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Trochaic Feet in Spontaneous Spoken Southern Min*

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Poetry and constructed examples suggest that Taiwan Southern Min (Taiwanese) has trochaic (binary, left-headed) feet. The present study provides new evidence from a large corpus of spontaneous spoken Southern Min. First, disyllabic word size is the most productive size: rare words (including coinages) are most likely to be disyllabic. Second, when discourse markers are repeated for emphasis, odd-numbered repetitions are significantly favored, yielding a strong-final (hence emphatic) line. Third, in speech contexts with a higher proportion of disyllabic words, speakers are more likely to choose the disyllabic form of variable-size words. Together our results suggest that trochaic feet play an active role in spontaneous Southern Min speech.

0. Introduction

Morphemes in Sinitic languages are almost always monosyllabic, and since Chinese characters are almost always monomorphemic, they almost always represent monosyllables as well. Nevertheless, linguists have collected considerable evidence that larger prosodic constituents also play a key role in Sinitic phonology, in particular trochaic (binary, left-headed) feet. Evidence for such constituents has been found in Sinitic languages as distantly related as Mandarin (e.g., Duanmu 2007) and Southern

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Min (e.g., Hsiao 1991), and since evidence even exists for classical Chinese (e.g., Feng 1998, Duanmu 1999), trochaic feet are likely to be a feature of all modern Sinitic languages.

The bulk of this evidence comes from dictionary data and poetry, with additional evidence (mostly for Mandarin) from informal native-speaker intuitions, speech corpora, and experiments. After reviewing this evidence in section 1, we discuss new evidence for trochaic feet in Taiwan Southern Min (Taiwanese), based on statistical analyses of a large corpus of spontaneous speech (almost one million word tokens). In section 2 we show that the disyllabic word size is the most productive prosodic size in Southern Min, that emphatic repetitions of discourse markers conform to a trochaic pattern, and that Southern Min speakers adjust the prosodic size of words depending on the speech context. As we conclude in section 3, our study not only confirms that trochaic feet play an active role in natural speech in Southern Min, but also offers a variety of new analytical techniques that could readily be applied to studying prosody in other languages.

1. Trochaic feet in Sinitic languages

Trochaic feet are prosodic constituents of two equal-weight elements (e.g., syllables), with greater prominence on the first (which may be realized as stress), forming a strong-weak (SW) pattern. Despite the lack of clear stress contrast in Sinitic, evidence for trochaic feet in this language family is still available from a wide variety of sources.

It has long been observed that words in modern Mandarin tend to be disyllabic (around 70% of the vocabulary, as estimated by Zhou and Marslen-Wilson 1995). For example, native place names are almost always disyllabic, even newly coined ones (e.g., 新北(市) for New Taipei (City)), and given names are either disyllabic or, when monosyllabic, combined with the family name to form a disyllable (e.g., 蔡素娟 may be called 素娟, but 麥傑 would tend to be called 麥傑). The disyllabic tendency is productively maintained by operations that expand monosyllables via empty morphs (e.g., 桌 ~ 桌子) or reduplication (e.g., 哥 ~ 哥哥), or that delete contextually redundant morphemes (e.g., 羊 ~ 山羊); following Guo (1938), Duanmu and colleagues (Duanmu

1999, 2013, Duanmu and Dong 2015, forthcoming) call such words "elastic". Even multisyllabic words can be contracted to disyllables (e.g., 葡萄牙語言 ~ 葡語; Myers, 2012a). This disyllabic tendency is already observable in classical Chinese (Duanmu 1999, Duanmu and Dong forthcoming), suggesting that the ancestors of all modern Sinitic languages already had disyllabic feet (though Feng 1998 argues that in the very oldest texts, prosodic binarity involved moras, with heavy syllables able to form feet on their own).

Disyllabic feet also help explain tone sandhi in languages as otherwise different as Mandarin (Shih 1986, 1997) and Southern Min (Hsiao 1991). For example, even though native Mandarin speakers prefer to apply Tone 3 sandhi to 找 in both forms in (1) (based on Shih 1997:96), only in (1b), where 找 ends a disyllabic word, is it also possible to not apply it, suggesting that this disyllabic word forms a foot and that tone sandhi is optional across foot boundaries. Failure to apply tone sandhi in (1a) is more awkward because the monosyllabic first word cannot form a foot on its own, forcing it to become prosodically attached to the following word and making tone sandhi obligatory. Because the resulting trisyllabic foot would be formed recursively, Shih calls it a super-foot.

