

# Social Meaning in Prosodic Variability

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## 1 Introduction

It is quite common, among linguists and lay observers of language alike, to remark on the peculiar rhythmic qualities of a language, dialect, or individual person's speech. Linguists' attempts to classify language varieties according to their characteristic rhythm, starting at least as early as Pike's (1945) introduction of the rhythmic categories of stress timing, syllable timing, and mora timing, have generated much research and at least as much debate.

Rhythm figures heavily in popular metapragmatic characterizations of speech and dialect difference, in Chinese as in other languages. Multiple interviewees in Zhang's (2005) survey of business professionals in Beijing reportedly characterized Beijing dialect as "rhythmic" as well as *iyang duncuo* 'varying from high to low, pausing and shifting,' a stereotype of the "rhythm and melody of poetry and speech" (445). Notwithstanding the limitations of the explicit metalanguage available to describe it, speech rhythm clearly draws the attention of language users.

In the context of speech and language research, "rhythm" has had a number of theoretical and operational interpretations. Famous among them is the syllable-timing/stress-timing/mora-timing system, which divides language varieties according to their characteristic isochronous interval. Syllable-timed languages are those in which intervals between given points in adjacent syllables (say, onsets) are roughly equal, whereas in stress-timed languages, it is the intervals between subsequent *stressed* syllables that are equal. The intuitive appeal of this approach was never matched by evidence that isochrony, that is, regular patterns of evenly timed intervals (whether between stresses or syllables), could be acoustically verified in any language; later proposals suggested isochrony was perhaps a perceptual phenomenon (Lehiste 1977).

Despite the setbacks of the isochrony paradigm, the past decade has seen an exciting renaissance in research on linguistic rhythm. The introduction of the Pairwise Variability Index (PVI), first seen in work on Singapore English (Low, Grabe and Nolan 2000) and popularized by Grabe and Low's (2002) work comparing rhythm in the world's languages, set off a wave of comparative, typological, and sociolinguistic work. The PVI is a measure of timing differences between adjacent stretches of speech, which can be as short as segments or as long as syllables. It works by computing a representation of differences in duration between adjacent segments; different flavors of the measure do this somewhat differently (see Section 2, below), but in general, the lower the PVI score, the more evenly timed or equally spaced the intervals are. Higher PVIs, meanwhile, indicate more variability in the durations of adjacent intervals. This retains one intuition of the isochrony hypothesis; namely that languages where adjacent intervals have similar durations sound different from languages where the equivalent intervals are not necessarily similar in duration. But it relaxes the assumption that isochrony *must* hold at some level in all language varieties.

Another prosodic phenomenon that has seen a new wave of research in recent years is phrase-final lengthening (Gordon and Munro 2007, Smith 2002, Turk and Shattuck-Hufnagel 2007). It is cross-linguistically common for phrase-final syllables, phrase-final feet, and other units after the last stressed syllable to be extended in duration. Wagner and Dellwo (2004) have proposed that final lengthening helps to demarcate the domains across which other rhythmic effects apply, so it is important to take final lengthening into account when measuring rhythm, for instance by identifying the domain of final lengthening and excluding it from PVI calculations.

The "new" rhythm measures, which include the PVI, as well as %V,  $\Delta V$ ,  $\Delta C$  (Ramus, Nespors, and Mehler 2000), Deterding's (2001) Variability Index (VI), and Dellwo's (2006)  $\text{varco}\Delta C$  and related measures, are appealing for their ease of application and replicability. Although different in the details, each has in common that they provide a precise, acoustically grounded method for calculating a measurement of rhythm for a concrete stretch of speech. Their introduction has helped researchers find the empirical basis for the intuition of rhythm's salience as a variable across languages, dialects, and speakers.

The recognition of linguistic rhythm patterns begins in infancy (Nazzi and Ramus 2003), and

may even be shared with some non-human primates (Tincoff, Hauser, Tsao, Spaepen, Ramus, and Mehler 2005). Szakay (2008) has demonstrated that rhythmic variations is a salient diacritic of ethnic dialect difference in New Zealand, at least when evaluators are familiar with the varieties in question.

