a, i].

The present study investigates the acoustic effect of the prosodic boundary on vowels based on the speech of four professional news announcers from the Boston University Radio News corpus. We examine the quality and duration of 2 front high vowels [i, ɪ] and 2 diphthongs [eɪ, oʊ] for 2 or 3 prosodic boundary conditions (Word boundary (Wd), (Intermediate phrase boundary (ip)), and Intonational phrase boundary (IP)). Despite interspeaker variability, major findings were (1) when compared with the results of laboratory speech, F1 and F2 values of the vowel /i/ provide only weak evidence of boundary-induced enhancement; (2) the enhancement of phonological features was asymmetric, with a more consistent and greater effect on the vowel height dimension than on backness; (3) the acoustic distinction between tense/lax and between monophthongs and diphthongs was greatly expanded; (4) final lengthening was inconsistently observed across vowels; and (5) the correlation between lengthening and feature enhancement was weak, suggesting that they are two independent effects of prosodic phrase boundary.

Our findings show that the final position in a prosodic phrase is a prosodically prominent position, marked by feature enhancement and lengthening of vowels. These two effects were found to be independent of each other. Speakers choose either feature enhancement or lengthening, or they may choose both at the higher prosodic phrase boundary. This suggests that speakers may mark a prosodically prominent position with only a minimum effort using either of the two prominence-lending strategies.

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Contrast Preservation and Neutralization: Nasal Vowels in Chinese Diminutive Words

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This paper is part of a larger project seeking a principled account of (i) when and why a nasal vowel is derived under Chinese diminutive formation and (ii) which nasal vowels are preferred and why they are preferred. Three Mandarin dialects are examined from the perspective of contrast preservation and neutralization within the root-diminutive paradigm.

In Beijing Mandarin, deletion of coda [n] under diminutive suffixation does not produce a nasal vowel but deletion of [ŋ] leads to a nasal vowel: p^ha**n** + r → p^h**a**r 'plate'; p^ha**ŋ** + r → p^h**ã**r 'side'. Although the asymmetrical outcome may result from the stronger nasal flow in the Vng rime (Zhang 2000), I argue that the choice for an oral versus a nasal vowel (instead of two oral or two nasal vowels) in the diminutive forms has the advantage of preserving the morphological contrast; i.e. the diminutive forms of the two roots remain distinct.

In Huojia Mandarin, all VN rimes in the roots become nasal vowels under diminutive formation (1). I propose that contrast maximization (Flemming 2002, Sanders 2002, Padgett 2003, Itô & Mester 2003, 2004), together with rounding enhancement for back vowels (Stevens et al 1986), motivates the selection of these three nasal vowels. The contrasts in the three pairs of rimes in (2a) are maximized in the front-back and/or mid-low dimensions, and the resulting nasal vowels are maximally dispersed within the non-high perceptual space (2b). Contrast neutralization of [əŋ]-[aŋ] → [ɔ̃]-[ɔ̃] (1cd) then becomes inevitable since there is no way to maximize contrasts for all four pairs of rimes to have maximally dispersed nasal vowels.

In Jiyuan Mandarin, a VN rime with a non-low vowel in the root has a nasal vowel in the diminutive form. This serves to preserve the contrast between a V(G) root rime and a VN root rime ((3ab) & (3cd)), although the contrast between the Vn and Vng roots are neutralized (3ac). The two VN rimes with a low vowel behave differently with a contrast of a mid oral vowel and a low nasal vowel in the diminutive forms (4). I explore a perception-based account in which these two vowels are chosen to maintain an adequate perceptual distance for contrast preservation/maximization.

In all three dialects, contrast preservation/maximization and contrast neutralization coexist within the root-diminutive paradigm, leading to the larger question of how the two conflicting forces interact and how a language finds a balance between them.

(1)

a.	an	→	ã	*ɛ̃	
b.	ən	→	ɛ̃	*ə̃	
c.	aŋ [ɑŋ]	→	ɔ̃	*ɑ̃	*ã
d.	əŋ	→	ɔ̃	*ə̃	*ɤ̃

(2) a.

an ←→ aŋ		ən ←→ əŋ		ən ←→ an		
ã	ã	ə̃	ə̃	ə̃	ə̃	no contrast
ã	ɑ̃	ɛ̃	ɤ̃	ə̃	ã	better contrast
ã	ɔ̃	ɛ̃	ɔ̃	ɛ̃	ã	best contrast

b. vowel dispersion

ɛ̃	ɔ̃	
		ã

(3)

Root rime		Derived diminutive rime
a.	in	ĩɥ
	iŋ	ĩɥ
b.	i	iɥ
c.	ən	ə̃ɥ
	əŋ	ə̃ɥ
d.	əw	əɥ
	əj	əɥ

(4)

Root rime		Derived diminutive rime		
a.	an	ø	*ø̃	*ã
b.	aŋ	æ̃		*ã

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Does vowel harmony facilitate speech production?

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Does vowel harmony facilitate speech production? That is the question that this study seeks to answer. An experiment was designed to test whether back harmonic and height harmonic vowel combinations can be produced more quickly or with fewer errors than vowel combinations that are disharmonic with respect to those features. If the answer is yes, the facilitative effect can be taken as evidence that vowel harmony promotes ease of articulation, facilitates speech planning, or both.

Ease of articulation has been widely cited as a factor in phonological processes such as reduction and assimilation. It is reasonable to speculate that harmonic vowel sequences are somehow easier to produce than disharmonic sequences. If so, experimental subjects could be expected to produce phrases containing harmonic vowel sequences more quickly and/or with fewer errors than when the target phrases contain disharmonic vowel sequences. Alternatively, it is possible that a facilitative effect for speech production associated with vowel harmony is attributable to economy in speech planning. It is possible that the ability to repeat aspects of a speech plan makes it easier to implement the plan. For example, once the feature value [+back] is activated, the ability to, in a sense, recycle that feature value may lead to economy in speech planning.

In this experiment, Spanish speaking subjects were recorded as they produced nonsense phrases of the shape 'CVCV la CVCV' in a speeded repetition task. Subjects made significantly fewer errors when producing phrases that contained back harmonic vowel combinations compared to when they produced phrases that contained vowel combinations that were disharmonic with respect to backness. This finding indicates that back vowel harmony has a facilitative effect on speech production. There was no significant difference when comparing error rates on phrases containing height harmonic vowel combinations to error rates on phrases containing height disharmonic forms. Thus there is no significant evidence that vowel height harmony facilitates speech production in the same way that back harmony does. There were no significant differences in rate between harmonic and disharmonic vowel sequences for either back harmony or height harmony.

The divergent findings with respect to back harmony versus height harmony suggest that the benefit to speech production associated with back harmony may be attributable to ease of articulation but cannot be attributed to economy in speech planning. If recycling of a feature value was responsible for the benefit to speech production, it would be expected that recycling of the height feature would provide the same advantage as recycling of the back feature. The difference is more understandable if facilitation derives from ease of articulation. It is possible that the gestures required for the intervening consonant interfere with the ability to maintain a certain tongue height but do not interfere, or interfere to a lesser degree, with the ability to keep the tongue relatively forward or relatively back. Alternatively, it is possible that ease of articulation does not extend to height harmonic sequences because different tongue muscles are

used to achieve the height target in the production of high front vowels and high back vowels. On the other hand, the same muscles are used to produce [+back] vowels regardless of height.