(1)	a.	*zhao3 yan3-jing4	*(找)(眼鏡)	cf.	zhao[2] yan3-jing4
	b.	xun2-zhao3 yan3-jing4	(尋找)(眼鏡)		

Traditional sources of evidence also suggest that binary feet in Sinitic languages are trochaic (left-headed). This is most obvious in the rare cases where stress contrasts are unambiguous, as with the distribution of toneless (unstressed) syllables. Thus in standard varieties of Mandarin, empty suffixing morphs are toneless (e.g., 桌子) while empty prefixing morphs are fully toned (e.g., 阿明). In varieties with productive tone reduction processes, the trochaic structure is sometimes quite clear, as in the contrast between 知道 (zhi1dao0) 'know' and 不知道 (bu4zhi0)dao4 'wonder'. Even in Taiwan Mandarin, which like Southern Min stresses almost all syllables at least to some degree, reduplicated forms are audibly left-headed (e.g., 姊姊 jie3jie0; Sproat and Shih 1993).

Poetry also reflects trochaic rhythm (with morphosyntactic complications: Hsiao 1991, 2007, Duanmu 2004; Duanmu 2007 makes related observations about the ordering of mono- and disyllabic constituents within Mandarin compounds). Hsiao (2007) discusses the particularly striking example of Southern Min nursery rhymes, which are chanted with claps on the strong syllables. Moreover, these rhymes tend to have odd-numbered lines, because, with trochaic feet, odd-numbered lines end on a strong syllable, as illustrated in (2) (based on Hsiao 2007:92, using his romanization). The "x" here represents an empty syllable, which has the effect of making the final spoken syllable feel more prominent.

(2) (烏 貓) (穿 裙) (無 穿) (褲 x)
o niao tsheng kun bo tsheng kho
black cat wear skirt not wear pants
'The black cat wears a skirt but wears no pants'

Traditional linguistic evidence has its limitations (Ohala 1986; Myers, 2012b): dictionary analyses may mistake fossilized patterns as productive, informal native-speaker judgments may be noisy or biased, and analyses of poetry may confuse natural grammar with poetic convention. Nevertheless, trochaic feet in Sinitic are also supported by evidence from corpus analyses and experiments.

In two independent corpus analyses of Mandarin speech, Kochanski et al. (2003) (a single speaker reading texts) and Tseng et al. (2005) (sixty speakers reading texts) modeled fundamental frequency (and also duration, in the case of Tseng et al.) in terms of various parameters, including prosodic constituents. Both found that for proper statistical fit, it was necessary to include constituents intermediate in size between the syllable and the prosodic phrase (metrical feet in the case of Kochanski et al., prosodic words in the case of Tseng et al.). The model of Kochanski et al. (2003) even included explicit parameters for the contrast between strong and weak syllables within words (affecting the faithfulness of tone contours to their lexical templates). This allowed them to discover that not only do disyllabic words show a statistically robust strong-weak (SW) pattern, but four-syllable words show a (SW)(sw) pattern, with the first

trochaic foot itself stronger than the second. Though the authors do not use the term, this recursively formed structure is akin to the notion of super-foot introduced in Shih (1986).

There are very few experimental studies on prosodic constituents in Sinitic speech (e.g., syllables: O'Seaghdha et al. 2010; prosodic words: Chiu 2005), but among them are studies by Perry and colleagues on metrical feet. One of these (Perry et al. 2006) suggests there are differences in prosodic processing across Sinitic languages: using a syntactic disambiguation task, the researchers found that Mandarin speakers are more biased towards disyllabic constituents than Cantonese speakers. Even more intriguing is the study by Perry and Zhuang (2005), which asked how speakers choose between the monosyllabic (e.g., 羊) and disyllabic form (e.g., 山羊) of elastic words (though the authors do not use this term). Participants were asked to name objects shown in a series of pictures. When the list consisted solely of objects with elastic names, speakers tended to choose the monosyllabic name, but when mixed with non-elastic words of a fixed disyllabic size (the authors give no examples, but could have included words like 蘋果), speakers more often chose the disyllabic version of the elastic words. As the authors note, in addition to showing that metrical feet are mentally active during Mandarin speech production, these findings also seem to pose a challenge to the highly influential model of word production advocated in Levelt et al. (1999), which claims that the selection of the lemma (the syntactic/semantic core of a word) is complete before phonological processing begins. If the alternative forms of an elastic word have separate lemmas, this model predicts that it should be impossible for prosodic context to prime the choice between them. The obvious solution (suggested in Myers 2012a) is to suppose that elastic variants share a single lexical "lemma" (in scare quotes since this may go beyond Levelt et al.'s notion) that is modified, by expansion to a disyllable or reduction to a monosyllable, during phonological processing.

