

A TENTATIVE STUDY ON TEMPORAL STRUCTURE OF SENTENCE IN STANDARD CHINESE

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普通话语句时长结构初探

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〔提要〕 这是一个探索性的研究,主要目的是通过对若干典型测试句的时长特性的测量分析,从语句重心转移而引起的时长变化中考察各语音单元之间的时长分布关系,力图寻找普通话里主宰不同语句时长结构的基本规律,而不是对不同句型的时长模式的一般研究。

实验材料分为两部分,第一部分包括四个由同样的音节系列“这双鞋不结实”组成、但表达不同语义内涵的小句,各小句中对比重音的位置随各自语义重心的不同而转移。这部分语料由三位标准普通话发音人用中速说出;第二部分语料是将这些小句分别嵌入四个不同的句子环境,原先各小句相应的语义内涵由所在的语句环境自然地赋予和生成,这部分语料由九个具有不同方言背景的发音人用普通话自然地说出。然后,通过声学实验,对这两部分语料进行了时长测量和比较分析。

从上述有限语料的实验结果可以得出以下几点初步印象:

(1)音节作为本文考察的最小语音单元,它的时长是最复杂多变的。就绝对时长而言,变化的范围很大,第一组三个人的音节总平均时长为 232 毫秒,其中最大值为 380 毫秒,最小值为 80 毫秒。第二组九个人的音节时长总平均值为 186 毫秒,最大值为 392 毫秒,最小值为 149 毫秒;就音节与音节之间的相对时长关系而言,主要取决于它们在句中的重音地位。

(2)两音节词作为普通话里最重要的语音结构单元之一,它的时长分布模式是一种以词重音类型的对立为基础的、在语句的各个不同层面上保持相对不变的基本时长结构单元。

(3)多音节结构中音节之间的时长分布关系既受语句重心转移的影响,又受词重音类型的制约,显得异常地纷繁复杂,而实际上还是在不同层次上遵循一种相对稳定的、类似于两音节结构的时长分布模式,它是以音节的时长变化作为基本调节因子,在类似于两音节时长结构的框架内进行内部补偿调节而实现的。因此,从这个意义上说,两音节词的时长分布模式是主宰普通话语句时长结构的基本间架。

(4)语句的重心转移和词重音类型的变化对句中时长分布产生不同的影响,但是,这两种影响并非完全独立,而是彼此关联、相互制约的。一方面,语句重心转移、即对比重音位置的转移所引起的时长变化是全局性的,包括句中各短语间、词间或音节间时长分布关系的总体性调整;而词重音类型的变化、即词内重音位置的变更对时长分布关系的影响是局部性的,主要涉及词内的时长分布格局,对整句时长结构一般没有影响。另一方面,语句重心转移所造成的影响必须通过某种形式的,以词重音对立为基础的两音节时长分布格局来实现:当句子的对比重音与所强调的词的重音位置一致时,尽管强调重读的音节及整个词都大大加长了,但该词的基

本时长结构不变;而当这两种重音的位置不一致时,也就是在句子对比重音落在词内非重读音节上的情况下,这时的时长变化就不仅限于该词的整体性伸长,而且会改变该词的时长结构,即通过改变该词的词重音类型来适应时长比例关系的变化。但是,这种情况一般不会发生在轻声词内。

(5)上述几个特点不仅表现在三个说标准普通话的人的语料中,而且相当一致地表现在九个具有不同方言背景的说话人所说的普通话语料中,由此可见,它们是普通话语句时长结构基本特点的客观反映,因而自然而然地为所有说普通话的人共同遵守。

ABSTRACT

As a tentative study on temporal structure of Chinese sentence, the purpose of this investigation is to search the basic frame of temporal distribution in a sentence by observing the influence of contrastive accent and lexical stress upon durational distribution of the sentence in Standard Chinese, rather than a general discussion on temporal patterns of sentences in different syntactic categories.