Sociolinguistic interest in rhythm goes back at least as far as Low, Grabe, and Nolan's (2000) use of PVI to compare Singapore and Standard British varieties of English. A large-scale study of African American English provided strong evidence for change over time in prosodic rhythm, with recordings of ex-slaves from around the turn of the 20<sup>th</sup> century showing remarkably more syllable-timed productions than contemporary AAE speakers, who themselves showed no significant rhythmic differences from contemporary Anglo speakers. As for final lengthening, sociolinguistic work is sparser. It has been associated with pragmatic effects like identifying yes/no questions in French (Smith 2002). Kiesling (2005) finds final lengthening in a style stereotypically associated with Australian immigrant ethnicities and marked primarily by the use of high-rising final intonation and a distinctive pronunciation of orthographic *-er*.

Some observers have commented that the PVI measure exhibits wide variability. When applied to speech elicited using different materials, tasks, or elicitation procedures, or even to different subsets of the same data, the PVI is known to be a fairly noisy measure. Interspeaker variation in Spanish PVI is comparable in magnitude to the difference between mean PVIs for other world languages (Grabe 2002). Speech rate is positively correlated with syllable timing (Dellwo and Wagner 2003), at least in overall "stress-timed" languages. Even within speakers, rhythmic variability may change depending on topic—for instance, "drama" among elementary school children in northern California (Drager, Eckert, and Moon 2008).

Depending on their theoretical orientation, researchers may see variability in measures of rhythm as either a roadblock to clear, replicable findings, or an opportunity to investigate the roots and meaning of variability. While seeking to reduce spurious noise in measurements, this paper takes the latter path, conducting a sociophonetic analysis of prosodic rhythm in a Chinese TV serial drama. I demonstrate that at least some interspeaker variability in rhythmic measures can be attributed to meaningful sociolinguistic factors, with a clear divide in two rhythm measures according to speaker gender and a secondary divide among male speakers attributable to stylistic factors.

## 2 Methods

The implementation of the PVI for measuring speech rhythm often changes with the concerns and data sources of particular researchers. Reflecting a rejection of the phonological assumptions of earlier paradigms in rhythm research, Grabe and Low (2002) took a mostly agnostic attitude toward the existence of phonological units of organization such as syllables, words, or even segments, and based their segmentation criteria on a purely acoustic distinction between vocalic and non-vocalic signals. Thomas and Carter (2006) relaxed this skepticism somewhat and made segmentation distinctions based on word and syllabic boundaries and onset/coda status of some liquids. In addition, in order to better deal with their spontaneous data, they compared only vocalic intervals, not attempting to calculate so-called consonantal PVI. Other authors have introduced and argued for PVI measures comparing durations of other phonological units, such as syllables and feet (Asu and Nolan 2006). Syllabic PVI (here, SPVI) has also been used to characterize Cantonese and Mandarin (Mok 2008).

Other, non-sequential acoustic measures, such as  $\Delta C$  (the standard deviation of consonant segment duration—compare  $\Delta V$  for vowels), have been proposed (Ramus et al. 2000), and despite criticism that they do not describe rhythm per se, but merely durational variability (Low et al. 2000), authors are re-reassessing their effectiveness at capturing rhythm patterns (Dellwo 2006). Dellwo proposes a speech rate-normalized version of  $\Delta C$  and related measures, the "variation coefficient for  $\Delta C$ ," or  $\text{varco}\Delta C$ , and he shows that, like normalized vocalic PVI, such a measure also succeeds in positioning languages along a stress-timed/syllable-timed continuum. Both PVI and  $\text{varco}\Delta C$ -type measures have been applied to varieties of Chinese, typically putting both Cantonese and Mandarin at the far extreme of the syllable-timed pole, with Mandarin slightly more stress-timed (Mok 2008).