While the evidence for trochaic feet in Sinitic seems robust, none of the previous studies looked at spontaneous speech (not even the Mandarin corpus studies), and there have also been hints that Sinitic languages may differ somewhat in prosodic processing. Our study aims to address these points by looking at spontaneous speech in Southern Min.

2. Trochaic feet in spontaneous spoken Southern Min

Our data source is our own CCU Taiwanese Spoken Corpus (國立中正大學臺灣閩南語口語語料庫: Tsay and Myers 2015; Ruan et al. 2012), available online at http://lngproc.ccu.edu.tw/SouthernMinCorpus/. The corpus consists of transcriptions of spontaneous conversations from radio chat shows broadcast in Chiayi and Yunlin counties, transcribed in 本字 (where they exist) and otherwise in the romanization system of the Ministry of Education (MOE), Taiwan (Ministry of Education 2008). Word segmentation mostly follows the Academia Sinica Balanced Corpus of Mandarin (Tsay 2007; Huang et al. 1997). Based on these segmentations, our corpus has 921,875 word tokens, almost the size of the classic English corpus of Kučera and Francis (1967). Most of the speech is in Southern Min (805,074 word tokens, over 85% of the total), but there is also some code-switching into Mandarin, English and other languages.

Unlike the corpus analyses of Kochanski et al. (2003) and Tseng et al. (2005), we do not rely on acoustic parameters like F0 or duration to test for trochaic feet. Instead, we address three novel questions that are answerable using the transcriptions themselves. In section 2.1, we ask whether the disyllabic word size is not merely the most common Southern Min size, as observed for Mandarin by Zhou and Marslen-Wilson (1995), but also the most productive. In section 2.2, we ask whether the emphatic repetition of discourse markers obey metrical constraints, similar to those observed by Hsiao (2007) in Southern Min nursery rhymes. In section 2.3, we ask whether the choice of monosyllabic versus disyllabic elastic word size is primed by prosodic context in spontaneous Southern Min speech, similar to what Perry and Zhuang (2005) found in their Mandarin picture naming experiment.

2.1 The productivity of disyllables

While there is obviously a connection between the number of existing words in some lexical class and the synchronic productivity of that class (see, e.g., Yang 2005), productivity and class size are not identical concepts. Thus the fact that Sinitic lexicons are dominated by disyllabic words does not, by itself, prove that speakers coin disyllabic words more readily than words of other sizes.

Baayen and Renouf (1996) suggest a simple way to quantify the potential coinage rate of a lexical class: count the number of words in that class that are hapax legomena, that is, words that appear exactly once in the corpus. The higher the ratio of hapax legomena in the class as a proportion of all hapax legomena in the corpus, the more productive that class should be. According to this measure, by far the most productive prosodic word class in our Southern Min speech corpus is that of disyllabic words (ratio .50), followed by trisyllabic words (ratio .30), monosyllabic words (ratio .10), and four-syllable words (ratio .07).

Another way to measure the same contrast in relative productivity is to plot what Baayen and Renouf call growth curves, by counting the number of tokens (individual instances) of a given word size in increasingly larger samples of the corpus and plotting them against the number of types (distinct lexical entries). As shown in Figure 1, the growth curve for disyllabic words far outstrips all of the others not only in overall height in the graph (reconfirming that most Southern Min word types are disyllabic), but also in slope: the steepness of the disyllabic growth curve shows that even if we were to continue to transcribe further Southern Min conversations, new word types (potential coinages) would continue to appear. By contrast, the much flatter slopes for monosyllabic and four-syllable words suggest that they may be reaching their full quota; the slope for trisyllabic words, like the hapax legomena ratios, suggests a productivity level above these but below disyllabic words.

