Reduplication as Evidence for the Geometry of Tone

Reduplication as Evidence for the Geometry of Tone

Laura J. Walsh

University of Massachusetts, Amherst

1. Introduction[1]

Languages differ in their treatment of tone in reduplication. Some languages copy tone just like segmental material. Other languages fail to copy tone and must supply default or assimilated tones to the reduplicative affix. The question that will be addressed here is why tone reduplicates in some languages but not in others. Can we predict how a language will treat tone in reduplication based on other facts about the language?

To illustrate the different ways in which languages treat tone in reduplication, let us look at some examples of tone reduplication and tone non-reduplication[2]:

---

[1]I would like to thank the following people for invaluable discussion, comments, and criticism of this work: Mary Clark, Lyn Frazier, Amalia Gnanadesikan, Anand Gnanadesikan, John Kingston, David Odden, Jeffrey Runner, Suzanne Urbanczyk, Ellen Woolford, members of audiences at UMass and CLS 1992, and especially John McCarthy. A shorter version of this paper was published in the proceedings of the 1992 meeting Chicago Linguistic Society.

[2]In languages with two tones, I will mark the high tone as [´]. The low tone will be unmarked. In languages with three tones, high will be marked with [´] over the vowel, low will be [`], and mid will be the unmarked vowel. Where I have given data for languages with more than three tones, I have noted the diacritics used.

(1) Tone non-reduplication: Shona (Myers 1987)

(a) t - a - fámba	→	t - a - fámba - famba
we walked		*we walked about*
(b) ku - féyéwá	→	ku - féyéwá - feyewa
to be investigated		*to be investigated (for a long time)*
(c) ku - rwa	→	ku - rwa - i - rwa
to fight		*to fight every so often without due cause*
(d) ku - símúká	→	ku - símúká - simuka
to stand up		*to get up and sit down all the time*

(2) Tone reduplication: Ewe (Ansre 1962)

(a) ke	→	keke
to be wide		*to be very wide*
(b) así	→	asíasí
hand		*hand by hand; easily*
(c) fo	→	fofo
to beat		*beating*
(d) akɔ́me	→	akɔ́meakɔ́me
near one's body		*closer and closer to one's body*

I will suggest that these two types of reduplication are a direct result of the locus of tone in the phonological geometry. My proposal is that languages parameterize the location of tone in the phonological representation. A language may have either segmental tone or prosodic tone. If in a language tonal features are part of the segmental representation, tone must be reduplicated. When tone is represented prosodically (on the syllable or the mora), tone does not necessarily copy. This representational distinction is independently motivated by other aspects of the phonology of these two types of languages. In particular, segment-tone interactions will help in refining a diagnostic which will allow us to recognize whether a language has segmental tone or prosodic tone. We will see a correlation between segment-tone interaction and tone reduplication.

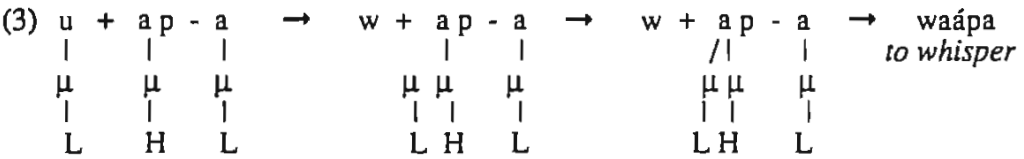
In Section 2, I give an overview of the debate about the representation of tone. I sketch both the segmental tone and prosodic tone proposals that have been made. Section 3 explores the predictions that these proposals make with respect to reduplication. In Section 4, the main proposal of this paper, the Tone Geometry Parameter, is developed. In Section 5, I present the results of a cross-linguistic survey that I have conducted. Areas for further investigation are raised in the final section.

2. Background

For many years, evidence has been brought forth in the phonological literature to support tone as both prosodic (Leben 1973, 1978; Goldsmith 1976; Yip 1980,1989; Archangeli & Pulleyblank 1986; Hyman 1989; and Bao 1989 among many others) and segmental (Halle & Stevens 1971; Sagey 1986; Kingston & Solnit 1988; Bao 1990; Clark 1990; and Duanmu 1990 among others). One of the main reasons that autosegmental theory (Goldsmith 1976) was created in the

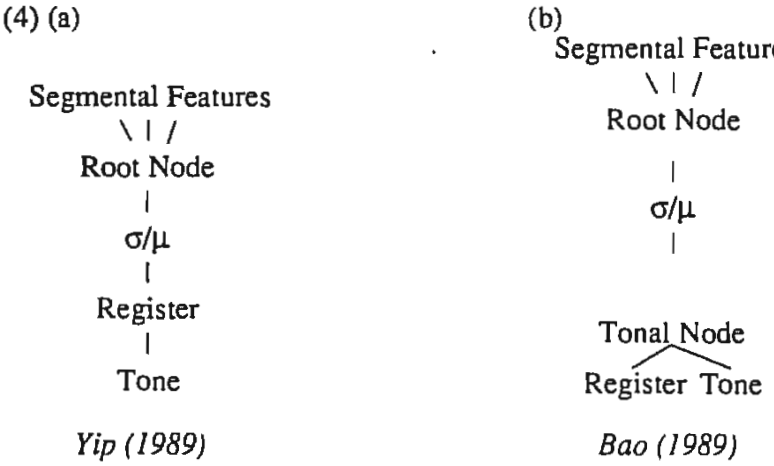
first place was to deal with the autonomy of tone from other features. Floating tones, stability effects, tone in language games, and purely tonal morphemes have all led to the proposal that tone is prosodic.