The results of the experiment indicate that vowel backness harmony facilitates fast speech production. Vowel height harmony does not offer the same benefit. This facilitative effect supports the view that harmony, like other assimilatory processes, reduces the complexity of articulation, and is thus available as a mechanism to promote ease of articulation.

Register, Contour, and Markedness in Chinese

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In the literature of tonology, it is generally assumed that contour tones are more marked than level tones, as they are more "complicated", or more difficult to produce and perceive (Yip 2002, Zhang 2002). In terms of level tones, Yip (2002) suggests that, in a two-toned system, low tones are less marked than high tones. Chen (2000) emphasizes on the fact that if a language has one tone, it is almost a high tone, suggesting that high tone would be the unmarked one.

The goal of this research is to propose a tonal representation capable of rendering *naturally* account of the notion of tonal markedness, the linearity of contour tones, and diverse sandhi systems of Chinese dialects. We work under the assumption of a universal tonal periodic skeleton HLHL postulated by Carvalho (2002), analogue to the syllabic skeleton CVCV as proposed by Lowenstamm (1996). Based on the principles of government phonology, this model permits to explain two major characteristics of Asian tonal systems—the register and the contour.

We conjecture that Chinese tones are constraint in a portion of this periodic skeleton: a tonal template HLHL. Chinese contour tones can be analyzed in a succession of two level tones defined by an intratonal government relationship H/L encoding the notion of register. Starting from the principles of intertonal government and the hypothesis in which the intratonal head of the governing syllable governs its melodic homologue of the governed syllable, this model will shed light on the paradoxal character of contour tones, it can furthermore elucidate diverse sandhi systems of Chinese dialects, and some frequent phenomenon of African tonal languages, such as polarity and downstep.

Our hypothesis is that the rising tone, and even the level tone are more marked than the falling tone in Chinese because they imply two contours HL rather than one, just like the falling-rising tone of Mandarin. This observation is largely confirmed by the topology. In a statistics on 187 tonal languages, Zhang (2002) noticed that 37 languages have a falling tone without the rising one. Only three languages have a rising tone without the falling one: Margi, Lealao Chinantec and Zengcheng. Concerning level tones, we assume that they are more marked than contour tones in Chinese since they have not only two contours HL, but also a *median* void tone. Their existence should imply the presence of contour tones, but the opposite is wrong. This assumption is supported by empirical facts, where a language can have *only* contour tones without level tones, as in Shanghai and Chengtu. We will finally provide empirical evidence to show that the high register is structurally non-marked, rather than the low one.

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Tai Tonogenesis, Synchronic Evidence in Lao and Thai, and Subphonemic Contrasts

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Tones in Tai languages developed through a tonogenesis process (Brown 1965) where three contrastive proto-tones (700 A.D.) acquired three noncontrastive variants (high, mid or low), depending on syllable-initial consonant type (1400 A.D., Tai spoken in Sukhothai). Thai and Lao synchronic tone systems developed from this basic interaction between proto-tone and initial consonant, reflected today in orthographic consonant classes (high, "mid," and low). A twenty-word list widely used to study Tai languages (Gedney 1964) is based on an array of four consonant classes ("mid" divided into two), three proto-Tai tones, and two syllable types that yields 12 cells for potentially contrastive tones in "smooth" syllables [(1) below]. Synchronic descriptions of Tai languages show *significant* variation *within language-across dialects* in the number of tones, the phonetic shape of each tone, and the mapping between tone and lexical item—the phonological factoring of the 12 cells for that dialect—; and sometimes *within dialects*.

This paper analyzes tone in two dialects of Lao (Central Vientiane dialect, and Southern Savannakhet dialect) and of Thai (Central/Standard, and Northern). Data include (i) multiple tokens of at least five words for each of the 20 Gedney categories, words spoken in both isolation and in sentence frame, (ii) acoustic phonetic measurements of pitch, and (iii) native speaker judgments about phonemic contrast and where tones in particular words are the same or different. Basic results are presented on the phonetics and phonology of tone in each dialect and language.

Two major findings are: I. *Dialects of each language show synchronic residues of the Tai tonogenesis categories.* Though initial consonants have changed in both languages (e.g. the same Lao consonants comprise both High and Low orthographic consonant classes with each sound spelled with two different graphemes), the proto-twelve categories still underlie both phonetic and phonological synchronic differences between dialects. For example, there are major phonological differences in *A in both languages. In Thai, Northern Thai splits the Central dialect mid tone (*A2-*A3) into two tones, one a mid tone (*A2-b and *A3) and the other (*A2-a) merged with the rising tone (*A1 in both). In Lao [(2) below], there are five contrastive tones in both dialects, *A2 words do not carry distinctive tone in either (but do in other Lao dialects), but the tonal phonemes are not the same tones in both dialects: *A2 is merged with *A1 and the rising tone phoneme in Vientiane, but with *A3 and the high falling tone phoneme in Savannakhet [(3) below]. II. *Subphonemic contrasts correspond to proto-categories of Tai tonogenesis*. For example, *A2 is phonetically distinct in both Lao dialects [(4) below], though it is phonologically merged with *A1 in Vientiane (as the rising tone) and with *A3 in Savannakhet (as that dialect's high falling tone). These within-category acoustic differences provide dramatic evidence for Tai tonogenesis, and the autonomy of the phonological level; and appear to explain the synchronic framework of dialect variation and intelligibility. The paper concludes with discussion of the perceptual space for tone and dialect in Lao and Thai.

(1) Tonogenesis in Tai "smooth" syllables

Orthographic Consonant Classes		Three Proto-Tai Tones		
		*A	*B	*C
High consonants	- *voiceless friction sounds	A1	B1	C1
"Mid" consonants	- *voiceless unaspirated sounds	A2-a	B2-a	C2-a
	- *glottal sounds	A2-b	B2-b	C2-b
Low consonants	- *voiced sounds	A3	B3	C3

(2) Representative tone minimal pair set for Lao

A1	A2	A3
[kha:]	[ga:]	[kha:]
'leg'	'crow'	'stuck'
ຂາ	ກາ	ຄາ

B	C1	C2-3
[kha:]	[kha:]	[kha:]
'galaṇga'	'to ḳill'	'merchant'
ຄາ	⁾ຂ	ຄາ

(3) Phonological factoring of the proto-system in two contemporary Lao dialects

Vientiane Tones – Central Dialect

rising	rising	high	mid	low falling	high falling
↗	↗	˥	˧	˩↘	˥↘
A1	A2	A3	B	C1	C2-C3

Savannakhet – Southern Dialect

rising	high falling	high falling	mid	low falling	rise-fall glottalized
↗	˥↘	˥↘	˧	˩↘	↗↘
A1	A2	A3	B	C1	C2-C3