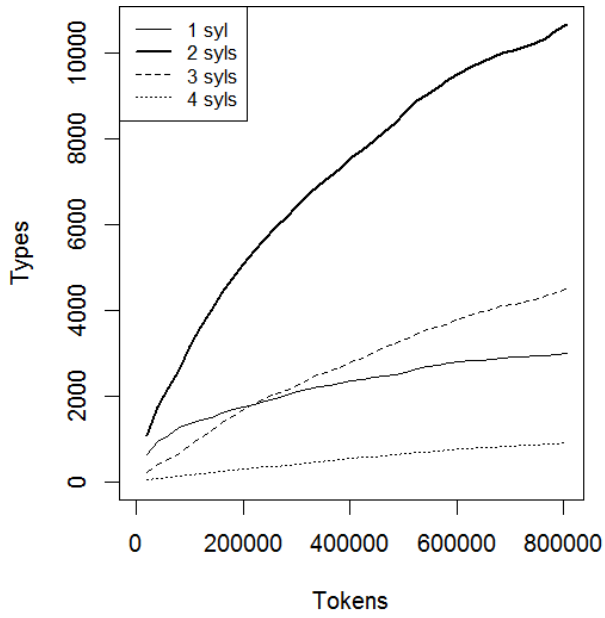

Figure 1. Productivity growth curves for Southern Min words of various sizes

There may be other ways to explain these productivity differences without reference to metrical feet. For example, monosyllabic words are monomorphemic, and in all languages it is harder to coin morphemes than polymorphemic words; Southern Min phonotactics also restricts the creation of new syllables. The relative productivity of the other three sizes conforms to a general economy principle favoring shorter words (we return to this principle in the next section). Nevertheless, in the context of all of other evidence, reviewed above and introduced below, it is clear that the high productivity of disyllables is just what one would expect if trochaic feet were favored in Southern Min.

2.2 The metrics of discourse markers

Speakers use discourse markers to signal information about the discourse itself, rather than its content, for example when Mandarin speakers interpose 「對!」 in a conversation just to show that they are following what the other speaker is saying, even if they do not necessarily agree. Some discourse markers may be repeated for emphasis

(e.g.,「對對對!」). This is not specific to Sinitic languages: English speakers can also interpose "Right! " or "Right, right!" for the same discourse reasons.

Interestingly, when Sinitic speakers repeat discourse markers, they seem to favor odd-numbered repetitions. Mandarin-speaking readers can ponder their own intuitions about the utterances below, but our impression is that the odd-numbered repetitions in (3a,c,e) sound more natural than the even-numbered repetitions in (3b,d,f). Informal intuitions also suggest that fewer repetitions are favored over longer ones: consistent with the economy principle mentioned in the previous section, (2a) seems to be used more often than (2c), which in turn seems to be more common than (2f).

(2) a. 對! b. 對對!
c. 對對對! d. 對對對對!
e. 對對對對對! f. 對對對對對對!

If these intuitions are valid, repetitions of this Mandarin discourse marker obey the same generalization noted by Hsiao (2007) for Southern Min nursery rhymes, suggesting that the explanation may be the same as well: speakers mark emphasis on the discourse marker by making sure that its repetition ends on a strong syllable. Odd-numbered repetitions can only ensure this, however, if the syllables are grouped into trochaic feet, as illustrated in (4).

(4) a. (對 x)
b. (對對)(對 x)
c. (對對)(對對)(對 x)

These claims can be tested quantitatively in our corpus of Southern Min, which has the similarly repeated discourse marker 著 /tiəʔ^{4}/ 'right'. We counted all instances (filtering out other uses of this morpheme) in repetitions from one to an astounding ten syllables. We then analyzed these ten values using Poisson regression (for count data) in two separate models, to see which fit the data better. One model contained only a variable representing the length of the repetition in syllables and its square (to allow the length effect to be nonlinear), and the other included these length variables plus a

variable representing whether the length was even or odd, along with an interaction between length and oddness (to allow for the oddness effect to vary in strength depending on length). The oddness variable reflects the effect of trochaic feet, so in the discussion below we call the model including this variable the model with feet, and the simpler one the model without feet.