I calculated normalized syllabic PVI scores for the durations of adjacent syllables within

utterances according to the following formula, where  $s_i$  is the duration of the  $i$ th syllable in the utterance:

$$100 \times \frac{s_i - s_{i-1}}{(s_i + s_{i-1})/2}$$

I excluded scores involving either of the final two syllables for each utterance, which may have been involved in final lengthening. I then took median utterance-level PVI values, in line with Low, Grabe, and Nolan (2000). Speakers' PVI scores are the mean of these utterance-level values. Taking the median at the utterance level mitigates the effect of highly variable pairwise values, since as Thomas and Carter (2006) point out, using the mean increases the susceptibility of the PVI metric to extreme outliers.

Varco $\Delta$ S (Dellwo 2006), the variation coefficient for  $\Delta$ S ( $\Delta$ S a measure of variability in syllable duration), was calculated for each utterance as  $s_u/\bar{d}$ , with  $s_u$  the sample standard deviation of syllable duration for that utterance and  $\bar{d}$  the mean syllable duration for that utterance. Overall speaker scores were the means of the utterance scores.

To study final lengthening, I performed a smoothing splines ANOVA (Davidson 2006; Gu 2009; Koops 2009) in R, using syllable durations as the response and speaker (or gender, in a separate run) and syllable position as predictors. Smoothing splines regression is appropriate because, unlike linear regression, it makes no assumptions about the shape of the relationship between the response and the predictors—essential when dealing with the relationship of position in utterance to syllable duration.

Data came from a mainland China TV serial drama from 2008, entitled *Nüren Hua* ‘Women flowers.’ The show is set in 1912, in Anqing, a southern Chinese city. At the time, contemporary standard language ideologies were still in their infancy, and a distinctive regional variety of Mandarin or Wu Chinese would have been heard there. Considering this, it is notable that the Chinese spoken by the characters consists of various varieties of standard Mandarin—this is hardly unusual in the contemporary Chinese mediascape, but it does call our attention to the fact that televisual representations of linguistic practice are tailored to the expectations of a contemporary listening audience.

I focus on six characters from *Nüren Hua*, three women and three men. Choosing these characters is meant to give a picture of some of the variability in depictions of women and men in the show. An online poll provides incidental evidence of the salience of the three women I choose from the viewers' standpoint; it asks which of the three has the most *gexing* ‘individuality’ (*Baidu tieba* 2008). The men, meanwhile, are the women's primary love interests or significant suitors. Each character has a distinct position in Anqing society, as well as their own engagement with “modernizing” practices and institutions, distinctions evinced quite well by their occupations and typical clothing.

Huang Mei'er (Huang), a naïve but talented young opera performer, is arguably the main character. Eligible for marriage and sought after by both the young master of the Liu house (the villain) and the tailor who does the costumes for her troupe (her sweetheart), she is strong-willed and often opposes interference in her affairs, despite being branded as a *ruo nüzi* ‘weak girl.’ She also appears on stage in beautiful, elaborate opera costume, singing a local performance form that itself is called *huangmei* opera. These signs index Huang's authentic, natural femininity, in recognition of present-day ideologies of gender.

Lin Xuelian (Lin) is a savvy businesswoman and the proprietor of the teahouse that hosts performances by Huang's opera troupe. She is skilled at maintaining equilibrium at her establishment despite the interference and opposition of powerful men of the local establishment and relatives of her late husband. She is financially well-off, and dresses in lush silk outfits in traditional style. Although relatively restrained by her social position as a widow, she profits from modern institutions such as gender-equal inheritance laws and foreign commerce.

Ouyang Xiu (Ouyang) is a serious and principled nationalist educated in Japan and committed to women's liberation, running a local girls' school. She is unafraid to take direct action, publicly striking the patriarch of a local noble house and secretly infiltrating his family storehouses to set fire to their opium reserves. Of any of the characters, she comes the closest to embodying the Republican-era ideal of the “new woman.” She is often seen in Western-style tweed outfits with

trousers, a bowtie, and tied-up hair.

Li Qingquan (Li) is a battalion commander in the “new army,” a modernized fighting force at the heart of the Chinese Republic’s military strength; he is typically seen in uniform or a Sun Yat-sen suit. Wu Yusheng (Wu) is a lawyer and magistrate, who wears a distinctive white Sun Yat-sen suit. Like Ouyang, both Li and Wu studied abroad in Japan and participated in Sun Yat-sen’s *Tongmenghui* (the predecessor of the Nationalist Party, which took power in 1911, one year before the events in the series). Li and Wu are significant love interests for Ouyang and Huang, respectively.