(4) Subphonemic contrasts: Within phoneme acoustic differences corresponding to historical tonogenesis stages

(4a) Vientiane (female speaker)

	/rising/		Synchronic contrastive tone
	[174_245]	Hz	
[[170_278]	[178 _256]]	Hz	Subphonemic contrast
*A1	*A2		*Proto tonal categories

(4b) Savannakhet (male speaker)

	/high falling/		Synchronic contrastive tone
	[130 ¯104]	Hz	
[[122 ¯99]	[138 ¯109]]	Hz	Subphonemic contrast
*A2	*A3		*Proto tonal categories

Tone Melodies in Llogoori

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A strikingly well-attested characteristic of Bantu languages is the presence of tone-melodic patterns superimposed on the verb stem, marking tense-aspect-mood inflection. There is considerable variation within Bantu as to how these tone melodies are realized: they involve addition of a H at some end of the stem, but may have other characteristics. For example, the position where the melody is realized may differ, selecting either the right edge, the penult, the second mora of the stem, or even the third or fourth position from the stem's beginning; the position of realization may be determined by whether the stem has a lexical H or L tone; melodic Hs may also cause the deletion of lexical Hs.

In this paper, we discuss the inflectional tone-melody system in Llogoori, a Bantu language of Kenya. The language is striking in possessing a considerable number of melodies, which we show can be understood in terms of a fairly small number of parameters. All told, TAM categories can be grouped into 6 distinct melodic patterns, even controlling for effects of general phonological rules generating superficial differences. One of the findings revealed in this study is that the positioning of the melodic tone depends on the lexical tone of the verb, so that in the M1 pattern used in such tenses as the consecutive and persistive, the melodic H is realized on the first two moras in lexically L toned verbs, but after the first syllable in lexically H toned verbs. On the other hand, this lexical-tone dependence for position of melody mapping is melody-specific, so that the M2 pattern of the crastinal future and the M4 pattern of the remote past do not distinguish H and L verbs in terms of position of the melodic H. Another interesting property of the melodic tone system is that lexical tones are themselves all obliterated on the surface in the presence of a melodic tone pattern. A third property of the system of tone melodies is that the distinction between a long falling toned penult vs. a long level H toned penult is entirely a function of which tone melody is used in the particular tense. Finally, rather atypically within Bantu, the presence of an underlyingly H toned object prefix causes a wholesale change in tone melody in H tone verbs – essentially, the melodic H is eliminated just in case the first two syllables of the macrostem (object prefix plus stem) are H toned.

STRESS AND TONE SANDHI: A STUDY ON SICHUAN MANDARIN

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The status of stress in Chinese is a matter of debate, and so is the interaction between stress and tone. This article proposes that (i) Sichuan, a sub-dialect of Mandarin Chinese, regularly licenses stress to all the disyllabic words; and (ii) the surface tones of Sichuan words largely depend on their stress patterns. The article is composed of two parts: The first part concerns the phonetic features and crucial acoustic data will be shown. The second part demonstrates the relationship between stress pattern and morphology, and phonological analysis for tone sandhi will be provided.

Based on my experience as a native speaker, most necessary data have already been obtained and analyzed. However, I will still carry out some formal experiments to check the results. I am recruiting two natives of Chengdu City who live in MSU to be informants. In order to prove the existence of stress in disyllabic words, some quasi-homophones i.e. the words (being expected to) differ only in stress, not in syllable structure or underlying tones, will be used. The words will be presented with carrier sentences. See an example below:

a. 我看到了浇水这个词。浇水－UR: tɕjɑʊˊ sweɪˇ Stress Pattern: iambic

b. 我看到了胶水这个词。胶水－UR: tɕjɑʊˊ sweɪˇ Stress Pattern: trochaic

Different SRs for those quasi-homophones are expected, due to the contrast in stress pattern. Manipulation of duration may be the primary contributor of stress, though many other features would be involved simultaneously. Another experiment will be carried out to check the four underlying lexical tones, which are sometimes controversial in literature. Finally the disyllabic words with all the combinations of stress patterns and tones will be recorded. The surface tonal features of the words will be analyzed so as to reveal how stress patterns and tone sandhis are related.

A big portion of the article contains phonetic studies. However, phonological analysis will also be provided. A "sonority profile hypothesis" is proposed to account for the sandhi patterns. In this hypothesis, a word is regarded as a domain that conforms to a rising-falling profile of sonority, and tone sandhi is a process leading to optimal output satisfying the profile.

As a summary, this article is one of the first attempts to discover the regular stress pattern of a Chinese dialect. Therefore it would be a notable contribution to the big issue of stress in Chinese. It is also an elaborate study on Sichuan tonetics. The phonological analysis, especially the sonority profile hypothesis, is an innovative solution to problems regarding tone sandhi.

LARYNGEALIZED RESONANTS IN WASHO

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In Washo, a severely moribund language spoken in California and Nevada, Jacobsen (1964) analyzes glottal stop + sonorant clusters as underlying sequences (e.g., *ʔm, ʔn, ʔl*, not *m', n', l'*) and voiceless resonants, or glottal fricative + sonorant clusters, as unitary segments (e.g., *m̥, n̥, l̥*, not *hm, hn, hl*). However, recent work on syllable weight and Washo morphology challenge this bipartite analysis. In this paper we provide a phonetic description of Washo's laryngealized resonants, and then we offer a unified treatment of laryngealized resonants by analyzing glottal stop + sonorant clusters, like voiceless resonants, as unitary segments.

While Jacobsen analyzes Washo's voiceless resonants as unitary segments (i.e., *m̥, n̥, ŋ̊, y̥, l̥, w̥*), their distribution is restricted: voiceless resonants are absent intervocalically after stressed short vowels, whereas /h/ + resonant sequences appear only after stressed short vowels (e.g., *láhla* 'in my leg', *wamáhmi* 'it's cloudy'). /h/ does not occur in preconsonantal and final positions elsewhere. However, Jacobsen treats glottal stop + sonorant clusters as sequences to avoid morphophonemic errors. Yet phonetic and phonological evidence indicate that these clusters are actually glottalized resonants that pattern like voiceless resonants: glottalized resonants realize as glottal stop + resonant clusters after short stressed vowels, but as preglottalized resonants elsewhere (e.g., *máʔwiʔ* 'hawk'; cf. *ʔlúweʔi* 'they're sitting').

This complementary distribution of glottalized resonants and glottal stop + resonant sequences suggests a phoneme common to both. Recent work on segmental quantity alternation, which reveals a previously unnoticed requirement in Washo to keep the stressed syllable heavy (e.g., CVC or CVV; Yu, 2005), indicates that voiceless and glottalized resonants undergo segmental fission, splitting into glottal + resonant sequences immediately after short stressed vowels to satisfy the heavy stressed syllable requirement.

Primary evidence for this unified treatment comes from reduplication patterns in Washo. Plural reduplication, which copies the final CV of the root, copies no more than one pre-vocalic segment (*ʔéwsiʔ* → *ʔeśwsiʔ* 'father's brothers'). In keeping with the unitary segment analysis, voiceless resonants reduplicate as single segments (*mél̥u* → *mel̥úl̥u* 'old men'), but the glottal stop + resonant sequences reduplicate as a unit (*báʔlew* → *baʔléʔlew* 'Paiutes'), betraying their single segment nature.