Figure 2 shows the results, transforming the count values into a base-10 log scale (so "0" represents 1 because $10^0 = 1$, "1" represents $10^1 = 10$, "2" represents $10^2 = 100$, and so on); this scale squeezes the high counts (e.g., 5,774 for one-syllable forms) and low counts (e.g., 1 for ten-syllable forms) into one readable graph (Poisson regression assumes a log scale anyway). The graph shows that both models capture the nonlinear drop in counts for increasingly longer repetitions, but the model with feet fits the observed data significantly better (by a likelihood ratio test: $\chi^2(3) = 1321.2$, $p < .0001$). In fact, it fits the data almost perfectly, at least up until the repetitions of over six syllables, where there is insufficient data (only 13 tokens). This with-feet model shows a significant effect of the preference for shorter repetitions ($B = -0.41$, $SE = 0.09$, $z = -4.53$, $p < .0001$) and its nonlinearity ($B = -0.05$, $SE = 0.01$, $z = -4.25$, $p < .0001$), the preference for odd-numbered repetitions ($B = 1.83$, $SE = 0.14$, $z = 12.86$, $p < .0001$) and its interaction with both linear and nonlinear components of the length effect ($B = -0.57$, $SE = 0.09$, $z = -6.25$, $p < .0001$; $B = 0.05$, $SE = 0.01$, $z = 3.60$, $p < .001$). These interactions imply that the oddness effect weakens as length increases, though this may be due to the paucity of data on repetitions over six syllables long. Interestingly, nine-syllable repetitions are still more common (four tokens) than their even-numbered neighbors (one token each for eight- and ten-syllable repetitions).

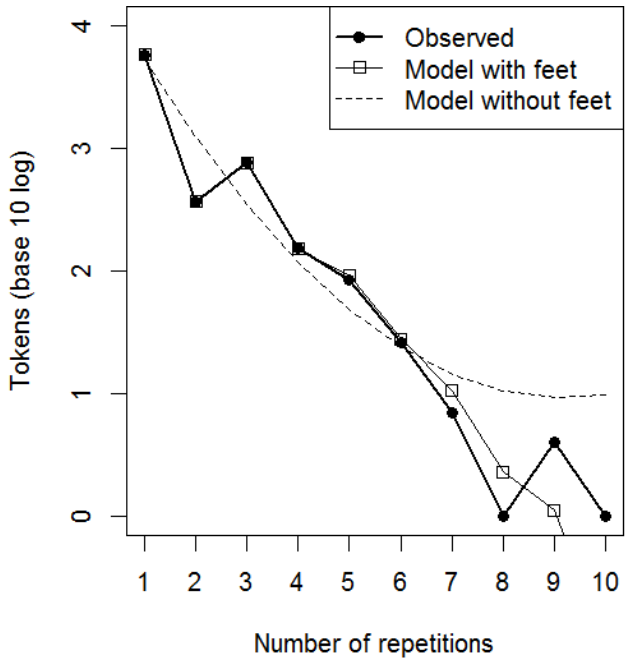

Figure 2. Modeling preferences for fewer, odd-numbered repetitions of 著

The ability of regression models to disentangle variables (here, the oddness effect, which we ascribe to metrical structure, and the length effect, presumably due to a general economy principle) suggests that they might also help deal with one of the limitations of poetry-based evidence, namely the difficulty of disentangling grammar from poetic convention. Thus we applied the same without-feet and with-feet models to the counts of Southern Min nursery rhyme line lengths reported in Hsiao (2007:88); length was again treated as nonlinear, and the with-feet model tested for an interaction between length and oddness. The results are illustrated in Figure 3. Again the model with feet had a much better fit ($\chi^2(3) = 1481$, $p < .0001$), with significant linear and nonlinear effects of length ($B = 1.84$, $SE = 0.07$, $z = 26.63$, $p < .0001$; $B = -0.18$, $SE = 0.01$, $z = -28.26$, $p < .001$) and a significant preference for odd-numbered lines ($B = 1.09$, $SE = 0.18$, $z = 6.02$, $p < .001$). Instead of an economy effect on length, however, there was a preference for medium-length lines, with five-syllable lines being ideal. Moreover, the model seriously overestimated the number of expected one-syllable lines,

which are in fact virtually absent from Hsiao's corpus (only one token). It appears that this mismatch and the nonlinear length pattern are due to poetic convention. Nevertheless, as Hsiao observed, the oddness pattern remains quite robust: even in poetry, grammar still contributes its preference for trochaic feet. Interestingly, unlike our natural-speech data, there is no interaction between the length and oddness effects (*p*s > .4), consistent with the notion that grammar and poetic convention should operate in distinct mental domains.