Stability effects are perhaps the most straightforward of the arguments. Tone does not always go the way of the segmental material to which it is associated. When there is deletion of a vowel, for instance, the tone of that vowel often stays behind and associates to another vowel. In this example from Makua, a Bantu language spoken in Tanzania and Mozambique, the formation of a glide from a vowel leaves behind the tone of that vowel[3]:



For the sake of argument, I have shown tone associated to the mora. The [u] prefix above has a low tone attached to its mora. When that vowel becomes a glide, it ceases to have a mora. Compensatory lengthening then follows, which preserves the number of moras in the word. Here, the mora that previously belonged to the vowel [u] is maintained in the form of a lengthened [a]. When this [a] receives the mora from the [u], it also receives the tone of the [u]. In this way, tone can be seen as having independence from segmental material.

In current terms, this would mean that the tonal features are part of the prosodic or metrical structure dominating the root node. The tone bearing unit would be the mora or the syllable itself. To illustrate such a geometry, we can look at two representative models which support the notion of tone as prosodic:



The crucial aspect of these geometries is that tone is represented in the prosodic structure. Tone is effectively separated from segmental features. "Register" and "tone" are the tonal features in these models. Yip claims that tone is a feature

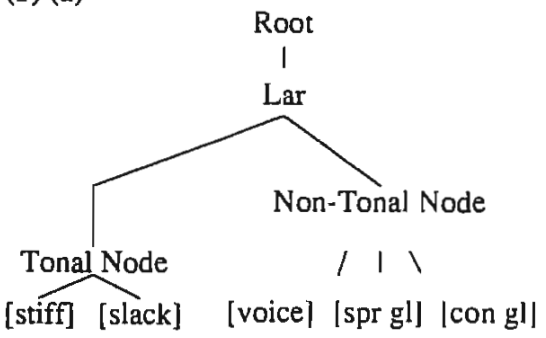
[3]Example from Kenstowicz & Kisseberth (1979), page 123.

dependent on register. Bao proposes that register and tone are both dependent on a third node, the Tonal Node. These particular dependency relations are not central to the issue of this paper. The key for our purposes is that tone is prosodic, not segmental, in these theories.

The other side of this debate maintains that tone is a feature like all other segmental features. Most proponents of the segmental tone analysis claim that tone is a laryngeal feature and should therefore be represented under the laryngeal node. There are two main reasons for doing this: (1) the acoustic and articulatory properties of tone are very closely related to, and in some cases identical to, laryngeal features; and (2) having tone as a segmental feature provides an explanation for tonogenesis (the historical creation of a tone language from a non-tone language based on laryngeal feature distinctions in onsets), tonomitosis (the historical splitting of tones in a tone language as a reflection of previous voicing or glottalization distinctions in onsets), and the synchronic interaction of tone with laryngeal features. An example of synchronic segment-tone interactions is observed in the phenomenon of tone spreading. The voicing of consonants in many languages determines whether these consonants will be opaque or transparent to tone spreading. The usual case is that low tones cannot spread past voiceless consonants and high tones cannot spread past voiced consonants.

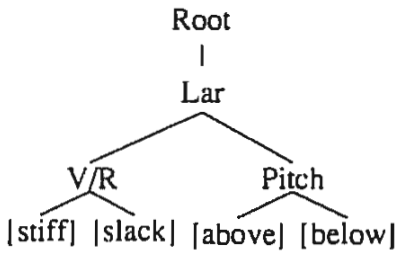
Two representative examples of a geometry treating tone as a segmental feature are given below[4]:

(5) (a)



Kingston & Solnit (1988)

(b)



Duanmu (1990)

What is important to notice about these structures is that all of the tonal features are located under the laryngeal node. Tone has the status of a segmental feature. These models are important to us because tone is represented below the root node. This proximity of tone to other laryngeal features is appealed to in explaining the segment-tone interactions mentioned above.

3. Implications of Tone Geometry

The choice of where tone is represented in the geometry makes predictions about tone in reduplication. If tone is a segmental feature, it must copy in

[4]V/R in the Duanmu geometry stands for Voicing/Register. His claim is that this is a single feature: voicing for consonants and register for tone on vowels.

reduplication. This follows from the fact that reduplication always treats segments as unanalyzable units or "islands". Except for melodic prespecification (Marantz 1982) and melodic overwriting (McCarthy & Prince 1986, 1990), the features within a segment are not accessible to individual manipulation by reduplicative copying. Thus, we do not find a rule of reduplication that copies all the segments in a word but does not copy the voicing tier, as in (6):

(6) badaka → *pataka - badaka

This islandhood of segments is found in several other domains as well: secret languages (Bagemihl 1988), stray erasure (Ito 1986), and speech errors (Shattuck-Hufnagel & Klatt 1979).

On the other hand, the claims of prosodic tone are not as strong. Whether prosodic tone copies or not depends on what is stipulated by the rule of reduplication. It is well accepted that segmental material is copied in reduplication. What is not clear is the treatment of prosodic structure (McCarthy & Prince 1986, 1988; Steriade 1988). Given a prosodic template for reduplication, such as those argued for in Marantz (1982) and McCarthy & Prince (1986), segmental material is always copied. As Steriade (1982) succinctly points out, Marantz suggests that "reduplication represents the affixation of an incompletely specified phonological unit (p. 198)." For Marantz, this phonological unit is a skeletal template of Cs and Vs to which segmental material from the base associates. McCarthy & Prince take the template to be a prosodic constituent, often a syllable. What is left unspecified in the affix template is supplied by the base. Let us consider that in some reduplication what is provided by the base is prosodic. For example, the template which is affixed to the base could be a foot. The information supplied by the base then includes moraic and possibly syllabic information. It is as if what is copied from the base is everything "below" the level of the template. If this information includes moras and syllables, then it could include tone as well, when it is attached to the mora or the syllable[5]. Further more, if the mechanism for total word reduplication were to specify a "prosodic word" template, then all prosodic structure would be copied. In this way, we can see how it could be possible for prosodic tone to reduplicate. Crucially, segmental tone must always copy. If tone is prosodic, on the other hand, it will be copied just in case reduplication copies prosodic information[6].