Thus, the unified treatment of laryngealized resonants in Washo best explains the distribution of glottalized and voiceless resonants since it reveals that they pattern uniformly through segmental fission. This treatment also accords with studies restricting laryngeals to phonetically salient positions (Steriade, 1997).

Using lexical tones in word identification: Patterns of learning in native English speaking adults

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All natural spoken languages differentiate words by vowels and consonants (segmentals). Most languages also use pitch patterns (suprasegmentals) to mark word meaning. Research has shown that adults can learn to recognize phonetic contrasts that do not occur in their native language. It has also been shown that adults can learn to recognize words based on non-native segmental contrasts. However, it has not been shown whether adults can learn to use non-native suprasegmental (lexical tone) contrasts for identifying words. In this study, native English-speaking adults underwent training to learn to use Mandarin lexical tones to identify a vocabulary of 18 artificial words. All subjects were also tested on their ability to identify the same pitch patterns in a non-lexical context. Unlike previous studies on segmental contrasts, we found that not all participants were able to learn to use non-native suprasegmentals in word identification. Moreover, subjects who successfully learned the vocabulary had higher pre-training (non-semantic) tone identification scores and were more likely to have extensive musical training than the subjects who failed to learn. This research shows that, in at least some adults, lexical tones can be learned for communication, and that success in learning is associated with non-linguistic auditory ability.

Is the phonology grounded in the phonetics? Vietnamese tone

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The exact relationship between phonetics and phonology has long been debated in phonology. One view is that it should be one-to-one: 'the phonological features must be identical to phonetic ones'. The other view is that phonology and phonetics are two separate entities and the relationship between 'the phonological features and phonetic ones is not that of identity' (Bromberger and Halle 1986). In the literature on Vietnamese tones the first view claims that there is a mismatch problem between the phonetic properties of tones and their phonological patterns. This paper provides support for the second view. It addresses two issues. First, the mismatch problem is misleading, and the phonology of tone is grounded in the phonetics in Northern dialects. However, new data from Hue, one of major dialects of Central Vietnam, show that although the two dialects share the same phonological system, the phonetic realizations of tones in the two dialects are very different.

In reduplication, there are two tones that do not pattern as expected as do other members of their groups (Vu 1982, Hoang 1989, Alves 1997, Nguyen & Edmonton 1997). This behavior calls for an unmotivated ad hoc rule to switch the registers (Burton 1992, Ngo1984). A study of Northern Vietnamese dialects (Pham 2003) showed that relative pitch level is not a good

indicator of tone. Instead, the phonation types of breathiness and creakiness appear to be consistently the most important phonetic cues in identifying tone. The mismatch problem disappears if phonation types rather than pitch heights are used to classify tones.

However, this solution does not amount to saying that the phonology of tones always has a one-to-one relationship with the phonetics of tones. Data from two speakers of Hue dialect show considerable acoustic differences in tones from those of Northern Vietnamese dialects. For example, in the Hue dialect not only do tonal contours seem to be as varied among tones as in the Northern dialects, but they also show different contours, i.e., the same phonological tone has a level contour in Northern dialects but appears as rising in the Hue dialect. A high tone in Northern dialects appears as the lowest tone in the Hue dialect. In terms of phonation types, creaky voice does not seem to play a significant role in the Hue dialect as it does in the Northern dialects. Results from a pilot study using the Hue dialect suggest that there is a clear difference between the phonology and phonetics of tones, at least in the Vietnamese case.

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Tone, Minor Syllable, and Infixation in Kammu

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The Mon-Khmer languages of Southeast Asia are well known for their characteristic minor 'syllables,' and their propensity to become tonal. As part of the so-called 'sesquisyllabic' words, e.g. words with one and a half syllable, this type of syllable has had important implications for the theory of syllable structure. A sesquisyllable consists of two parts: a minor syllable and a major syllable. By convention, the major syllable refers to stressed final syllable the word while minor syllable refers to the unstressed first (half-)syllable (Matisoff 1973).

Shaw (1994:118) describes the minor syllable as 'a syllable consisting of one or two consonants and no vowel' and analyzes the structure of minor syllable as having a 'nuclear' consonant, which can also be an obstruent. Data from Northern Kammu described by Svantesson (1983) show that this characterization is not accurate. I argue that most of them are weightless, while some minor syllables are associated with one monomoraic rhyme. The two sesquisyllbic words may conform to one of the following templates respective: CV.'CV(:)(C) or CVC.'CV(:)(C). As demostrated by the templates, both types of minor syllables necessarily have a vowel nucleus on the surface.

Most importantly, I explore the tonal behavior of sesquisyllables in relation to syllable structure and affixation in Kammu, the only language known to have tonal contrast on minor syllable. I argue for an underlying association between tone and onset, drawing evidence from infixation and tonal dissimilation. The distinction between non-moraic and monomoraic syllables captures elegantly the tonal behavior of Kammu minor syllables. Specifically, I propose that tone, at least in Kammu, must be linked to a mora in the phonological output.

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An OT Analysis of the Tonal Phenomena of Bodo

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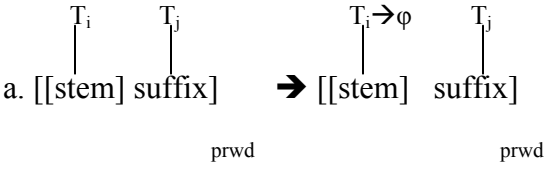
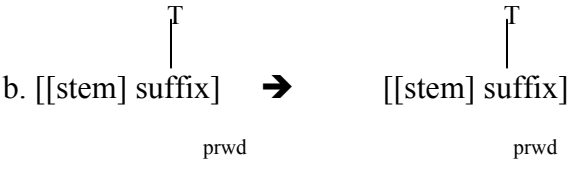
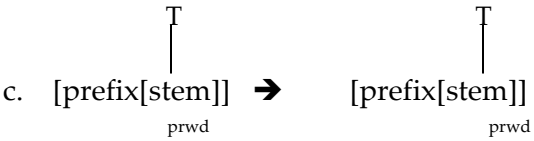
Bodo is a Tibeto-Burman tone language spoken in many parts of the Northeastern states of India as well as in parts of Bangladesh and Nepal.

In some of the previous works tonal phenomena in Bodo is described at length (Sarmah 2003, 2004). Bodo has two lexical tones, namely High (H) and Low (L) and a default Mid (M) tone. It has an interesting tone assignment pattern where a lexical tone is assigned to the rightmost edge of the prosodic word and the default tone is assigned elsewhere. In this paper we would like to give an Optimality Theory (OT) account of the tonal phenomena in Bodo.