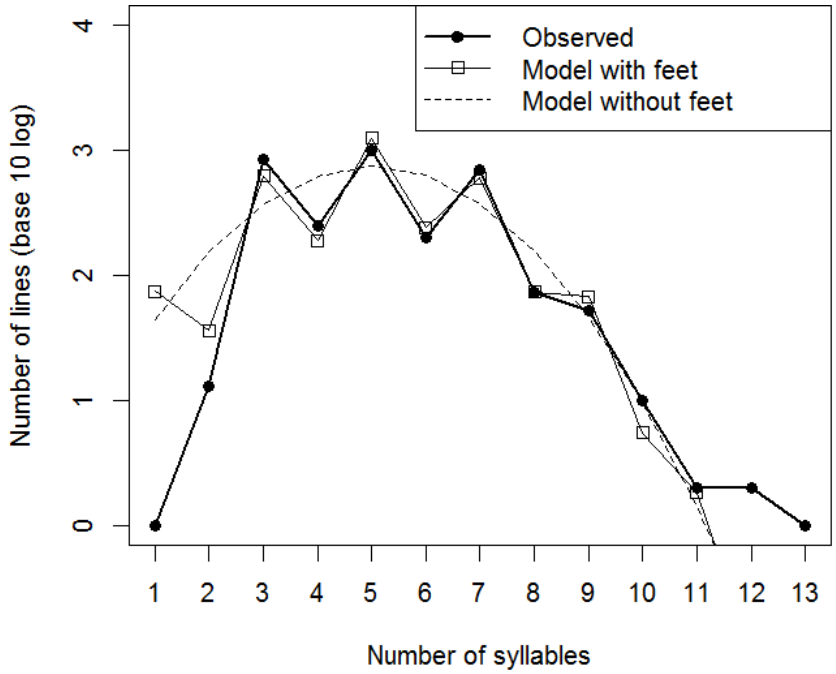

Figure 3. Combined effects of poetic convention (dashed line) and metrical structure

If Southern Min grammar insists on trochaic feet, we expect such feet to constrain the repetitions of other discourse markers as well. Here we examine just one other, namely 好 /hə^{53}/ 'OK'. As illustrated in Figure 4, the results are essentially the same as for 著: a preference for odd-numbered repetitions (*B* = 1.06, *SE* = 0.13, *z* = 7.98, *p* < .0001) overlaid on a nonlinear preference for shorter repetitions (*B* = -3.58, *SE* =

0.33, z = -10.77, p < .0001; B = 0.35, SE = 0.07, z = 5.38, p < .0001); there was insufficient data to test for an interaction.