Relevant approaches have discovered that syllable is the most active constituent on durational variation, and the lexical - stress based temporal patterns of disyllabic words are the most stable frame on durational distribution in Standard Chinese. These findings are revealed again in the present study. According to the data obtained here, we would further claim that, on the one hand, the manifestations of syllable duration is definitely determined by its stress status in either the contrastive accent at sentence level or the lexical stress at word level, but it is varied regularly within the disyllabic frame and it is true in all different sentence environments; On the other hand, durational distribution in terms of syllable duration between subunits in polysyllabic constituents, like word or above in Standard Chinese is also sensitive to the change on stress distribution in a sentence, it appears in multiplex shapes, but does follow a relatively fixed pattern which is resembled to the frame of disyllabic words. This process is executed in different speech levels through the variation of syllable duration. In this sense, therefore, the variation of syllable duration is the basic factor of adjustment, and the temporal patterns of disyllabic words are the basic frame in build-up the temporal structure of Chinese sentence.

1. INTRODUCTION

Duration as one of the four key - elements of speech sounds in a language seems to be simple, but rather complex than pitch, intensity and sound quality. Actually, durational property is more difficult to be described, since it is unlike sound pitch, which is mainly correlated to tonal contrast, and sound quality, which is correlated to phoneme distinction, but there is no such kind of phonological or phonetic representation that can be properly correlated to durational property in linguistics. Whereas, as a matter of fact, durational property in speech is one of the key - elements that can not be ignored. In the first place, the prosodic features, such as stress and intonation of a language are closely related to time

domain. As what has been pointed out by Sloodweg (1988) and Sluijter (1992), the metrical structure is predominantly coded in the durational properties of syllable string in Dutch, similar evidence is also found in Chinese (Lin, T., 1983; Lin & Yan, 1988). Moreover, some recent approaches suggested that durational relation also can affect segmental discrimination (Williem J. M. Peeters, 1991; Cao, 1992a, 1992b). Consequently, people have no way to avoid dealing with such thorny problem either in speech theoretical study or practical approach, and it is particularly important for speech processing, especially in seeking of solution on the discrepancy between static linguistic units and dynamic speech process when one conducts the synthesis and recognition of connected speech. Thus, trying to find out the regular temporal patterns of natural speech has become an urgent issue in this area.

Up to date, many of durational studies referred to Mandarin Chinese (as the Standard Chinese, hereafter is referred to SC) have contributed (e.g. Qi & Zhang, 1982; Feng, 1985; Ren, 1988; Cao, 1989, 1991), but only a few of them is concentrated on temporal organization of Chinese speech. In respect to the temporal structure of bisyllabic word frame in SC, Cao (1992c) has claimed that temporal structure of bisyllabic word in SC is word-stress based, i.e. the durational patterns are determined by the contrast of lexical stress. It is relatively stable and may be kept everywhere as a basic frame in connected speech. To examine this suggestion, the present study aims at further investigation on temporal structure of sentence by observing the relationship between stress distribution and durational manifestation within a sentence.

2. TEST MATERIALS AND METHODS

As what happened in many other languages, the manifestation in time domain of natural Chinese speech is so complex that one is hard to grasp its temporal structure. The most prominent expression in this aspect is the complicated manifestations of syllable duration in the utterance, including durational realization of different syllables in the same context and that of the same syllable in different circumstances. Our previous studies (Cao, 1989; 1991) have found that, in SC, the factors that causing of durational variation of a syllable are multiplex and operating in different ways, but the most direct one among them is stress status of the syllable in utterance. Consequently, to further discover the temporal organization in a sentence, the work reported here is concentrated on the observation to the influence of stress status upon durational variations, including the effect from contrastive accent shift in sentence level and that from lexical stress change in word domain.

Against the background mentioned above, two groups of test materials are employed in this investigation. Specifically, the first group includes four clauses, namely, the S1, S2, S3 and S4, each of them consists of the same syllable string but conveys different communication information due to different assignment of contrastive accent. Therefore, as it has been specified in list 1, the semantic prominence of each clause is different from each

other, and so is the placement of contrastive focus correspondingly.

This part of materials were uttered by three native SC speakers, they were asked to speak these clauses in the assigned contrastive accent.

The second group of test materials is using a syllable string the same as that in first group, but put into four different sentence environments of A, B, C, D, so that to automatically carry out the semantic intensions that corresponding to S1, S2, S3 and S4 respectively, they are specified in list 11.

This group of materials were uttered fluently by nine speakers who come from different dialect regions, but speak in Mandarin.

Durational measurements were taken from the wide band spectrograms through 5500 work - station. The measurements from group one are regarded as the isolated version, from which, we try to observe how the durational distribution in a clause is affected by contrastive accent shift, and try to find out the basic temporal patterns existed in these clauses; The measurements obtained from group two are regarded as the contextual version, through which, we try to test that whether the pattern obtained from this group is identified with that of group one, and to see if it is or not an objective law that to be universally followed by all the speakers, including native SC speakers and those just speak Mandarin but come from different dialect regions.