We notice that Type I derivations in Bodo follow the tone assignment pattern of the non-derived polysyllabic lexical entries allowing us to assign the word formation process to level I of Bodo lexical phonology model (Kiparsky, 1985). We saw three possibilities in this type, as following:







In all these cases the derived form follows the right aligned lexical tone assignment pattern. If there is a lexical tone that is not right aligned, it is either transferred to the right of the prosodic word or deleted if the right of the lexical item is already specified with a tone. In case of (a) type of derivations, we see that the tone of the suffix is preserved whereas the tone of the stem is lost. This prompts us to arrive at the conclusion that **MAX Sf LT>> MAX Stm LT** is underlyingly present in Bodo derivations.

However when we look into Bodo derivations it does not necessarily follow the above mentioned tone assignment pattern. Some of the derivations that do not follow the right aligned type of tone assignment can be exemplified as below:

(1)^{M}nōng^{+H}thang+mōn →^{M}nōng^{+H}thang^{+H}mōn

"you (hon.)+ mōn →you (hon., plural)"

(2) $^{+H}$kham+^{L}ho→$^{+H}$kham^{L}ho

"burn+ho → "to make burn"

In our analysis we overcome the problems of analyzing (1) and (2) type of problems while being in the domain of OT.

The Status of Turkish Fricatives

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The laryngeal status of Turkish stops has received considerable attention in the recent phonological literature, including the discussions by Inkelas (1995), Kornfilt (1997), Kallestinova (2004), and Petrova et al (2005). However, the laryngeal status of Turkish fricatives has not received much attention.

The main purpose of this paper is to i) present the results of the acoustic research of the Turkish fricatives, ii) propose that Turkish fricatives are either specified as [voice] or [spread glottis], and iii) lay out the full OT analysis of Turkish voicing assimilation extending Kallestinova's (2004) analysis to include both fricatives and stops. I demonstrate that this two-way contrast for Turkish fricatives accounts for both the results of the acoustic research and the voicing alternations.

Four male Turkish speakers were recorded in a sound treated room. Acoustic examination based on spectrogram and waveforms revealed that there is no *passive voicing* observed in Turkish fricatives (cf, Kallestinova 2004). As in the data in (1), no voicing alternation is observed for voiceless fricatives in Turkish. This suggests that the Turkish voiceless fricatives are specified as [spread glottis] because, unlike stops, no voicing alternation is observed in intervocalic positions. In the OT account, the constraints, ***VOICE / SPREAD GLOTTIS** (Davis 1998) and **FRIC-SG** (Fricatives are [spread] (Vaux 1998, Beckman and Ringen (2005)) guarantee that the voiceless fricatives remain voiceless between vowels. The interaction of these constraints along with **IDENT [SPREAD GLOTTIS]** and ***SPREAD GLOTTIS** is presented in (2).

The results of the acoustic study also show that in consonant clusters, it is always the obstruent *in the root* that determines the voicing specification of the cluster as shown in (3). To capture this generalization in OT, I propose an analysis with **AGREE (OBSTRUENT) [VOICE]** along with the root-faithfulness constraint. In accounting for voicing alternations in clusters, these two constraints are ranked higher than the faithfulness constraint for voicing. I also propose that in Turkish, voicing alternation in clusters is not a syllable-related phenomenon (cf. Korfilt 1997, Wilson 2003) because the analysis with surface-syllabification makes different predictions than the predictions by the root-faithfulness account as seen in (4). Since only the root-faithfulness account predicts the actual forms, I suggest that there is no coda devoicing in Turkish.

DATA (The data / examples are from the acoustic research unless specified otherwise.)

(1) No Voicing Alternation for Voiceless Fricatives Intervocalically

a) /tef+i/ → [te**f**i] (*[te**v**i]) 'tambourine, acc'

b) pas+ɨ/ → [pas**ɨ**] (*[paz**ɨ**]) 'rust, acc'

cf) /kap+ɨ/ → [ka**b**ɨ] (*[ka**p**ɨ]) 'cup, acc) (Kallestinova 2004: 128)

(2) High-Ranked ***VOI/S.G.** and **FRIC-S.G.**

/pas+ɨ/ → [pas$^{[sg]}$ɨ] (input with a [ø spread glottis] voiceless fricative)

/pas+ɨ/	*VOI/SG	FRIC-S.G.	IDENT [SG]	*SPREAD GLOTTIS
☞a) pas$^{[sg]}$ɨ			*	*
b) pazɨ		*!		
c) pasɨ		*!		
d) paz$^{[sg]}$ɨ	*!		*	*

***VOI/SG** and **FRIC-SG** prohibits passive voicing even if the input voiceless fricative is not specified as [spread glottis].

(3) Fricatives in a Cluster (root is underlined)

a. /tuz+tan/ → [tuz**d**an] (*[tu**s**tan]) 'salt, abl'

b./pas+tan/→ [pas**t**an] 'rust, abl'

c. /ad+vari/ → [a**d**vari] 'name-like'

d./kap+vari/ → [ka**p**fari] (*[kap**v**ari]) 'cup-like'

(In all cases, the obstruent *in the root* determines the voicing of the cluster.)

(4) Syllable-Final Devoicing Makes a Different Prediction

a. /ad+zli/ → [a**d.**zli] (*[a**t.**zli]) 'name-collective suffix' (made-up word) *([d] in coda)*

b. /ad+vari/ → [a**d.**vari] (*[a**t.**vari]) 'name-like' *([d] in coda)*

(Analysis with final-devoicing predicts the devoicing of the root-final consonant. However, the root final voiced stop remains voiced regardless of the syllabification.)

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Statistical learning, cross-constraints and the acquisition of speech categories: a computational approach

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Infants learning the phonetic categories of their native language must recognize which distinctions are relevant to their language and which are not. While they initially discriminate both native and non-native phoneme contrasts, infants quickly learn to discriminate only those contrasts that are present in their language (Werker & Tees, 1984), and eventually form language-appropriate phonetic categories. One way they might do this is to take advantage of the statistics available in their linguistic environment. Previous work has shown that infants are indeed sensitive to and make use of the distributional statistics for speech sounds (Maye et al, 2002). Infants exposed a series of sound in which phonetic cues formed two clusters learned two categories. Infants exposed to a unimodal distribution learned only one.

We implemented this hypothesis in a computational model. Data representing the distribution of Voice Onset Times (VOTs) for one of several languages were fed into a statistical learning model. These data were based on the statistical distributions of VOT measured by Lisker and Abramson (1964). The model began with a set of Gaussian distributions located at random locations in VOT-space. On each generation, it was given a particular VOT. The model then adjusted the distributions, giving a greater weight to the distribution that best matched the input. Over successive generations, the model was able to fit the input distributions for a variety of languages differing in VOT boundaries and categories. Thus, this form of statistical learning, as implemented in a relatively simple learning device, and can learn actual phonetic categories.

We next used the model to examine the role of cross-linguistic patterns on learning. Cross-linguistic similarities may place constraints on the properties of the phoneme categories that must be learned (see Newport & Aslin, 2000, for a similar argument). By varying the starting states of the distributions in the model and evaluating their effect on successful learning, we can determine the relative importance of the initial category locations on the model's performance. If the starting states correspond to categories that are common across languages, they may yield better performance by the model. However, if these starting states provide no advantage, the model's performance will be similar to the condition in which its initial categories are random. This would suggest that statistical learning is a sufficiently powerful mechanism for the acquisition of speech categories without the cross-linguistic constraints. Findings suggest that while statistical learning is sufficient for a most learning-situations, there may be a small benefit to cross-linguistic constraints.