4. Tone Geometry Parameter

What if both segmental tone and prosodic tone theories are correct? I propose that languages parameterize the location of tone: in some languages it is segmental, while in others it is prosodic. This representational difference allows us to explain why the behavior of tone in reduplication differs cross-linguistically. The behavior of tone is dependent on the location of tone in the phonological

---

[5]Steriade (1982) argues that prosodic information must be copied in reduplication in order to maintain length distinctions. The possibility of reduplicating moras allows us to copy length as well as prosodic tone.

[6]A further question would be how prosodic tone could not reduplicate in total word reduplication. Is there evidence, for example, of moraic prespecification, as with core syllable reduplication (McCarthy & Prince 1986)? If prosodic structure were not copied from the base in some instances of total word reduplication, then prosodic tone would not copy either.

structure. In languages where tone is segmental, it copies. In languages where tone is prosodic, it will not copy unless the rule for reduplication specifies that prosodic material is copied.

There is a crucial problem in the strictly segmental theory when it comes to the case of reduplication. Segmental tone theories fail to account for languages which do not copy tone. If tone is segmental, it should copy like any other laryngeal feature. On the other hand, a theory which has only prosodic tone can handle the reduplication facts. The problem with such an account is that it fails to explain the correlation between tone reduplication and segment-tone interactions. This correlation will be made explicit in section 5.

Segment-tone interactions provide an independent test for segmental tone. If tones are prosodic, there is no reason to expect them to interact specifically with laryngeal features. If, on the other hand, tone is one of the laryngeal features, it would be natural to observe interaction between tone, voicing, glottalization, and aspiration. Indeed, these are just the segmental features that do interact with tone. Therefore, if tone interacts with laryngeal features in a language, we have grounds for claiming tone to also be a laryngeal feature in this language.

Synchronically, segment-tone interactions come in two main types: (1) the blocking of tone spreading by consonants of certain voicing values; and (2) morpheme structure constraints based on co-occurrence restrictions between onsets and tones of the following vowel. Hyman & Schuh (1974) present data from Ngizim, a Chadic language, which illustrate such blocking effects: low tones spread onto a following vowel if the intervening consonant is voiced.[7] If the intervening consonant is voiceless, the spreading is blocked:

(7)	/mùgbá + bái/	→	[mùgbà bái]	*"it's not a monitor"*
	/màarə́m + tə́n/	→	[màarə̀m tə́n]	*"big nose"*
	/šìitá + bái/	→	[šìitá bái]	*"it's not a pepper"*
			*[šìità bái]	

From this example, we can see how the feature [voice] can interact with tones. Here we note that voiceless consonants block low tone spreading; this is the usual direction of interaction. The counterpart to this is when voiced consonants block the spreading of high tones. Sonorants are usually transparent to all types of tone spreading. This transparency of sonorants is consistent with having sonorants underspecified for voicing (Ito & Mester 1989; Lombardi 1991; and Urbanczyk 1992).

The other type of segment-tone interaction that we observe is that of morpheme structure constraints which refer crucially to both tone and a laryngeal feature. The most common type of interaction refers to tone and voicing of the preceding onset, though glottalization and aspiration can also play such a role. In Ewe (Peng 1992), we see co-occurrence restrictions placed on the nouns. Low tones can only follow voiced obstruent onsets, while mid and high tones can follow voiceless onsets and sonorants:

[7]The spreading only occurs if there is a high tone on the vowel following the target vowel.

(8)

	Low Tone	Mid Tone	High Tone
Voiced Onset	vù *fight*	----	----
Voiceless Onset	----	fu *sea*	fú *bone*
Sonorant Onset	----	mo *face*	mɔ *road*

In Lahu (Matisoff 1973), a Sino-Tibetan language, morpheme structure constraints restrict tones based on the voicing, glottalization, and aspiration of the onsets of the syllable:

(9)

Onsets	*Mid Tone*	*High Falling Tone*	*Low Falling Tone*	*Low Tone*
Aspirated Consonants	√	√	X	X
Glottalized Consonants	√	√	√	X
Plain Obstruents	√	√	√	√
Nasals	√	√	√	√
f, š , h	√	X	X	√

When we observe the kinds of segment-tone interactions illustrated in Ngizim, Ewe, and Lahu, we have motivation for claiming the language to have segmental tone.

There are many languages which exhibit no segment-tone interactions. One method for recognizing this is to check the lexicon for co-occurrence restrictions to see that morpheme structure constraints do not crucially refer to both tone and another laryngeal feature. We can see in the following Igbo data (Clark 1990) that all tones are permissible after any onset in a root:

(10)

	Voiced Onset	*Voiceless Onset*	*Sonorant Onset*
High Tone	zụ́ *buy*	čí *close*	-wá *incipient*
Low Tone	bè *ever, yet*	fụ̀ *go out*	wè *pick up*

The other way to test a language for segment-tone interactions is to study tone spreading. We saw that in Ngizim tone spreading is sensitive to the voicing of consonants. If tones can spread past any type of consonant, we can safely conclude that laryngeal features do not interact with tone. In the example below from Shona (Myers 1987), the root has a high tone. The suffixes are underlyingly low-toned (or toneless). The high tone spreads rightward from the root and is not blocked by any type of segment:

(11)(a) ku - téng - á (cf. ku - ereng - a)
inf - BUY - final vowel READ
to buy
(b) ku - téng - és - á
to sell
(c) ku - téng - és - ér - á
to sell to
(d) ku - téng - és - ér - án - á
to sell to each other

Levergood (1987) gives evidence demonstrating that high tone spreading in Arusa, a Nilotic language of Tanzania, is "blocked only by the preceding high tone within the same word. . ." (p.78). The following example shows a high tone spreading past a sonorant and a voiced obstruent:

(12)

n	e	-	m	-	a	-	d	o	l	-	u	→	n	e	-	m	-	a	-	d	o	l	-	u
|			|							|		|			\		\		|								|
H			H								H		H						.		H								

I do not see him coming

No evidence of segment-tone interactions can mean one of two things:

(i) This is a language in which the tone is located in the prosodic structure, attached to the syllable or the mora. Because tone is separated from the laryngeal features, there is no chance for tone to interact with laryngeal features.