List I. Test materials(group one): four different clauses that consists of the same syllable sequence “zhe [tʂə] shuang [ʂuaŋ] xie [ɕie] bu [pu] jie [tɕie] shi [ʂɿ]” but with different contrastive accent

测试句表 1: 用同样音节系列“这双鞋不结实”构成的四个有不同对比重音的小句, * 代表强调重心

Clause (in Chinese transcription)	Gloss (capitalized part is accented)
S1 zhe shuang xie bu jie shi *	this pair of shoes is not DURABLE
S2 zhe shuang xie bu jie shi *	this pair of shoes is NOT durable
S3 zhe shuang xie bu jie shi *	THIS pair of shoes is not durable
S4 zhe shuang xie bu jie shi *	this pair of SHOES is not durable

List II. Test materials (group two): four carrier sentences that contains the S1, S2, S3 and S4 respectively

测试句表 2: 分别包含小句 S1, S2, S3 和 S4 的四个引导句

Sentence (in Chinese transcription)	Gloss (capitalized part is accented)
A. wo shou /zhe shuang xie bu jie shi/, ni shuo ne. *	I think this pair of shoes is not DURABLE, what do you think
B. wo shuo /zhe shuang xie bu jie shi/, bie mai ta. *	I say this pair of shoes is NOT durable, don't buy it
C. wo shuo /zhe shuang xie * bu jie shi/, bu shi shuo na shuang.	I mean THIS pair of shoes, in stead of that ones, is not durable
D. wo shuo /zhe shuang xie * bu jie shi/, bu shi shuo wa zi bu jie shi.	I mean this pair of SHOES, in stead of socks, is not durable

3. EXPERIMENTAL RESULTS AND ANALYSIS

Experimental results obtained from this investigation are summarized in the Tables I to VI. The data in Table I and II represent an outline on durational manifestations of the syllables and above units in test clauses of group one, and those in Table III and IV represent the corresponding partners obtained from the materials of group two. Table V shows a brief comparison on temporal distribution between these two versions. A brief comparison between different speakers is also conducted, specific situations can be observed roughly from Table VI.

3.1 Temporal structure of clauses spoken in isolation

Making a survey of the figures shown in Tables I and II, we can see that the variations in temporal distribution caused by contrastive accent shift are taken place over the whole clause and appeared as different size of chunk in different speech level, the specifications can be described as follows.

3.1.1 Durational distribution between phrases in clause layer

As what can be seen from Table II, durational relation between different polysyllabic units, such as phrases or word-combinations, is varied globally due to contrastive accent shift in different clause, i.e., the accentual focused unit is elongated and the non-focused one is correspondingly shortened. For example, the durational ratio of "bu jie shi" is obviously higher than that of "zhe shuang xie" in both of S1 and S2. Since in either cases, the semantic prominence is located in "bu jie shi", though the specific position of the focus within this unit is different between S1 and S2, as it will be specified in 3.1.2. Whereas, the semantic prominence in S3 and S4 has been shifted to "zhe shuang xie", so the

durational relation between the two phrases in S3 and S4 considerably differs from that of S1 and S2.

3.1.2 Durational distribution between words in phrase layer

A. In the focused phrase, durational distribution between words is definitely influenced by contrastive focus shift in the clause. Namely, the focused word is definitely elongated, and the non-focused ones are often shortened correspondingly. For instance, the ratio of “bu” vs. “jie shi” is about 8.4:42.8 in S1 where accent focus is located on word “jie shi”; while it becomes 18.6:33.8 in S2. It is obvious that, since in S2, the negative word “bu” is considerably elongated due to its focused status, and “jie shi” is shortened as a kind of inner compensations, so that to keep durational ratio of the focused phrase to the whole clause in almost the same level in both of S1 and S2. Likewise, the adjustment on durational relation between words “zhe shuang” and “xie” is also taken place in S3 and S4 due to their different stress status in each case.

