

Accentual Lengthening in Standard Chinese: Evidence from Four-syllable Constituents

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Abstract

This study examines the pattern of accentual lengthening (AL) over four-syllable mono-morphemic words in Standard Chinese (SC). I show that 1) the domain of AL in SC is best characterized as the constituent that is under focus; 2) the distribution of AL over a focused domain is non-uniform and there is a strong tendency of edge effect with the last syllable lengthened the most; and 3) different prosodic boundaries do not block but attenuate the spread of AL with different magnitudes. These results are also compared to the results of studies on AL in languages such as English and Dutch. While there are similarities of AL in these two typologically different languages, which open the possibility that some effects of AL are universal, there are clearly important differences in the way that AL is distributed over the focused constituent in different languages, due to the specific phonology of the language.

1. Introduction

It is probably no exaggeration to say that speakers of any given language encounters, more or less frequently, occasions that he/she needs to make a correction or signal a contrast during verbal interactions. The linguistic mechanism employed for such a purpose is defined here as contrastive focus. Understanding the realization of linguistic units under contrastive focus will not only shed light on the nature of the linguistic units, but also help improve models of human-machine interactions. Previous work shows that when a linguistic unit is contrastively focused, it undergoes durational increase, defined here as accentual lengthening (AL).

Three observations make SC a particularly interesting case for the study of AL. First, detailed studies of AL have been conducted only on Germanic languages. Typologically, it would thus be important to see if AL in SC also exhibits comparable patterns. Second, it is observed that lexical stress plays a very important role in determining the pattern of AL in languages such as English, Dutch, and Swedish, all of which show that a relatively large amount of lengthening starts on the stressed syllable and extends to the neighboring unstressed syllable(s) [1, 2, 3]. This raises the question as to how the pattern of the AL in SC is determined, especially given that the phonological status of stress in SC is notoriously controversial. Third, notions that have been proposed to be domains of AL in other languages are either controversial or different in SC. For

example, in Swedish, the foot is posited as the domain of lengthening ([3]), which includes the stressed syllable plus its following unstressed syllable. In SC, the notion of foot has been posited as an important prosodic unit in accounting for third tone sandhi ([4]). The nature of this foot, however, differs from the Swedish foot in that it usually consists of two or more syllables with various morpho-syntactic relations. Another notion, the orthographic word, defined as the domain of lengthening in English and Dutch ([2]), is also problematic in Standard Chinese, because the Chinese writing system does not annotate word boundary, which leads to a certain level of uncertainty in native speakers' judgment of the precise location of word boundaries. Given these observations, it is clear that the study of contrastive focus in SC is essential for us to understand better the universal as well as the language-specific patterns of AL. This experiment was thus designed to examine the patterns of AL in SC, aiming to develop a fuller typology of AL.

2. Method

2.1. Material

The design of the test materials has taken three things into consideration. First, only four-syllable mono-morphemic words were tested. They are composed of two feet parsed from left to right ([5]). This choice gives us a good control of the edge effects for possible durational adjustment ([6], [7]) and provided us with opportunities to examine how foot and word might serve as relevant AL units.

Second, we also took into consideration how to naturally elicit contrastive focus on constituents of various sizes within a four-syllable constituent so that we can have contrastive focus on a syllable, a within-word foot, or the whole four-syllable word. One good resource is transliterated foreign names. A map reading task was designed, consisting of tribes and cities in Australia, with some names real but most made-up. The main task was for the subjects to correct mistakes that the experimenter made in these names so that contrastive focus on various parts of the constituents was elicited. As these names could be confusing, it makes sense that mistakes are likely to be made. This provided us with a natural setting in which subjects were asked to make corrections on these made-up names.

Third, as to the makeup of the test items, only limited number of tonal and segmental combinations was examined. For any four-syllable constituent, there are 16 possible tonal combinations even when we keep its segmental and syllabic compositions constant. The limited choices were to control the size of the experimental corpus. [8] shows that both tone and syllable type affect a syllable's duration in Standard Chinese. The compromise was to include four-syllable constituents which either have the same lexical tone but different segmental/syllabic combinations or have similar segmental/syllabic combinations but different tones. Specifically, I included 1) four constituents with 1st (high) tone or 2nd (rising) tone only for all four syllables of the constituents 2) four four-syllable constituents with similar segmental compositions but four different tones. Altogether 10 test items were used in the experiment.