(ii) This is a language in which tone is under the laryngeal node but happens not to show interactions with other laryngeal features. Just because tone does not interact with laryngeal features in a particular language, we cannot automatically assume that tone is prosodic. Therefore, negative evidence, where we see no segment-tone interactions, is not a conclusive test.

We have been looking at segment-tone interactions as evidence for segmental tone. It would be natural to turn this process around and use prosody-tone interactions as evidence for prosodic tone. Take for example a language like Mandarin Chinese, where it has been claimed that no neutral-toned syllable can bear stress (Yip 1980)[8]. The stress on a syllable makes reference to the tone. Given the standard assumption that stress is prosodic, here we see an interaction between prosody and tone. If stress' interaction with tone indicates that tone is prosodic, our claim is that stress could not have such an effect on segmental features. This claim becomes a problem when we look at the effect of stress on vowels. In Spokane (Interior Salish), all unstressed vowels are deleted, as seen in the example of reduplication below (Carlson & Flett 1989)[9]:

(13)

p'in	→	p'p'n'p'in'
long objects lying on the ground		*long objects are lying on the ground*

[8]Yip (1980) takes the "neutral tone" to be a an underlying tone with register but no tone specifications. The tone is determined by spreading but the register is determined lexically. Whatever the theoretical assumptions, this tone does contrast with the other tones of the language.

[9]Yip (1980) also claims that tones on unstressed syllables in Shanghai must be deleted. This parallels the Spokane case.

Another example is the familiar rule of English in which unstressed vowels are reduced to [ə]. These cases show stress having an effect on vowel quality. If tone is segmental, there is no reason why stress cannot have a similar effect on "tone quality". Therefore, prosody-tone interaction is not a valid diagnostic for prosodic tone. The reason for this conclusion stems from the type of interaction observed. Interaction between features is not in itself a diagnostic for the features being on the same tier. It is the "passive" interaction of the type we see in spreading and blocking as well as Morpheme Structure Constraints that indicates proximity. "Active" processes, such as the deletion seen above with stress, regularly occur between features of differing tiers and tell us nothing about the organization of the features involved.

The Tone Geometry Parameter predicts certain correlations between the behavior of tone in reduplication and segment-tone interactions:

(14)

	Tone Reduplication	*Tone Non-Reduplication*	*Both Tone Reduplication and Non-Reduplication*
Segment-Tone Interactions	Segmental Tone	Predicted Never to Occur	Predicted Never to Occur
No Segment-Tone Interactions	Cannot Diagnose	Prosodic Tone	Prosodic Tone

This chart lays out what the Tone Geometry Parameter predicts for all possible combinations of segment-tone interactions and tone reduplication. We can see that if a language has segment-tone interactions, it will necessarily reduplicate tone as well. This is because only segmental tone can interact with laryngeal features and segmental tone necessarily reduplicates. If there were a language in which tone interacted with segments but did not reduplicate, the Tone Geometry Parameter would be shown to be incorrect.

The other thing to notice about the predictions laid out in the chart is that if tone is not reduplicated in a language, that language must have prosodic tone. The only unclear case is when tone reduplicates but there is no evidence of segment tone interactions. We cannot tell if tone is segmental or prosodic in such a language based only on these two criteria. In such an instance, tone could be segmental but just happen not to interact with laryngeal features. On the other hand, the tone could actually be prosodic, but the rule of reduplication stipulate that prosodic material be copied.

The last column in the chart, "Both Tone Reduplication and Non-Reduplication," does not refer to inconsistent behavior. A few languages have different rules of reduplication for different word classes. For example, in Mandarin (Yip 1980), classifiers and verbs reduplicate tone while adjectives do not reduplicate tone. Rules of reduplication can differ from each other in whether they specify syllable reduplication or total word reduplication (McCarthy & Prince 1986). Similarly, distinct rules for distinct word classes can differ in whether they specify the copying of prosodic material.

5. Language Facts

To see if this correlation between segment-tone interactions and tone reduplication is held up by the data, let us look at a sample of thirteen different languages selected from six distinct language families (the references for the languages are given in the bibliography and examples of the behavior of each language are given in the appendices):

(15)

Language Family	*Language*	*Reduplicated Tone*	*Segment-Tone Interactions*	*Conclusion*
Austro-Asiatic	Vietnamese	Yes&No	No	Prosodic Tone
Bantu	Kihehe	No	No	Prosodic Tone
	Kinande	No	No	Prosodic Tone
	Shona	No	No	Prosodic Tone
Chadic	Margi	Yes	No	Can't Diagnose
	Ngizim	Yes	Yes	Segmental Tone
Kwa	Akan	No	No	Prosodic Tone
	Ewe	Yes	Yes	Segmental Tone
	Igbo	Yes	Yes	Segmental Tone
	Yoruba	Yes&No	No	Prosodic Tone
Nilotic	Arusa	No	No	Prosodic Tone
Sino-Tibetan	Lahu	Yes	Yes	Segmental Tone
	Mandarin	Yes&No	No	Prosodic Tone

We can see from this chart that the predictions of the Tone Geometry Parameter are borne out. There is an absolute correlation between segment-tone interactions and tone reduplication: if a language has segment-tone interactions it will also reduplicate tone. What is absent in the chart is of equal interest. There are no languages which have segment-tone interactions and fail to reduplicate tone. This is the case that is predicted never to occur and indeed we see no evidence that it does.