Liu Jianxiong (Liu), son of Anqing’s prominent Liu family, is the primary villain of the series. His family has a standing rivalry with the Wu family, and he is romantically interested in the main female character, Huang. A profligate and would-be dandy, he often combines Chinese silk outfits with a jaunty Western-style straw hat, as he has a hard time finding a tailor to fit a full Western suit to his large figure.

This project investigates speech rhythm and final lengthening for each of these characters using the formulas and methods described above. The source of data was episodes one through six of the show, with audio obtained from the DVD version. For each speaker, I located stretches of mostly “conversational” speech, trying to avoid more melodramatically inflected instances of shouting, crying, pleading, and public speech, under the assumption that this could introduce even more variability in terms of speech rate and syllable duration than that occasioned by my use of “naturalistic” materials.

I segmented each stretch of talk in Praat by intonation unit and syllable. The romanized orthographic representation of the syllable, with representations of tone and coda rhotacization, were annotated for each syllable. Criteria for intonational boundaries were drawn from the preliminary criteria outlined for Mandarin-ToBI (Peng, Chan, Tseng, Huang, Lee and Beckman 2006), and any break higher than “3” (major phrase boundary, within breath groups) was counted as the end of an intonation unit, which will be alternately called an “utterance” in the discussion below. A total of 375 utterances and 2370 syllables were segmented in this fashion.

### 3 Results

#### 3.1 nSPVI and varcoΔS

Table 1 and Figure 1 report the median nSPVI for the speakers, and Table 2 reports their VarcoΔS scores. Figure 1 also gives an idea of the range of variability among the world’s languages for these two measures.

Women		Men			
Huang	Lin	Ouyang	Li	Liu	Wu
40.3	36.6	37.8	29.8	32.5	35.4

Table 1: nSPVI by character.

Women		Men			
Huang	Lin	Ouyang	Li	Liu	Wu
44.6	44.8	42.6	34.6	34.3	39.1

Table 2: varcoΔS by speaker.