2.2. Elicitation of focus

Subjects were given, on the computer screen, information in Chinese about the geographical relations of the tribes and cities in Australia which were named after the test items, illustrated in (1). They were then asked to make corrections of inaccurate statements, uttered by the experimenter and also shown in Chinese on the screen (2). There are two types of mistakes. One was wrong information about part of the constituent (see (2) with the wrong information in italic and underlined). This induced correction on either a foot or a syllable of the constituent. The other was wrong information about the whole constituent. This induced correction on the entire constituent. A typical answer from the subject is shown in (3) (with emphasis on the focused part in bold and underlined).

- (1) Given Information:
xīní zài gēbāduōlā dōngběi miàn.
Sidney locate gēbāduōlā east north side
- (2) Experimenter:
xīní zài hóngdū duōlā dōng běi miàn.
Sidney locate hóngdū duōlā east north side
- (3) Answer from Subject:
búdùi. xīní zài **qē bā** duōlā dōngběi miàn.
No. Sidney locate gēbāduōlā northeast side

The baseline condition to compare the effect of AL was obtained by eliciting focus on the later part of the sentence, as exemplified in (4-5).

- (4) Experimenter:
xīní zài gēbāduōlā dōng nán miàn.
Sidney locate gēbāduōlā east south side
- (5) Subject:
búdùi. xīní zài gēbāduōlā dōng**běi** miàn.
'No. Sidney locate gēbāduōlā northeast side

Focus on the whole four-syllable word was elicited from all test items, while focus on subcomponents of a word was elicited from four of the items that have the same lexical tone on all four syllables, simply to reduce the amount of work for the subjects.

2.3. Subjects and recording

Data reported here are from 2 male and 2 female native speakers of SC. Subjects were first shown a map of (part of) Australia with a short introduction of the made-up tribes, in particular their geographical settings, relative to each other as well as to other famous or made-up cities in Australia. All subjects reported that these names sounded natural to them except that they were not easy to remember.

All sentences with different focus conditions were randomized with a computer program. Three repetitions were elicited. Recording was done with Sony Digital Mega Bass MZ-R55 at the sampling rate of 16000. Subjects were told that the purpose of the recording was for a study of focus in Standard Chinese, but they were naïve as to what exactly would be examined. Whenever subjects responded without detectable emphasis on the to-be-corrected item, they were asked to repeat the utterance.

2.4. Measurement and statistical test

Segmentation was based on spectrogram and zoomed waveforms, supplemented by evaluation of the audio recording. The segmented files were then subjected to a computer program to obtain the duration. Analysis of Variance Tests were conducted in SPSS. MANOVA (Multivariate Analysis of Variance) was used with syllable durations as the dependent variables and focus, tonal combination, and subject as independent variables.

3. Results

3.1. Focus on the whole four-syllable prosodic word

As shown in Figure One, when a four-syllable word was contrastively focused, all syllables were lengthened (Tests of Between-subjects Effects for the four syllables respectively: $F_{s1}(1, 215) = 33.463, P < .001$; $F_{s2}(1, 215) = 29.114, P < .001$; $F_{s3}(1, 215) = 33.098, P < .001$; $F_{s4}(1, 215) = 150.88, P < .001$). Their magnitudes of lengthening, however, were non-uniform. Specifically, all subjects consistently lengthened the last syllable the most (34 ms. and 17%). The other three syllables lengthened less (1st ó: 18 ms., 10%; 2nd ó: 12 ms., 7%; 3rd ó: 16 ms., 8%). There were some speaker variations in the relative magnitudes of lengthening between the 1st and 3rd syllables, but the second syllable lengthened the least.

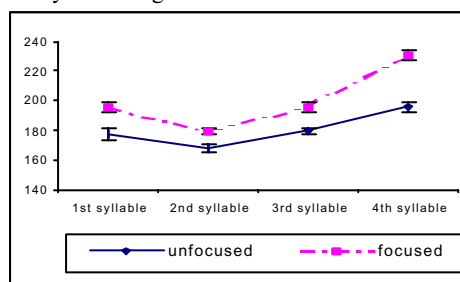


Figure 1: Durational adjustment of four-syllable monomorphemic words (in ms.)