Our chart of predictions, filled in with the languages found in the sample, looks like this:

(16)

	Tone Reduplication	*Tone Non-Reduplication*	*Both Tone Reduplication and Non-Reduplication*
Segment-Tone Interactions	4 Ngizim, Ewe, Igbo, Lahu	0	0
No Segment-Tone Interactions	1 Margi	5 Kihche, Kinande, Shona, Akan, Arusa	3 Vietnamese, Yoruba, Mandarin

In terms of the proportion that these languages represent within the sample, we find:

(17)

	Tone Reduplication	*Tone Non-Reduplication*	*Both Tone Reduplication and Non-Reduplication*
Segment-Tone Interactions	31%	0%	0%
No Segment-Tone Interactions	8%	38%	23%

Let us compare these numbers with the numbers expected by chance if segment-tone interactions and tone reduplication were completely independent phenomena:

(18)

	Tone Reduplication	*Tone Non-Reduplication*	*Both Tone Reduplication and Non-Reduplication*
Segment-Tone Interactions	12%	12%	7%
No Segment-Tone Interactions	27%	27%	16%

These numbers are based on the sample taken, so the predictions might not hold universally. However, since these thirteen languages represent six different language families and since there is distinct behavior noted within families, we have reason to be fairly confident of the numbers derived from this sample.

What is important to notice is the discrepancy between predicted and actual percentage of representation. The cases which the Tone Geometry Parameter predicts will never occur should represent close to 20% of the languages. Instead we find 0%. The chance that this would be the case if segment-tone interactions and tone reduplication were not related in any way is 2.2%. This is almost the most significant percentage away from chance as possible. It is ten times more likely that we would have found the configuration predicted by chance. This casts doubt on the hypothesis that segment-tone interactions and tone reduplication are independent processes. In fact, these numbers strongly support the claim that segment-tone interactions and tone reduplication are interdependent just as the Tone Geometry Parameter predicts.

Of possible interest is the fact that only one language, Margi, exhibits tone reduplication without segment-tone interactions, the "Cannot Diagnose" case. Unlike the two cases just noted, this rarity is not predicted by the Tone Geometry Parameter. In terms of what is predicted by chance, this type of case should represent just over one-quarter of the languages. In this group of languages, it represents only 8%. If this is more than an accident of sampling and is a true reflection of the rarity of this type of language, some explanation is in order.

The explanation might lie in an acquisition account. It may be that children "cannot diagnose" where tone is represented in a language that does not provide sufficient clues. If tone reduplication can be accomplished with either segmental or prosodic tone, then tone reduplication by itself is not an indication of how tone is represented. Having segment-tone interactions along with tone reduplication may be preferred because it is a clear signal that tone is segmental. Since knowing how tone is represented is crucial to understanding the phonology of a tone language, children must be provided with enough information to develop a representation of tone appropriate to their language. Combinations of behavior that reinforce each other may therefore be favored in order to ease acquisition of the language.

On the surface, languages like Shanghai Chinese seem to present a problem for the Tone Geometry Parameter. There is evidence of segment-tone interactions in Shanghai in the form of morpheme structure constraints (given in Appendix B). One may be tempted to say that tone does not reduplicate in this language because tones of the base are not seen on the reduplicated affix. A case like Shanghai does not supply evidence for the Tone Geometry Parameter, but neither is it a counter-example.

There is no way to determine if Shanghai reduplicates tone or not. Shanghai has a rule which deletes all tones on non-initial morphemes in compounds and other phonological words (Shen 1987; Selkirk & Shen 1988). Given any two morphemes, only the tones of the first are preserved as shown schematically below:

(19)

HL	+	HL	→	HL
σ		σ		σσ
		+MM'	→	HL
		+LM'	→	HL
		+H	→	HL
		+LM	→	HL

In reduplication, therefore, all tones on the non-initial morpheme are deleted, the tones of the initial morpheme spread, and default low tones are inserted on any remaining syllables. Let us suppose for a moment that tones are not copied. The default low tone will automatically show up on the second morpheme. If, on the other hand, tones are copied in reduplication, they will be deleted and the morpheme will show up on the surface with the default low tone. The only way to recognize if the tones had copied is if there were any evidence of them left behind after deletion. If, for example, the tones of the copied morpheme interacted with the tones of the original morpheme and changed them in a predictable way we would have evidence that the tones had copied. Unfortunately, Shanghai has no tone sandhi that would allow us to detect this. Shen (pc), a native speaker of Shanghai, confirms that there is no way to diagnose whether Shanghai reduplicates tone or not. I therefore assume that tone does copy in reduplication. This is done on purely theoretical grounds since the empirical evidence is inconclusive. The Tone Geometry Parameter predicts that if a language has segment-tone interactions it will also reduplicate tone. Since nothing in Shanghai contradicts this claim, this is the position I am taking.

6. Areas for further investigation

The Tone Geometry Parameter has a number of consequences in the phonology of tone languages. There are two main areas of investigation that need to be pursued in light of the patterns noted in the previous section: (1) research to further define and refine the Tone Geometry Parameter. This includes determining what counts as evidence for the phonological representation of tone in feature geometry. (2) Re-evaluating the tonal phonology of languages in light of the arguments presented here.

Tone stability is an area that has been used in the past to argue for the prosodic nature of tone. It would be interesting if stability effects were only found in languages which otherwise indicate that they represent tone prosodically. However, it does not seem clear that stability effects are strong evidence in any direction. Since tone spreading is a very common process, it would be natural to look at tone stability as a case of tone spreading before deletion of a vowel. In Kirundi, a Bantu language of Burundi, hiatus is resolved by deletion of the first vowel. Goldsmith (1990) claims that the tone of the deleted vowel is preserved and associates to the following vowel[10]:

(20) umugoré + ararima → umugorárima

[10]Goldsmith does not give a gloss for this form. It means something like "that woman hoes".

However, he also notes that word-initial vowels are always underlying toneless. Kirundi could spread tone to toneless vowels as a matter of course. Subsequent deletion may in fact delete the tone along with the vowel, but the tone has already spread to the previously toneless vowel.

Stability effects are seen with other segmental features: nasality and even rounding. This has traditionally been viewed as spreading before deletion. The same could hold of tone. There may actually be true stability of tone, but the evidence would need to be evaluated very carefully to rule out the possibility of spreading and deletion.