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The Phonetics and Phonology of Tone and VOT in Cantonese

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This study investigates the possible effects of lexical tone on Voice Onset Time (VOT) in Cantonese, a tonal language with a two-way contrast between short-lag (voiceless unaspirated) and long-lag (voiceless aspirated) stops. VOT was measured as the time interval between the stop burst and the onset of voicing for the following vowel. The recorded speech of 6 native speakers each producing 10 repetitions of 20 different words contrasting in aspiration and tone was analyzed. Tokens from each individual subject were divided into two sets for the purpose of comparison. The first set involved a comparison between the effects of a high-level 55 tone and a mid-level 33 tone. Results show that words beginning with aspirated stops with a 33 tone corresponded to higher VOT than words with a 55 tone while unaspirated stops showed no significant differences. To determine whether these differences are due directly to phonological tone or to the phonetic F0 onset, a second set of tokens compared the effects of 4 different phonemic tone categories (55, 35, 33, and 21) on VOT. Results show that, ultimately, what makes a difference may not be lexical tone in itself but perhaps the F0 onset. Words beginning with a lower F0 onset (and thus the 35, 33, and 21 tones) correlated with higher VOT than words beginning with a higher F0 onset (the 55 tone). There seem to be no significant VOT differences between words with the 35 and 33 tones suggesting that the observed effects may be more phonetic than phonological. Results from this study will be discussed in the framework of research on the phonetics-phonology interface.

Tuning in and tuning out: speech perception in native- and foreign-talker babble

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Studies on speech perception in multi-talker babble have revealed asymmetries in the effects of noise on native vs. foreign-accented speech intelligibility for native listeners (Rogers et al., 2004, Language & Speech 47(2):139-154) and on sentence-in-noise perception by native vs. non-native listeners (Mayo et al., 1997, JSLHR, 40:686-693), suggesting that the linguistic backgrounds of talkers and listeners contribute to the effects of noise on speech perception. However, little attention has been paid to the language of the babble. This study tested whether the language of the noise also has asymmetrical effects on listeners. Replicating previous findings (e.g. Bronkhorst & Plomp, 1992, JASA, 92:3132-3139), our results showed poorer English sentence recognition by native English listeners in 6-talker babble than in 2-talker babble regardless of the language of the babble, demonstrating the effect of increased psychoacoustic/energetic masking. In addition, our results showed that in the 2-talker babble condition, native English listeners were more adversely affected by English than Chinese babble. These findings demonstrate informational/cognitive masking on sentence-in-noise recognition in the form of "linguistic competition." Whether this competition is at the lexical or sub-lexical level and whether it is modulated by the phonetic similarity between the target and noise languages remains to be determined.

Are voiced fricatives always specified with [voice]?

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Many phonologists today agree that languages such as English and German have a spread glottis contrast to distinguish lenis and fortis stops. Word-medial stops surface with passive voicing in certain environments when they are underlyingly not specified for a laryngeal feature. In contrast, there is some question about fricatives. Iverson and Salmons (2003) remark that, like stops, fricatives have a spread glottis contrast in English and German, with only weak voicing of lax fricatives in all positions. They claim that when they occur, "voiced" fricatives are voiced more strongly in true voice languages than they are in aspirating languages. In other words, they suggest that the "voicing" of fricatives in aspirating languages is different from that in true voice languages, as it is "variably" or "less" voiced in aspirating languages. Since Westbury and Keating (1986) have shown that voicing of word-initial stops requires active gestures, it is unclear how a word-initial fricative could be different from stops and undergo passive voicing.

This study compares word-initial and word-medial lenis and fortis fricatives in aspirating languages and true voice languages. The duration of the voicing is measured against the duration of frication, to see whether in fact voicing languages have more robust voicing than do aspirating languages. The results bear on the issue of the correct representation of fricatives in aspirating languages such as English and German. Data is being collected from native speakers of German, English, Hungarian, Bulgarian and Polish. By comparing overall durations of fricatives and the percentage of voicing duration to total frication, we will be able to see whether true voice languages have more voicing or even more consistent voicing than do aspirating languages.

If the aspirating languages are found to have equally "robust" voicing, it will support the claims of Jessen (1998) and Beckman and Ringen (2005) that while stops in aspirating languages have a [spread glottis] contrast, fricatives contrast in both [voice] and [spread glottis]. On the other hand, if the word-initial fricatives in the aspirating languages are found to show more variability in voicing or be overall of a lower intensity and duration than in true voice languages, it will support the claims of Iverson and Salmons (2003), perhaps suggesting that aspirating languages do not treat word-initial fricatives differently from stops, and that any voicing in them would be due to something other than voice specification.

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Exploring Strict Dominance and Violability with Turing Machines and Computability

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There are at least two components of Optimality Theory (Prince & Smolensky 1993/2004) that set it apart from other generative linguistic models: violable constraints and a strict dominance relation (ranking) of those constraints. Our aim is to investigate how strict dominance and violability relate to formal computational complexity. The alternative to strict dominance is Harmonic Grammar's (Legendre, Mityata & Smolensky 1990) additive numerical ranking in which violations are weighted by the numerical strength of the constraint; the optimal candidate having the lowest weighted score. The alternative to violable constraints is inviolable constraints in which optimal candidates do not violate any constraints.

Our chief result shows that a deterministic Turing machine(TM) can be implemented in OT by a TM-specific set of markedness and faithfulness constraints that evaluate a set of candidate computational histories produced by GEN. Interestingly, the kind of ranking (strictly dominant or additively numerical) has no bearing on the outcome, since the optimal candidate does violate any of the constraints encoding the transition function of the Turing machine. Our result coincides with Smolensky (2005) which showed how Harmonic Grammar could implement a Turing Machine. Therefore, there is no computational complexity difference between Harmonic and OT grammars. Furthermore, any Turing-recognizable language can be implemented in a set of inviolable constraints, meaning for all of the violable-constraint (OT) grammars used in linguistics there exist equivalent inviolable-constraint grammars giving the same formal language.

However, we show that our OT-Turing machine is too powerful, because with slight modification the mechanism can be used to solve the Halting Problem, implying that no general mechanism exists for optimizing over an arbitrary set of constraints. So which part of OT is too powerful? Although none-of our constraints alone can solve the halting problem, following (Frank & Satta, 1998), we conclude that optimization with strict dominance, is tantamount to computing a successive, finite intersection among the constraints. Neither context-free or context-sensitive languages are closed under intersection, so a system that uses intersection as the process of optimization can take computational less complex pieces and compute a more complex function. One reason linguistic systems might use strict ranking is not because of *what* they compute, but rather *how* the computation of more complex functions is performed via simpler constraints. It remains part of future work to determine precisely what limits must be placed on the constraints themselves to ensure that the optimization process is decidable.