3.2. Focus on the sub-components of a prosodic word

- *Focus on foot within a prosodic word*

Figure 2 illustrates that when a within-word foot was focused, both syllables were lengthened (Tests of Between-Subjects Effects: focus on the 1st foot: $F_{s1}(1, 88)=81.647, P < .001$; $F_{s2}(1, 88)= 93.833, P < .001$; focus on the 2nd foot: $F_{s3}(1, 88)= 74.622, P < .001$; $F_{s4}(1, 88)= 39.970, P < .001$). Furthermore, both syllables were lengthened, to a large extent, with similar magnitudes (within the first foot: 1st ó: 37.5 ms. and 20%; 2nd ó: 33.9 ms. and 21%; within the second foot: 3rd ó: 28.2 ms. and 15%; 4th ó: 33.6 ms. and 18%).

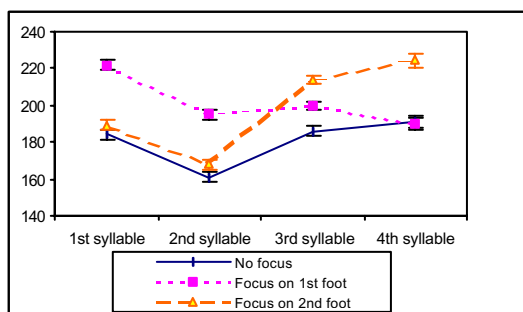


Figure 2: Durational adjustment of foot within a four-syllable mono-morphemic word (in ms.)

Worth noting is that there was a spill-over effect of lengthening on the preceding as well as the following syllable of the focused foot was also observed. When the 1st foot (composed of the 1st and 2nd ó) was focused, its following syllable, the 3rd syllable, was also lengthened significantly ($F_{s3}(1, 88) = 16.710, P < .001$) but the 4th syllable was not affected. When the 2nd foot (composed of the 3rd and 4th ó) was focused, its preceding syllable, the 2nd syllable, was also lengthened significantly ($F_{s2}(1, 88)= 4.489, P = .037$) but the 1st syllable was not affected. Further, there was also a tendency that this spillover effect was stronger in the rightward direction than in the leftward direction.

- *Focus on syllable within a prosodic word*

Figure 3 illustrates the accentual lengthening of a single syllable out of a four-syllable constituent. Three things are worthy of note. First, the focused syllable was lifted out of the whole constituent with a robust lengthening effect (focus on the 1st ó: $F_{s1}(1, 76)=89.517, P < .001$; focus on the 2nd ó: $F_{s2}(1, 76)= 271.003, P < .001$). Second, there was also a spill-over lengthening effect on the preceding as well as the following syllable of the focused syllable. When the 1st syllable was focused, its following syllable, the 2nd syllable of the constituent, was also lengthened significantly ($F_{s2}(1, 76)= 51.273, P < .001$). The 3rd and the 4th syllables, however, were not affected. When the 2nd syllable was focused, its preceding syllable, the 1st syllable of the constituent, was lengthened significantly ($F_{s1}(1, 76)= 16.832, P < .001$). The following

syllable (i.e. the 3rd syllable of the constituent) also showed significant lengthening ($F_{s3}(1, 76)= 28.25, P < .001$).

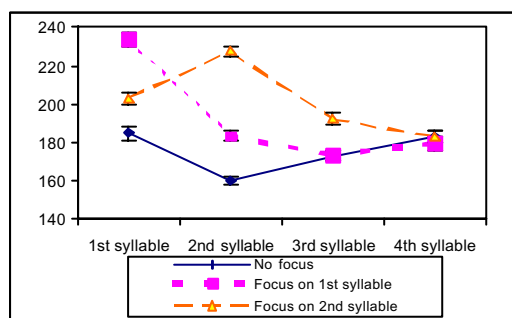


Figure 3: Durational adjustment of syllable in a four-syllable mono-morphemic word (in ms.)