The study of secret languages has been an interesting source of evidence to phonologists working on tone. The odd fact about tone in secret languages is that almost without fail, tone is treated as prosodic (Bagemihl 1988). The only exceptions to this come from Thai and Burmese secret languages which actually have a choice. There are two different versions of their secret languages, one in which tone is not moved when the syllable is transposed and one in which tone is transposed along with the segmental material.

(25)[11] duu + nǎŋ → dǎŋ+ nuu
da ŋ+ nŭu

Again, prosodic tone has a choice; it could be transposed or not depending on whether the rule for transposition stipulates that prosodic material is also moved. However, Thai has segment-tone interactions (Gandour 1976), indicating that it has segmental tone. So, the bigger question here is why language games treat all tone as prosodic when other parts of the phonology indicate that tone is segmental.

Alternate modalities of speech such as speech drumming and whistling (Bagemihl 1988) raise the same issue as secret languages. In the drumming and whistling of tone languages, only vowel length and tone are preserved. This seems to point to tone as prosodic. The explanation for the behavior of tone in both secret languages and in alternate speech modalities is likely to be one and the same. There is evidence that these processes occur postlexically. Perhaps very late, metalinguistic treatment of tone reflects the resetting of all languages to prosodic tone. This resetting of the tonal representation might be part of a larger reversion to default values in language games. The processes seen in language games would then reflect unmarked values rather than the marked values utilized by the corresponding natural language.

Other phenomena in language games might then be explained in these terms. For instance, melodic overwriting, such as in Estonian and Kannada language games, employs the unmarked vowel |i|. Prosodic licensing (Ito 1986) is another place to look for marked-to-unmarked shifts since it is often altered from the natural language to the language game. Javanese, for example, does not allow voiced stops in word-final position. However, these same segments are

[11]Thai has five tones: low, mid, high, falling, and rising. The unmarked tone is mid and the | ˇ | notes a rising tone.

licensed in word-final position in Javanese Total Segment Reversal (Bagemihl 1988):

(26) (a) [botjah] *boy* → [hatjob]
(b) [dolanan] *play* → [nanalod]

Licensing, then, follows a more permissive, possibly default, set of requirements in language games. Assuming prosodic tone to be the default and segmental tone to be the marked case, tone in language games would behave like prosodic tone regardless of the geometry of tone in the natural language.

Finally, the Tone Geometry Parameter has implications for the theory of feature geometry. Other proposals have been made which suggest that phonological representations are fixed on a language particular basis (Yip (1990) proposes double dependency of [lateral] and [murmur]; Piggott (1992) suggests that the feature [nasal] can be dominated either by the Soft Palate Node or by the Spontaneous Voicing Node). These are just two examples which counter the notion that dependency relations in feature geometry are universally determined. The goal of feature geometry, however, is to provide a universal explanation for the behavior of languages. We must therefore be careful to constrain the differences allowed individual languages so that the explanatory power of the geometry is not lost.

It is interesting to examine which features have fueled language-specific claims for feature geometry. Manner features have been the most troublesome. It is reasonable to ask if there is something about the class of manner features which disposes it, or even "licenses" it, to vary in the phonological geometry cross-linguistically. Yet even defining how inclusive the class of manner features should be is not straight forward. This question leads us to ask where tone fits into the schema of feature classes. This is one direction to take in looking to give adequate power to feature geometry while continuing to restrain it in order to preserve its explanatory abilities.

7. Conclusion

Some languages reduplicate tone, while others do not. We have seen that the location of tone in the phonological representation makes a prediction about the behavior of tone in reduplication. The presence of segment-tone interactions is also dependent on whether tone is represented under the laryngeal node or in the prosodic structure above the root node. If tone is segmental, it has the chance to interact with laryngeal features. Segmental tone also must copy in reduplication just like any other segmental feature. A theory which allows only for segmental tone cannot account for languages that do not reduplicate tone. On the other hand, a theory providing only prosodic tone gives no explanation for the absolute correlation between segment-tone interactions and tone reduplication. The proposal laid out in this paper, the Tone Geometry Parameter, claims that the location of tone in the phonological representation is fixed on a language particular basis: some languages have segmental tone while others have prosodic tone. The behavior of tone in reduplication is a direct result of this representational difference.

Appendix A
Reduplication[12]

Language Family

Austro-Asiatic

Vietnamese:

(1) Tone reduplication

n o i	→	n o i - n o i	
| |		| | | |	
H M'		HM' HM'	
talk		*keep talking and talking*	

(2) Tone non-reduplication

b ɨ	→	b ɨ b ɨ	
|		| |	
L		H L	
be big		*be very big*	

Bantu

Kihehe:

Tone non-reduplication

(1)

k u - h a: t a	→	k u - h a: t a - h a: t a	
| | | |		| | | | | | |	
H H L		H L L H L	
to ferment		*to ferment a bit*	

(2)

k u - t o v a	→	k u - t o v a - t o v a	
| | | |		| | | | | | |	
H H L		H L L H L	
to beat		*to beat a bit*	

Kinande:

Tone non-reduplication

(1)

o - k u - b o k o	→	o - k u - b o k o - b o k o	
| | | | |		| | | | | | | | |	
M H M H		M H M H M M	
an arm		*a real arm*	

(2)

o - m u - l o n g o	→	o - m u - l o n g o - l o n g o	
| | | | |		| | | | | | | | |	
M M M L		M M M M M L	
a village		*a real village*	

[12]The representation of tones used in this appendix is not meant to make any theoretical claims. It was chosen only for consistency and ease of exposition.