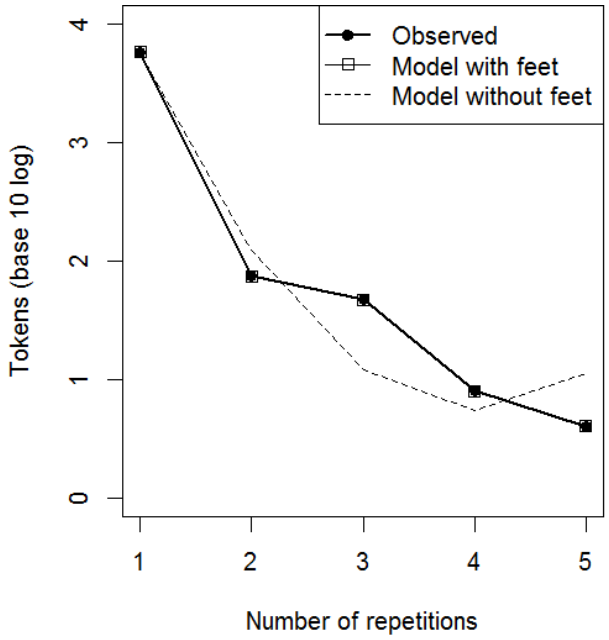

Figure 4. Modeling preferences for fewer, odd-numbered repetitions of 好

Not all discourse markers in Southern Min are monosyllabic, however. Should we expect a preference for odd-numbered repetitions when 著 is followed by an unstressed particle (transcribed in our corpus as a0 or la0)? On the one hand, such a disyllabic discourse marker will form a trochaic foot on its own, making it impossible to end on a strong syllable. But on the other hand, we have already seen evidence from Kochanski et al. (2003) that in Mandarin read speech, four-syllable words supplement the strong-weak pattern of each binary foot with a higher-level strong-weak super-foot pattern (i.e., (SW)(sw)). Thus it may be that speakers prefer to repeat even binary feet an odd number of times, so that the final foot, as a whole, is strong (e.g., (SW)(sw)(SW)(xx) where 'xx' represents an empty foot).

As illustrated in Figure 5, our data do indeed suggest a preference for ending repetitions on strong feet, as confirmed by the with-feet model (more precisely, with super-feet), with significant effects for oddness (B = 0.48, SE = 0.17, z = 2.82, p < .01) and length (though only linear this time: B = -3.44, SE = 1.09, z = -3.16, p < .001); there was again insufficient data to test for an interaction.

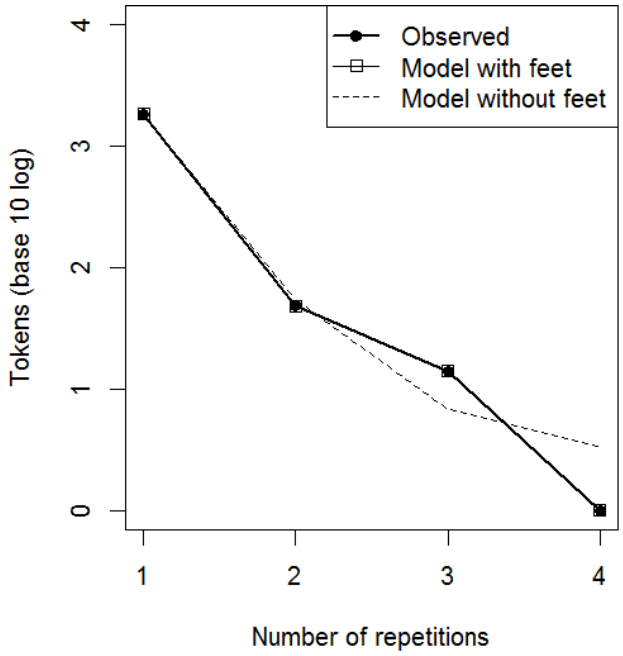

Figure 5. Modeling preferences for fewer, odd-numbered repetitions of 著 + particle

This robust preference for odd-numbered repetitions and poetic lines may potentially have some explanation other than trochaic (super-)feet, but unlike the case with disyllabic productivity, it is hard to imagine what it would be.

2.3 Priming elastic words

The results of Perry and Zhuang (2005) suggest that Mandarin speakers are primed by prosodic context when they choose between the monosyllabic and disyllabic forms of elastic words (e.g., 羊 ~ 山羊). Although their observations took place in an

artificial experimental setting, spontaneous speech is also subject to contextual priming effects, including lexical, syntactic, and prosodic priming (Pickering and Ferreira 2008).

To test whether the speakers in our Southern Min corpus were affected by prosodic context in their production of elastic words, we first selected a set of one hundred elastic words, where both variants appear in the corpus (with the help of Southern-Min-speaking laboratory assistants and Mandarin examples in Duanmu 2013, Duanmu and Dong 2015, and Duanmu and Dong forthcoming). We defined prosodic context as the proportion of disyllables in the string of ten words uttered just before an elastic word, whether or not they were produced by the same speaker as the elastic word itself (though they usually were). Eliminating strings containing code-switching left only 228 usable tokens, involving the 53 elastic words ("lemmas") listed in Table 1. No effort was made to ensure that the two variants within each pair were used in truly synonymous ways in the analyzed sample.