3.3. Attenuation of spill-over lengthening by word vs. syllable boundary

The previous section showed that contrastive focus induced robust accentual lengthening of the focused constituent and also there was spill-over effect of lengthening of the neighboring syllables of the focused constituent. Figure 4 compares results from two experiments and further confirms the rightward vs. leftward asymmetrical spill-over lengthening. It also shows that different prosodic boundaries (specifically, syllable vs. word) also attenuate spill-over lengthening with different magnitudes. In this figure, the first two groups of column on the left-hand side of the figure represent data from [8]. Here, focus on a mono-syllabic word affected the preceding mono-syllabic word's rhyme significantly ($F(1, 568) = 35.364, p < .001$) but not the onset. The magnitude, however, was not very big (6.6 ms. and 7%). The effect of contrastive focus on the following mono-syllabic word's duration, however, was significant only on the onset ($F(1, 568) = 12.072, p = .001$). The magnitude was again not very big (5.8 ms. and 8%).

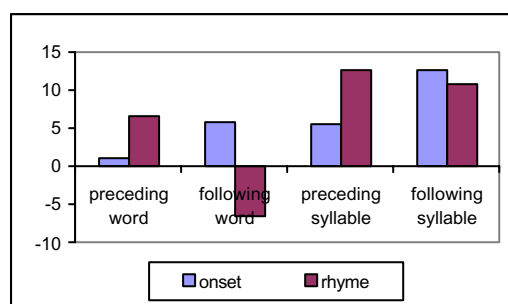


Figure 4: Spill-over effect of lengthening across different syllable vs. word boundaries (in ms.)

This suggests that the spill-over lengthening effect of a focused constituent across a prosodic word boundary on its neighboring syllables was small and also probably localized to the rhyme of the preceding syllable and the onset of the

following syllable when the focused constituent was a prosodic word on its own. The is in clear contrast with the effect of spill-over lengthening across syllable boundary within a prosodic word, as shown in the second two groups of column which represent data elicited with focus on a syllable within a four-syllable word (also described above). This figure illustrates further the asymmetrical spill-over effect of lengthening and also shows that prosodic word boundary has a much stronger attenuating effect than a syllable boundary in AL.

4. Discussion and Conclusions

When a four-syllable monomorphemic word was contrastively focused in Standard Chinese, all syllables lengthened. The distribution of the lengthening, however, was not uniform; the last syllable consistently lengthened the most. This pattern marks SC as different from languages such as Dutch, English, and Swedish. All of the latter languages have lexical stress, and AL seems to be very sensitive to lexical stress in that it is the stressed syllable that lengthens the most.

Comparing the accentual lengthening patterns across languages studied in comparable details, two observations are of note. First, in Swedish, when there is a long vowel in a stressed syllable, all segments within the stressed syllable are lengthened under focus; when there is a short vowel in a stressed syllable, it is the following long consonant that lengthens under focus [3]. Second, in English, [9] reports that when a constituent bigger than a word (e.g. a modifier + a noun) is focused, both words within the constituent are lengthened. Taking these two observations into consideration, it seems plausible to posit that the domain of accentual lengthening is whatever constituent under focus. Within the domain of AL, there may be non-linear distribution of lengthening, which results from the sensitivity of AL to the other language specific phonological constraints. Another possibility, as pointed out by Alice Turk (personal communications), is that in languages such as Standard Chinese, accentual lengthening may mark the boundary (especially the right one) of the focused constituent, while in languages such as Swedish and English, accentual lengthening may only mark the head, i.e. the stressed syllable, of the focused word. Given this possibility, then for an English four-syllable word, we predict that when its stress is on the first or second syllable, there should be durational adjustment pattern comparable to the cases when the first or second syllable in SC were focused.

We have also observed a spill-over lengthening effect of contrastive focus on the neighboring syllables. Two patterns emerged. One is that the rightward spill-over lengthening tends to be stronger than the leftward lengthening. Another is that the magnitude of such a spill-over lengthening is contingent on the type of prosodic boundary: Word boundary attenuates the lengthening much more than a syllable boundary. These findings are consistent with previous reports [10], which further suggests that such patterns of spill-over

lengthening may be universal. The effect of foot boundary, however, is not clear in our data, partly due to the experimental design, which prevents us from making straightforward comparisons to the effect of syllable and word boundaries. This, together with the question of how to account for the observed patterns of spill-over lengthening, remains to be further investigated in the future.

5. Acknowledgement

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6. References

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