Shona:
Tone non-reduplication

(1)

t-a-famba	→	t-a-famba-famba
L H L		L H L L L
we walked		*we keep walking*

(2)

ku-simuka	→	ku-simuka-simuka
L H H H		L H H H L L L
to stand up		*to keep getting up all the time*

Chadic

Margi:
Tone reduplication

(1)

pərda	→	pərda-pər da
H H		H H H H
sinew; tendon		*sinewy piece of meat*

(2)[13]

mə mu̱	→	məmə- mə mu̱
L L		L L L L
honey		*corn disease*

Ngizim:
Tone reduplication

(1)

gənu	→	gənanu
L H		L L H
get		*go around getting*

(2)

ɓəru	→	ɓaɓəru
L H		L L H
separate		*peel off*

Kwa

Akan:
Tone non-reduplication

(1)

kasa	→	kasa-kasa
L H		L H L L
speak		*speaking a lot*

[13]In Margi [u̱] is an allophone of [ə]. The phoneme is [ə] and the [u̱] only shows up word-finally.

(2)

p a m	→	p a m - p a m
| |		| | | |
L H		L H L L
drive away		*driving away often*

Ewe:
Tone reduplication
(1)

a s i	→	a s i - a s i
| |		| | | |
M H		M H M H
hand		*hand by hand; easily*

(2)

a k ɔ m e	→	a k ɔ m e - a k ɔ m e
| | |		| | | | | |
M H M		M H M M H M
near one's body		*closer and closer to one's body*

Igbo:
Tone reduplication
(1)

i - k w e	→	o - k w u - k w e
| |		| | |
H H		L H H
to agree		*agreeing*

(2)

i - b i	→	o - b i - b i
| |		| | |
H L		L L L
to print		*printing*

Yoruba:
(I) Tone reduplication

w o l e	→	w o l e - w o l e
| |		| | | |
M H		M H M H
lookhouse		*sanitary inspector*

(2) Tone non-reduplication

ọ k u n r i n	→	ọ k u n r i n - k u n r i n
| | |		| | | | |
M L M		M L M L L
man		*even men*

Nilotic

Arusa:
Tone non-reduplication
(1)

r a	→	i - r a - r a
|		| | |
H		H H L
you are		*you all are*

(2)

i š u	→	i - i š u - š u
| |		| | | |
H H		H H H L
you finish it		*you all finish it*

Sino-Tibetan

Lahu;
Tone reduplication

(1)

m a	→	m a - m a
|		| |
H		H H
be numerous		*very much*

(2)

q ɛ	→	q ɛ q ɛ
|		| |
L		L L
be wide		*be very wide*

Mandarin:

(1) Tone reduplication

z h a n g	→	z h a n g - z h a n g
|		| |
H		H H
sheet		*every sheet*

(2) Tone non-reduplication

h a o	→	h a o - h a o - r - d e
| |		| | | |
LM		LM H H
good		*vividly good*

Shanghai:

Tone reduplication[14]

t s a ʔ	→	t s a ʔ t s a ʔ
|		| |
H		H H
		t s a ʔ t s a ʔ
		| |
		H L

[14]I have noted that Shanghai reduplicates tone because of purely theoretical asssumptions. Because of the structure of Shanghai, there is no way to determine if tone is reduplicated or not. Since Shanghai has segment-tone interactions, the Tone Geometry Parameter predicts it must reduplicate tone. I have assumed that it does, despite the subsequent deletion of all tones on the non-initial morpheme. See footnote 6 in the body of the paper for discussion.

Appendix B
Segment-Tone Interactions

Chadic

Ngizim:

/mùgbá + bái/	→	[mùgbà bái]	*"it's not a monitor"*
/màarám+ tán/	→	[màaràm tán] /	
šìitá + bái/	→	[šìitá bái]	*"it's not a pepper"*
		*[šìità bái]	

Kwa

Ewe:

	Low Tone	Mid Tone	High Tone
Voiced Onset	vù *fight*	----	----
Voiceless Onset	----	fu *sea*	fú *bone*
Sonorant Onset	----	mo *face*	mɔ́ *road*

Sino-Tibetan

Lahu:

Onsets	*Mid Tone*	*High Falling Tone*	*Low Falling Tone*	*Low Tone*
Aspirated Consonants	√	√	X	X
Glottalized Consonants	√	√	√	X
Plain Obstruents	√	√	√	√
Nasals	√	√	√	√
f, š, h	√	X	X	√

Shanghai:

Tone	*Co-occurence Restrictions*
High Falling	Only after voiceless onsets
Mid Rising	Only after voiceless onsets
Low Rising	Only after voiced onsets
High (short)	Only after voiceless onset with glottal stop coda
Low (short)	Only after voiced onset with glottal stop coda

References

Akinlabi. A. (1984) *Tonal Underspecification and Yoruba Tone* Doctoral dissertation, University of Ibadan.

Ansre, G. (1962) "Reduplication in Ewe," Journal of African Languages 1.3, 128-132.

Archangeli, D., and D. Pulleyblank (1986) "The content and structure of phonological representations", ms., University of Arizona and University of Southern California.

Bagemihl, B. (1988) *Alternate Phonologies and Morphologies* Doctoral dissertation, University of British Columbia.

Bao, Z. (1989) "On the nature of contour tones," Linguistic Society of America conference, Washington.

Bao, Z. (1990) *On the Nature of Tone* Doctoral dissertation, MIT.

Carlson, B. and P. Flett (1989) *Spokane Dictionary* University of Montana Occasional Papers in Linguistics No. 6.

Clark, M. (1990) *The Tonal System of Igbo* Foris Publications, Dordrecht.

Cole, J. (1987) *Planar Phonology and Morphology* Doctoral dissertation, MIT.

Dembetembe, N. (1978) "Reduplication in Shona and its semantic effects," Proceedings of the Second African Languages Congress of Unisa, in E. Baumbach, ed., University of South Africa, Pretoria.

Duanmu, S. (1990) *A Formal Study of Syllable, Tone, Stress, and Domain in Chinese Languages* Doctoral dissertation, MIT.

Gandour, J. (1976) "Aspects of Thai tone," UCLA Working Papers in Phonetics 33, pp. 20-22.

Goldsmith, J. (1976) *Autosegmental Phonology* Doctoral dissertation, MIT.

Halle, M. and K. Stevens (1971) "A note on laryngeal features," RLE Quarterly Progress Report 101, pp. 198-213.