Table 1. Southern Min elastic words ("lemmas") tested in the priming analysis

刀 ~ 刀仔	位 ~ 位置	面 ~ 面容	魚 ~ 魚肉	歌 ~ 歌曲
文 ~ 文章	利 ~ 利益	厝 ~ 厝邊	喙 ~ 喙仔	演 ~ 演戲
月 ~ 月份	事 ~ 事件	家 ~ 家庭	報 ~ 報紙	錢 ~ 錢財
牛 ~ 牛肉	性 ~ 性格	展 ~ 展覽	期 ~ 期間	頭 ~ 頭殼
包 ~ 皮包	所 ~ 所在	時 ~ 時間	湯 ~ 湯頭	癌 ~ 癌症
本 ~ 根本	杯 ~ 杯仔	胸 ~ 胸坎	痛 ~ 痛疼	聲 ~ 聲音
目 ~ 目珠	南 ~ 南部	記 ~ 記載	媽 ~ 媽媽	禮 ~ 禮物
囝 ~ 囝兒	城 ~ 城市	骨 ~ 骨頭	碗 ~ 碗公	雞 ~ 雞仔
安 ~ 安全	相 ~ 相片	匙 ~ 匙仔	路 ~ 路段	攤 ~ 攤仔
死 ~ 死亡	秋 ~ 秋天	唱 ~ 唱歌	電 ~ 電源	
血 ~ 血絲	衫 ~ 衫仔	盒 ~ 盒仔	鼎 ~ 鼎仔	

We analyzed our dataset with mixed-effects logistic regression, with "lemma" as random variable, modeling disyllabic (vs. monosyllabic) word size choice in terms of the log ratio of disyllables to monosyllables in the previous ten words. The effect was positive and statistically significant ($B = 0.66$, $SE = 0.32$, $z = 2.1$, $p = .04$), but as shown in Figure 6, it was only consistent if the target elastic word, in either variant, did not appear within the ten-word window preceding it (71% of our sample), that is, if there was no repetition of the "lemma". Our sample proved too small to test for an interaction between disyllabic ratio and "lemma" repetition, however; including this interaction in the model merely caused all effects to become nonsignificant (ps > .1).

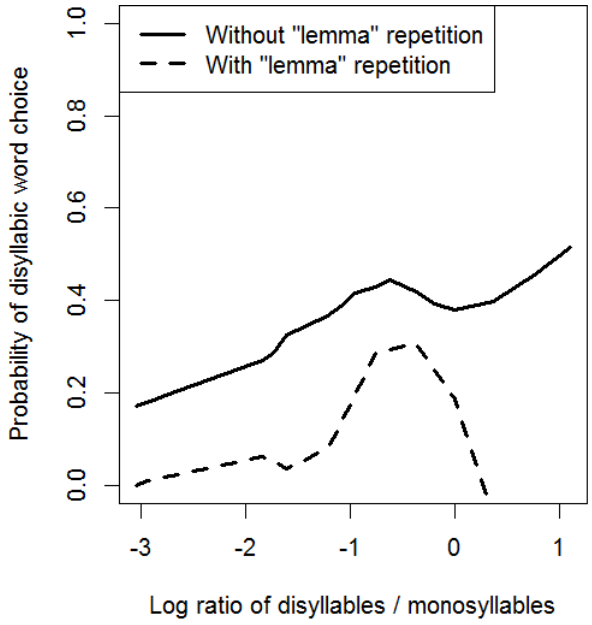

Figure 6. Priming of elastic word size in spontaneous speech

Our results thus seem to suggest that the greater the proportion of disyllables preceding an elastic word, the more likely Southern Min speakers are to choose the disyllabic form of this word. Future work will be needed to examine a sample large enough to test many potential confounds, including "lemma" repetition, code-switching, speaker of prime (prosodic context) versus target (elastic word), and non-prosodic

factors affecting disyllable ratio (e.g., register or the proportion of content to function words).

3. Conclusions

Despite the caveats we have noted throughout our discussion, we believe that we have provided novel evidence for the long-held claim that Southern Min phonology includes trochaic feet, by showing that such feet play an active role even in spontaneous speech. In particular, we showed that this activity is quantitatively measurable, given that trochaic feet are consistent with the high productivity of disyllabic words, with the preference for odd-numbered repetitions of discourse markers, and with the priming of elastic word size by prosodic context. None of our methods have been applied to phonological analysis before, and since they use nothing but the word-segmented transcriptions (not acoustic data), they are quite straightforward to use. We hope that interested readers will adopt or extend our methods in further explorations of our publicly available Southern Min corpus, or in speech corpora of other languages, Sinitic or otherwise.

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