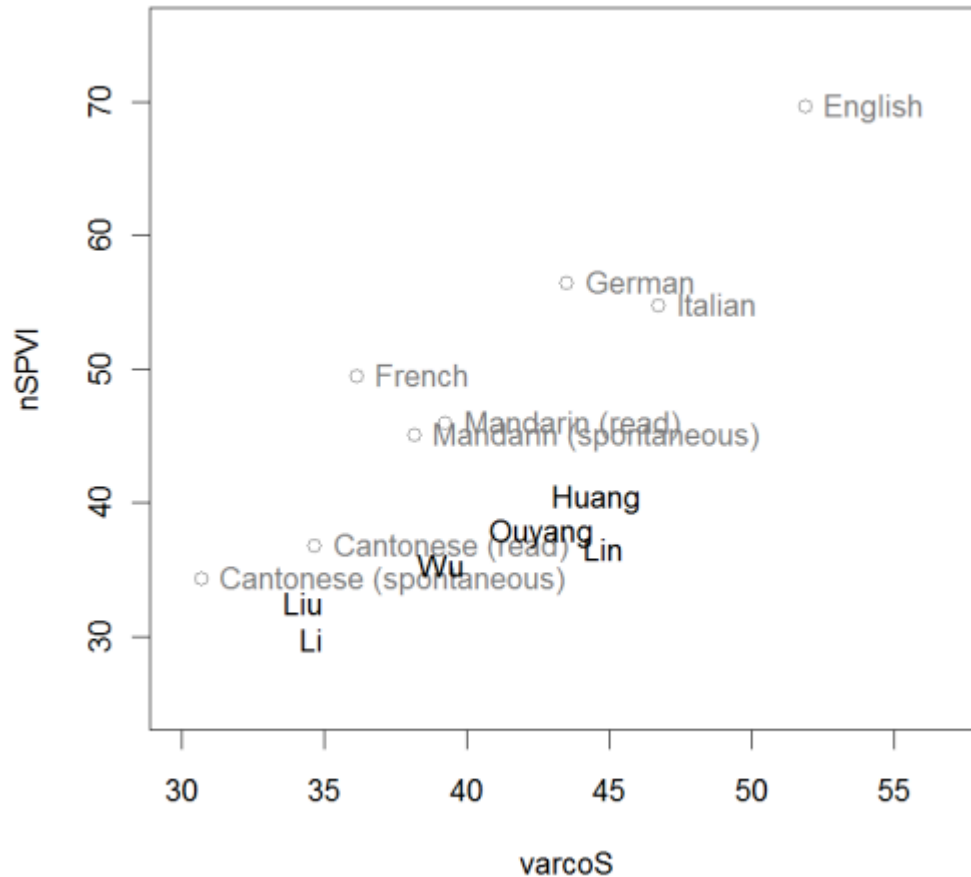


Figure 1: Median normalized Syllabic PVI and Varco $\Delta$ S. Reference values for world's languages in gray (Mok, 2008).

Reference values in Figure 1 come from Mok (2008), where the source material for measurements were short read passages. Measurements for Cantonese (spontaneous) and Mandarin (spontaneous) were provided by retellings of the North Wind and the Sun passage.

Varco $\Delta$ S measures for our speakers cover more of the range of variability among the world's languages than nSPVI does. The two most extreme speakers, Lin and Liu, span a range that includes six of the languages shown: read Cantonese, French, read Mandarin, spontaneous Mandarin, German and Italian. The range of nSPVI measures contains only read Cantonese and spontaneous Cantonese, but the distance between the most extreme nSPVI measures is roughly equivalent to the distance between read Mandarin and Italian.

An ANOVA testing for the relationship of speaker to nSPVI measures reveals no significant effect ( $DF=5$ ,  $F=1.39$ ,  $p=0.23$ ), indicating there are no per-speaker differences in nSPVI. However, as Table 3 shows, there is an effect of gender on nSPVI. The estimated female mean nSPVI is 5.55 points higher than the men's. For comparison, the difference between Mok's (2008) measurements of read Cantonese and Mandarin is 9.18 points, and Szakay (2008) found that experienced listeners could distinguish ethnic dialects of New Zealand English based on a mean difference of around 10 points.

	<b>DF</b>	<b>Sum Sq</b>	<b>Mean Sq</b>	<b>F</b>	<b>p</b>
Gender	1	0.2215	0.2215	4.669	0.03154
Residuals	286	13.5696	0.0474		

Table 3: ANOVA, nSPVI and Gender.

For varco $\Delta$ S, separate one-way ANOVAs for speaker (Table 4) and gender (Table 5) are both significant. In the by-speaker results, Tukey tests reveal that the women—Ouyang, Huang, and Lin—have significantly different varco $\Delta$ S from Li and Liu, but are not significantly different from Wu. In the by-gender results, women are estimated to be 7.86 points more stress-timed than men.

	<b>DF</b>	<b>Sum Sq</b>	<b>Mean Sq</b>	<b>F</b>	<b>p</b>
Speaker	5	5299	1060	6.6168	< 0.001
Residuals	282	45167	160		

Table 4: ANOVA, varco $\Delta$ S and speaker.

	<b>DF</b>	<b>Sum Sq</b>	<b>Mean Sq</b>	<b>F</b>	<b>p</b>
Gender	1	4444	4444	27.618	< 0.001
Residuals	286	46022	161		

Table 5: ANOVA, varco $\Delta$ S and gender.

### 3.2 Final lengthening

In interpreting smoothing spline ANOVA results, one common practice (Davidson 2006; Koops 2009) is to compare the 95-percent confidence intervals between levels of a factor or combination of factors. If the intervals for two levels of a factor overlap, we cannot say with more than ninety-five percent confidence that their “true” mean effects do not fall in the same range—indicating that their effects are not different. In Figure 2, below, I have plotted the estimated mean syllable duration, with confidence intervals, for the final few syllables of utterances four syllables or longer, for each speaker in the study. Figure 3 graphs the model estimate for ultimate syllable durations for each character, along with confidence intervals. Table 6 gives the numbers represented in Figure 3 for utterance-final syllables.