Hoffmann, C. (1963) *A Grammar of the Margi Language* Oxford University Press, London.

Hombert, J. (1978) "Consonant types, vowel quality, and tone," in *Tone: A Linguistic Survey* Victoria Fromkin, ed., Academic Press, New York, 77-111.

Hombert, J.; J. Ohala, and W. Ewan (1979) "Phonetic explanations for the development of tones," Language 55.1, 37-58.

Hyman, L. (1989) "Register and tone in tonal geometry," in Snider & van der Hulst (eds.) *The Representation of Tonal Register*, Dordrecht: Foris.
Hyman, L. M., and R. G. Schuh (1974) "Universals of tone rules: evidence from west Africa," Linguistic Inquiry 5.1, 81-115.
Ito, J. (1986) *Syllable Theory in Prosodic Phonology* Doctoral dissertation, University of Massachusetts, Amherst.
Ito, J. and A. Mester (1989) "Feature predictability and underspecification: palatal prosody in Japanese mimetics," Language 65.2, 258-293.
Kenstowicz M., and C. Kisseberth (1979)*Generative Phonology* Academic Press, San Diego.
Kingston, J., and R. Diehl (1992) "Phonetic knowledge and explanation: an essay on the nature of phonetic categories" ms., University of Massachusetts, Amherst and University of Texas, Austin.
Kingston, J., and D. Solnit (1988) "The tones of consonants" ms., Cornell University and University of Michigan at Ann Arbor.
Leben, W. (1973) *Suprasegmental Phonology* Doctoral dissertation, MIT.
Leben, W. (1978) "The representation of tone," in V. Fromkin, ed., *Tone: A Linguistic Survey*, Academic Press, New York, 177-219.
Lee, B. (1984) "A study on the autosegmental tiers through Akan reduplication," ms., University of Texas, Austin.
Lombardi, L. (1991) *Laryngeal Features and Laryngeal Neutralization* Doctoral dissertation, University of Massachusetts, Amherst.
Maddieson, Ian, ed.(1974) The Tone Tome: UCLA Working Papers in Phonetics 27.
Marantz, A. (1982) "Re Reduplication," Linguistic Inquiry 13.3, 435-481.
Matisoff, J. A. (1970) "Glottal dissimilation and the Lahu high-rising tone: A tonogenetic case study," Journal of the American Oriental Society 90, 13-44.
Matisoff, J. A. (1973) *The Grammar of Lahu* University of California Press, Berkeley.
McCarthy, J. (1992) "Structure Preservation in Chaha," Class notes, University of Massachusetts, Amherst.
McCarthy, J., and A. Prince (1986) "Prosodic morphology" ms., University of Massachusetts, Amherst and Brandeis University.
McCarthy, J., and A. Prince (1988) "Quantitative transfer in reduplicative and templatic morphology," in Linguistic Society of Korea (ed.), *Linguistics in he Morning Calm* 2, Hanshin Publishing Co., Seoul, pp. 3-35.
McCarthy, J., and A. Prince (1990) "Foot and Word in Prosodic Morphology: The Arabic Broken Plural," Natural Language and Linguistic Theory 8, 209-283.
Mutaka, N. (1990) *The Lexical Tonology of Kinande* Doctoral dissertation, University of Southern California.
Mutaka, N., and L. Hyman (1990) "Syllables and morpheme integrity in Kinande reduplication," Phonology 7, 73-119.
Myers, S. (1987) *Tone and the Structure of Words in Shona* Doctoral dissertation, University of Massachusetts, Amherst.
Newman, P. (1986) "Reduplicated nouns in Hausa," Journal of African Languages and Linguistics 8, 115-132.
Odden, D. (1981) *Problems in Tone Assignment in Shona* Doctoral dissertation, University of Illinois at Champaign-Urbana.
Odden, D., and M. Odden (1985) "Ordered reduplication in Kihehe," Linguistic Inquiry 16.3, 496-503.

Peng, L. (1992) "Voice asymmetry in Ewe nouns," Conference on African Linguistics.
Piggott, G. (1992) "Variability in feature dependency: the case of nasality," Natural Language and Linguistic Theory 10.1, 33-77.
Poser, W. (1981) "On the directionality of the tone-voice correlation," Linguistic Inquiry 12.3, 483-488.
Pulleyblank, D. (1986) *Tone in Lexical Phonology* Kluwer Academic Publishers, Dordrecht.
Ross, M. D. (1992) "Tonogenesis in the North Huon Gulf chain," ms., Australian National University.
Sagey, E. (1986) *The Representation of Features and Relations in Non-Linear Phonology* Doctoral dissertation, MIT.
Schon, J. (1862) *Grammar of the Hausa Language* Church missionary House, London.
Schuh, R. (1981) *A Dictionary of Ngizim* University of California Press, Berkeley.
Shattuck-Hufnagel, S. and D. Klatt (1979) "The limited use of distinctive features and markedness in speech production: evidence from speech error data," Journal of Verbal Learning and Verbal Behavior 18, 41-55.
Steriade, D. (1982) *Greek Prosodies and the Nature of Syllabification* Doctoral dissertation, MIT.
Steriade, D. (1988) "Reduplication and syllable structure," Phonology 5, 73-155.
Surintramont, A. (1973) "Some Aspects of Underlying Syllable Structure in Thai: Evidence from Khamphuan--A Thai Word Game," Studies in the Linguistic Sciences 3.1, 121-141.
Thompson, L. C. (1965) *A Vietnamese Grammar* University of Washington Press, Seattle.
Urbanczyk, S. (1992) "Representing glottalized sonorants," CLS 28.
Welmers, W. (1973) *African Languages Structures* University of California Press, Berkeley.
Yip, M. (1980) *Tonal Phonology in Chinese* Doctoral dissertation, MIT.
Yip, M. (1989) "Contour tones," Phonology 6.1.
Yip, M. (1990) "Two cases of double-dependency in feature geometry," ms. Brandeis University.