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Neural Bases of Listening to Speech in Noise

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Ubiquitous speech processing involves listening to speech in ecological environments where noise is often present. The current study investigates the neural mechanisms involved in perceiving speech in noise using a sparse sampling fMRI method. Subjects were asked to match auditorily presented words with picture choices. The auditory stimuli were either presented in quiet or embedded in multi-talker babble noise. Behaviorally, it was found that subjects were slower and less accurate in identifying words presented in noise. Comparison of hemodynamic responses associated with listening to the two types of stimuli revealed increased activation in left prefrontal, inferior frontal, anterior insular, and superior temporal regions when subjects listened to speech in noise. These results confirm the importance of the lateral auditory cortex in complex auditory processing and suggest that the prefrontal cortex is likely to be prominently engaged in subvocal rehearsal when noise is affecting the integrity of the speech signal.

On the Status of Prenuclear Glides in Mandarin Chinese

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Researchers have not reached a consensus on the status of the prenuclear glides in Mandarin Chinese. Traditional Chinese phonology tends to view the prenuclear glides as in the final or rhyme. Yet, in recent years, various proposals have arisen in this respect. Basically, there are three major proposals, namely, the prenuclear glides are: (1) in the onset; (2) in the rhyme: (3) indeterminate in terms of their position. This thesis examines the strengths and weaknesses of each previous proposal within the framework of non-linear phonology. While acknowledging that each proposal is reasonable and appropriate to some extent, I maintain that no single proposal can accommodate all the language data in Mandarin Chinese (or dialects). Meanwhile,

careful examination reveals that some researchers have misused some language data in justifying their arguments so that they have drawn the inappropriate conclusion. Through such an analytical review, the thesis argues that the classic Onset-rhyme syllable model is not appropriate for Chinese syllable analyses, esp. when it comes to the status of the Chinese prenuclear glides. Just because researchers attempt to locate the prenuclear glides in the Onset-rhyme syllable model, the controversy in terms of the alignment of the Chinese prenuclear glides arises. As a solution, the thesis proposes a compound Chinese syllable model, in which the prenuclear glide is independent of both the onset and the rhyme. The thesis also claims that such a compound syllable model not only avoids the controversy of the alignment of Chinese prenuclear glides, but also contributes to the explanation of various language data, such as language games and speech errors (slips of tongue).

Predicting prosodic boundaries from linguistic structures

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Leading theories of prosody maintain that prosody is shaped through the interaction of grammatical factors from phonology, syntax, semantics, and pragmatics (Nespor & Vogel 1986, Pierrehumbert 1980; Beckman & Pierrehumbert 1986; Ladd 1996), there is no consensus on how to model this interaction. Proposals have been made that the prosody interface is governed by mapping rules (Nespor & Vogel 1986), through the interaction of constraints (Selkirk 2000), or by the representations of discourse structure and surface syntactic structure (Steedman 2000), and that the mapping may be probabilistic (Ross & Ostendorf 1996; Taylor & Black 1998; Watson & Gibson 2004). While it is widely accepted that syntactic and prosodic structures are not isomorphic (Chomsky & Halle 1968; Cutler 1987), it is also often noted that the two structures are too highly correlated for their relationship to be ignored. Proponents of rule- or constraint-based mapping (e.g., Nespor & Vogel 1986, Selkirk 2000, Steedman 2000) maintain that prosodic constituents are contained within syntactic constituents, with exceptions. Proponents of probabilistic mapping (e.g., Ross & Ostendorf 1996; Taylor & Black 1998) propose boundary prediction based on *n*-gram part of speech tagging. Though these models correctly predict 86-89% of prosodic boundaries, they do not directly address the effect of syntactic constituency on prosodic boundaries. Recent probabilistic models (e.g., Ingulfsen 2004, Aaron 2004) make use of full syntactic parsing, but since automatic syntactic parsing is overall not very accurate (Taylor & Black 1998), the practical success of such methods is limited.

I provide a new probabilistic model of the mapping between prosody and phonology, syntax, and argument structure. The model encodes phonological features (the number of syllables and phones in each word, location of primary stress), shallow syntactic constituent structure (NP and VP), and basic argument structure (subject, object). A machine learning experiment using these features to predict prosodic phrase boundaries achieves more than 92% accuracy in predicting prosodic boundary location: 86.10% precision and recall in predicting boundary locations and 94.61% in predicting locations where no boundary is present. This model outperforms all published models in accuracy. This study sheds light on the relationship between prosodic phrase structure and other grammatical structures. It provides a simple algorithm for modeling the interface between distinct grammatical components, and can identify how much each linguistic factor contributes to the occurrence of prosodic phrase boundaries. The study also

shows that the inclusion of linguistic information in modeling prosodic events achieves the best accuracy.

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In Defense of Phonetic Analogy: Evidence from the Phonetics of Tonal Morphology

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Paradigmatic effects in phonology and morphology are commonplace in linguistic change and recent work has extended the idea to the synchronic domain (e.g., OO-correspondences; Burzio 1994, Benua 1995, Kenstowicz 1996). At issue here is whether paradigm uniformity at the phonetic level (i.e. Phonetic Analogy) exists. Steriade 2000 argues that paradigmatic uniformity is enforced through conditions that govern both phonological features and non-contrastive phonetic details. She concludes that the boundary between phonetics and phonology is not conducive to progress and deeper understanding and thus should be eliminated. However, recent studies have raised doubt about the need for phonetic analogy particularly in cases studied by Steriade (e.g., French schwa deletion (Barnes & Kavitskaya 2002); the Withgott effect of English flapping (Davis 2005, Raffelseifen 2005)). In this study, we offer experimental evidence for phonetic analogy from Cantonese tonal morphology, demonstrating that the phonetic realization of a derived form (in this case, a derived tone) may vary in the direction of its paradigmatic neighbor(s).

Background: Cantonese has six tones (55, 33, 22, 25, 23, 11). Besides the lexical 25 tone, a set of morphological processes may give rise to a syllable with 25 tone from a semantically related word (e.g., deverbal nominalization: *pɔŋ22* 'to weigh' → *pɔŋ25* 'scale'); diminutivization: *tʰoi11* 'terrace' → *tʰoi25* 'table'; Benedict & Bauer 1997). At issue here is whether the phonetic realization of the derived 25 tone may be influenced by the nature of the underlying tone.

Methodology: Five subjects recited a list of Cantonese monosyllabic words in a carrier phrase ten times. Four target words with derived mid-rising tone were selected, two from words with underlying 22 tones and the others from words with underlying 33 tones. Six fillers with non-derived non-25 tone were also included in the stimulus set to minimize the chances of the subjects figuring out the purpose of the experiment. Each subject produced 100 utterances ((4 target words + 6 fillers) x 10 repetitions). The overall f_0 contour, the duration of the rime, the f_0 minimum and the f_0 maximum were measured.