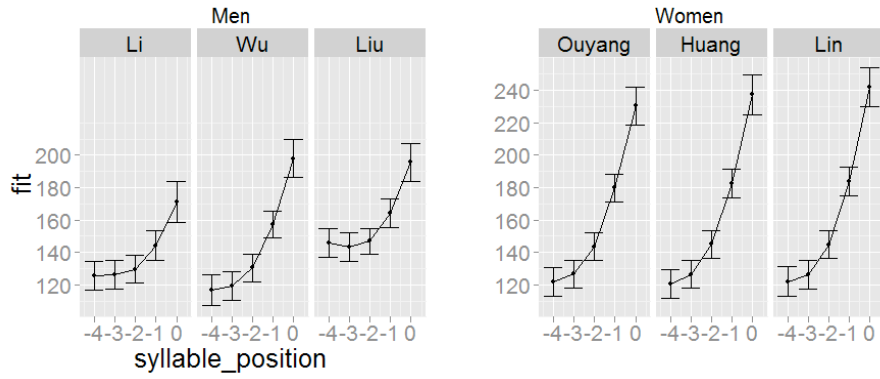


Figure 2: Estimated means of syllable durations in ms (y-axis), by speaker/gender and distance from utterance-final syllable (marked by “0”, x-axis). Error bars are 95% confidence intervals.

Gender	Speaker	Predicted Duration	Standard Error	95% Confidence Interval
Women	Huang	0.238957	0.006228	0.226747 0.251167
	Lin	0.240678	0.006097	0.228728 0.252628
	Ouyang	0.230571	0.006032	0.218751 0.242391
Men	Li	0.172815	0.006434	0.160205 0.185425
	Liu	0.19628	0.006363	0.18381 0.20875
	Wu	0.198511	0.006139	0.186481 0.210541

Table 6: Model-predicted utterance-final syllable durations (secs), with 95% CIs.

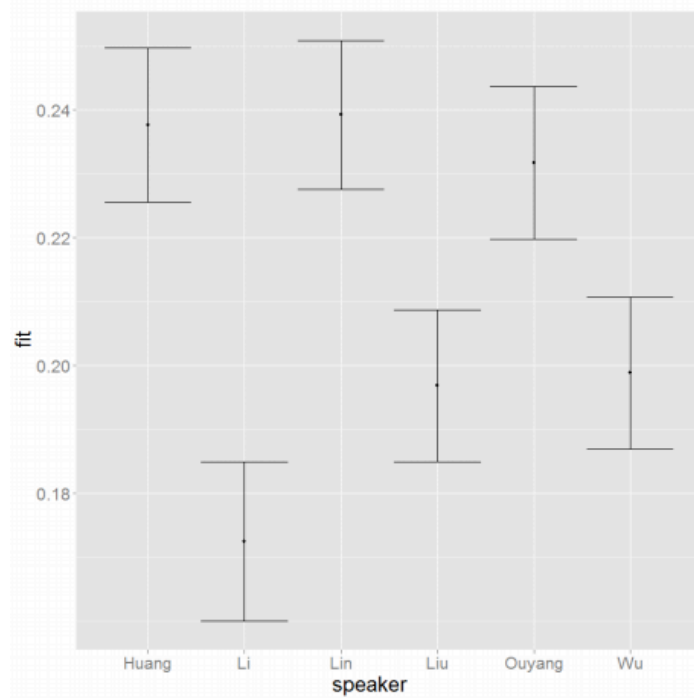


Figure 3: Model-predicted utterance-final syllable durations, by speaker.

In the duration of the ultimate syllable, there is one clear division separating all the speakers: the women (Huang, Lin, and Ouyang) have longer durations than the men (Li, Liu, and Wu). There are no distinctions among the women, but among the men, Wu has longer final syllables than Li, while Liu overlaps slightly with both other men.

#### 4 Discussion

On all three measures—sequential variability as measured by nSPVI, overall durational variability as measured by varco $\Delta$ S, and final lengthening—the men showed a clear difference from the women. The female characters showed higher levels of sequential and durational variability and higher degrees of final lengthening; their overall prosodic style could itself be labeled as “variable.” Men, conversely, were less variable and showed lower degrees of final lengthening—a prosodic style we might dub “measured.” This distinction bears a resemblance to the widespread impression of women’s pitch and intonation as highly dynamic or “swoopy” (Henton 1995). Although three characters from a television show are not a representative sample of Chinese women, to my knowledge no scholar has yet reported gender differences for rhythm or final lengthening.

The overall gender difference is mirrored in the distinction between two of the male characters: Wu and Li. Wu does significantly more final lengthening than Li, and post hoc tests for by-speaker differences in varco $\Delta$ S revealed the women were more variable compared to Li (and Liu) but not compared to Wu. Why is Wu’s prosodic style more “variable” and Li’s more “measured?” We might be tempted to write Li off as an outlier, but his extreme prosodic production on all three measures indicate that his “measuredness” is not accidental, and that the variability between Li and Wu’s rhythmic styles is not merely stochastic but carries social meaning.

Li and Wu are remarkably similar on many counts: both are young, Japan-educated modernizers, and both wear Sun Yat-sen jackets indexical of nationalist commitments and modern orientations. Li is a somewhat taciturn army officer and is often depicted dealing with obstacles and challenges through direct, violent action. Wu, in contrast, is a lawyer and highly literate court official, who shows impressive command of formal registers of spoken Chinese, as well as tact



and shrewdness in interpersonal dealings. As it turns out, the distinction between Li and Wu is precisely the difference between *wen* ‘literature, refinement’ and *wu* ‘martiality,’ a traditional binary for classifying different Chinese masculinities. Wu’s refinement and scholarly achievement make him an exemplar of *wen* masculinity, while Li’s brusque physicality is the embodiment of *wu*.

What do *wen* and *wu* have to do with rhythm? Besides the perhaps too-obvious affinities between martiality and a “measured” (i.e. regulated or even “marshaled”) prosody, as well as between the sociolinguistic virtuosity of refinement and a “variable” rhythm, we also observe that the divide between Li and Wu also places Wu “closer” to the women of the show, and Li extraordinarily far away. In this way the *wen-wu* dichotomy which they represent is likened, through rhythm, to the gender binary itself, and vice versa. This is an instance of fractal recursivity (Irvine and Gal 2000), by which existing semiotic distinctions are reproduced in new domains. The parallelism this constructs likens women to *wen* men (and vice versa), and differentiates women from *wu* men (and vice versa). This does not necessarily reveal the social meaning of rhythm in particular (that is, the core meaning in an indexical field approach, see Eckert 2008), but rather the behavior of some of its higher-order construals. Nevertheless, rhythm in this show is clearly implicated in the semiotics of gender and gendered masculinities.

## 5 Conclusion

Much work remains to be done in the sociolinguistics of rhythm and replicated, reliable results have only just begun to pile up in what is otherwise almost a cacophony of rhythm research from the past decade. It would be extremely useful, to improve comparability with other studies, to study the above data with the “standard” vocalic nPVI and intervocalic rPVI measures, rather than the syllabic PVI used here. Nevertheless, this paper has succeeded in demonstrating that at least some amount of “unsalutary” variability between speakers is not just noise but is attributable to meaningful sociolinguistic factors such as gender or socially meaningful style.

Alongside Kiesling’s (2005) study, this work has also pioneered the sociolinguistic dimensions of utterance-final lengthening, finding a robust gender difference (in that and in rhythm measures) that would be interesting to explore in larger speaker populations.

Rhythm and prosody are salient aspects of the paralinguistic signal, and there is much more work to do in determining what rhythmic variation means to speakers and hearers and how that meaning is conveyed. I hope that, like earlier work pointing out order behind the seeming chaos of variable linguistic performance, this paper serves as a stepping stone to truly in-depth investigations of the social meaning of rhythmic and prosodic variability.

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