Results: The experimental results suggest that the underlying tonal specification affects the surface realization of the derived rising tone. The overall f_0 contour of a 33-derived rising tone is higher than that of a 22-derived one. Data were analyzed using a two-way repeated measures ANOVA. There were significant main effects of underlying tone type (i.e. 22 vs. 33; $F(1, 4) = 19.39$, $p = 0.012$) and location of the measurement (f_0 min(imum) vs. f_0 max(imum); $F(1, 4) = 13.38$, $p = 0.022$) but no significant effect of interaction. A paired means Wilcoxon signed-ranked test showed significant differences at both the f_0 min ($p < 0.05$) and the f_0 max ($p < 0.05$) between the two varieties of derived rising tones.

Discussion and analysis: The existence of phonetic analogy and other subphonemic effects in morphology (Ernestus & Baayan 2003, Warner *et al*. 2004) highlight the fact that grammatical structures and their physical implementation cannot be separately studied. In particular, such evidence argues for a theory of grammar that must admit fine-grained phonetic details into phonological considerations and must allow the possibility for morphologically-related neighbors to influence each others on the surface (e.g., Exemplar Theory of Speech Perception and Production (Pierrehumbert 2001); Paradigmatic Correspondence (Steriade 2001).

An Experimental Study of Tone 2 Sandhi in Standard Chinese

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It has been reported that word frequency can affect the application of phonological rules and account for certain exceptions to what are otherwise fairly general patterns (Fidelholtz 1975, Hooper 1976, Bybee 2001). In this study we examine the relation between the frequencies of trisyllabic expressions in Standard Chinese and the application of tone sandhi.

In Standard Chinese there are four tones on full syllables, which are H, LH, L, and HL (Duanmu 2000). In a trisyllabic expression, the tone LH will change to H when it occurs after H or LH and before any full syllable, as shown in (1), where X is any full syllable.

(1) LH → H / H__X
LH → H / LH__X

Standard descriptions state that the tone sandhi occurs in at the normal speech rate, but not in careful speech (Chao 1968, Cheng 1973). There is, however, no experimental study on whether the rule is variable or whether it is sensitive to the frequencies of the expression.

In this study we plan to collect 100 trisyllabic expressions with different frequency values. Then we ask 10-20 speakers of Standard Chinese to read them at the normal speech rate. Next we examine whether tone sandhi has applied for each utterance. Statistic analysis will then be performed to determine whether or how frequency interacts with tone sandhi.

If time permits, we also plan to carry out a perceptual study to address the same issue. The same 100 expressions will each be read twice by a trained linguist, once with tone sandhi and once without. Native speakers will then be asked to judge whether each pronunciation is fluent/natural on a graded scale. Statistic analysis will then be performed to determine whether the frequency of an expression can affect the judgment on whether it should or should not undergo tone sandhi.

Asymmetries between Left- and Right-Dominant Tone Sandhi Systems

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Chinese tone sandi systems are often classified as either left- or right-dominant depending on whether the initial or final syllable in a sandhi domain retains its citation tone. One noted asymmetry between the two is that in left-dominant sandhi, e.g., Shanghai, the tonal melody of the initial syllable often spreads to the entire sandhi domain; but in right-dominant sandhi, e.g., Mandarin, the nonfinal syllables often take on sandhi tones that involve default insertion, tonal simplification, and neutralization. This asymmetry has not received a principled account.

I propose a theory of tone from which this asymmetry emerges as a prediction. Its crucial elements are as follows.

First, *ceteris paribus*, contour tones preferentially occur on the final syllable of a prosodic domain over nonfinal syllables due to the durational advantage afforded by final lengthening. This provides a greater incentive for a contour to spread across the sandhi domain from the initial syllable than from the final syllable. This can be captured by positional markedness constraints with an intrinsic ranking in OT: *CONTOUR$_i$-σ_j(NONFINAL) » *CONTOUR$_i$-σ_j(FINAL).

Second, to distinguish default-tone insertion from spreading, there needs to be a family of faithfulness constraints—FAITHFUL ALIGNMENT (FA)—which prevents tones from spreading from its original syllable to neighboring syllables. FA is divided into FA-LEFT and FA-RIGHT, which ban leftward- and rightward-spreading respectively; and within each subfamily, there are intrinsically ranked constraints FA-EDGE(*n*) » FA-EDGE(*n-1*) » … » FA-EDGE(1), EDGE = LEFT or RIGHT, where FA-EDGE(*i*) is violated by an output in which a tonal target is spread *i* syllables to the left or right. And crucially, for all *i*, FA-L(*i*) » FA-R(*i*). This is projected from the crosslinguistic phonetic observation that tonal coarticulation is of greater magnitude and duration progressively than regressively. By incorporating this set of rankings, the system further discourages leftward tone spreading from the final syllable.

I then show that the factorial typology of the current system exhibits a good fit to a typology of tone sandhi systems. In particular, it predicts two implicational relations for a language in which left- and right-dominant sandhis coexist: (a) if its right-dominant sandhi involves spreading, then its left-dominant sandhi also involves spreading; (b) if its left-dominant sandhi involves default insertion, then its right-dominant sandhi also involves default insertion. These are precisely the observations of the language typology.

Title: Laryngeal contrasts in Korean stops

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It is widely thought that Korean has three series of stops, sometimes called lax, tense and aspirated. However, this is dubious on typological grounds, since one of the series is always analysed as typologically somewhat unique (see e.g. Szigetvári, 1996).

Another peculiarity of Korean is alleged process of so-called post-obstruent *tensification*, which is supposed to change a lax obstruent following another obstruent (and preceding a vowel) into a tense one. This is usually taken to be an example of fortition, but no local source of "tenseness" seems to be available in the phonological environment. On the other hand, the process cannot be viewed as lenition either, since it occurs in a strong position (as defined in Ségéral and Scheer, 1999).

In the present paper we propose an alternative analysis of Korean stops, which contrasts only two laryngeal series, lenis (non-aspirated) and fortis (aspirated), thereby bringing Korean phonological system "back to normal." This is achieved by unifying the analysis of the laryngeal system with the analysis of consonant-tone interaction in Korean. Kim and Duanmu (2004) note that the tone of the "first vowel in the accentual phrase" (basically the first vowel of the word) depends on the preceding consonant: tense and aspirated obstruents are followed by a high tone vowel, while all other consonants (including empty onsets) are followed by a non-high (i.e. mid) tone vowel. (Consonants have no influence on vowel tone height in other positions.) We claim that phonologically, word-initial lax and tense stops are identical. What is different is the tone height of the following vowel.

Our analysis also explains data usually accounted for by appeal to tensification. It is widely known that lax stops get "voiced" in intervocalic position in Korean. We claim that post-obstruent tensification is an illusion created by *absence* of inter-vocalic voicing in post-obstruent position.

obstruents are unreleased in Korean is also explained by our analysis. While other analyses usually claim that tense and aspirated obstruents lenite to lax obstruents, and that the latter are 'simply pronounced' as unreleased in the pre-consonantal and word-final position, our analysis shows that the difference is in fact phonological. All obstruents lenite to unreleased stops in pre-consonantal and word-final position due to the fact that this is a weak position (Ségéral and Scheer, 1999).

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