B. In non-focused phrases, durational distribution between words seems to be rarely influenced by contrastive accent shift in the clause, comparing with that of their focused partner, the durational relation between subunits is relatively consistent. For example, the ratio of “zhe shuang” vs. “xie” is almost the same in S1 and S2 (i.e., 31.1:17.6 in S1 and 30.3:17.2 in S2), and so is the case of “bu” vs. “jie shi” in S3 and S4 (i.e., 7.6:36.6 in S3 and 5.3:36.7 in S4).

3.1.3 Durational distribution between syllables in word layer

According to the mean value presented in the rows of “zhe”/“shuang” and “jie”/“shi” in Table V, we can see that, in the level of disyllabic word, the durational relation between syllables precisely falls into the word-stress (i.e., lexical stress) based patterns which is found in our previous studies (Cao, 1989, 1992c), namely, the first syllable is slightly shorter than the second one in NM type (i.e., normal type of lexical stress, see Lin & Yan, 1988) words, like “zhe shuang”; while it is greatly longer than the second one in NT type (i.e., neutral type of lexical stress, idem) words, like “jie shi”. This situation indicates again that, such lexical-stress based temporal patterns are relatively stable, though the specific manifestations in S1, S2, S3 and S4 are quite different due to different assignment of contrastive accent.

Of course, there are some cases, such as the relation between “zhe” and “shuang” in S3 seems beyond the normal pattern of “zhe shuang”, however, this situation is more referred to the relationship between the roles from contrastive accent and lexical stress, the specifications will be discussed later in 4.1.

3.2 Temporal structure of clauses in different sentence contexts

3.2.1 The manifestations of syllable duration in sentence contexts

The figures given in Table III represent mean duration and relative ratio of each syllable in the test clauses. Comparing with the corresponding figures that given in Table I for the isolation version, some tendency could be observed.

First, the absolute duration of each syllable in different sentence contexts is varied in all time, that is, some of them is shorter than its partner in isolation version, but some of them is in the reversed case. However, as a general tendency, the contextual version is slightly compressed, it can be observed from Table I and III by comparing the syllable mean duration shown in the last three lines from the bottom. The factor that causing of such tendency is complex, it might involve in physiological and psychological restriction of speech production and perception, but a direct manifestation is related to the length of a sentence, though the mean duration of a syllable is not directly in proportion to the amount of syllable number in a sentence.

Second, considering of durational distribution within certain clause, there seems no significant difference between the cases of isolation and sentence contexts. If we take a general comparison on the related figures shown in Table I and III, the durational ratio held by each syllable in the versions of isolation and sentence context is staying in a comparable level. This situation indicates that durational relation between syllables within certain clause is relatively consistent, and it seems not to be influenced by syllable amount of the whole utterance.

3.2.2 Durational manifestation of speech units other than syllable in sentence contexts.

The figures given in Table II and IV represent the mean duration and relative ratio held by various speech units in different levels, such as the clauses, words or word combinations. These data tell us that the temporal structure of certain speech unit in different sentence contexts is basically identified with that in isolated version, though the absolute duration of them is different from that in the case of isolation. Take the word "zhe shuang" as an example, the ratio of its duration within the isolated S1, S2, S3 and S4 is of 31.3%, 30.3%, 39.7% and 32.7% respectively, and the corresponding partner in sentence A, B, C and D is of 32.6%, 26.9%, 37.1% and 29.0%. It is obvious that temporal distribution within certain clause or word combination is relatively consistent, no matter the clause is in isolation or situated in sentence environment. For the convenience of comparison, the durational ratios between words or word-combinations in the both cases are summarized in Table V, compare each pair of the figures listed in lines (1) and (2), the relationally invariance on temporal structure of certain speech unit is typically presented. Moreover, these pairs of figures give an impression that, durational relation between words or word combinations is quite similar to that of disyllabic words if in terms of syllable mean duration in each case.

4. GENERAL DISCUSSION

4.1 Relationship between the contributions of contrastive accent and lexical stress to the durational distribution

According to the situations described in section 3, we can say that the contributions of contrastive accent and lexical stress are different, but not completely independent. On the

one hand, as what has been specified in 3.1.1 through 3.1.3, shift on contrastive accent will cause an overall adjustment of durational relation in the whole sentence, while the change in lexical-stress usually only affects the durational relation within the word; On the other hand, however, the effect of contrastive accent must be executed through certain form of the lexical-stress based patterns, that is, when the placement of contrastive accent is identified with that of lexical stress, like the situation of "jie shi" in S1, the durational pattern of focused word is kept in original, though the absolute duration of the word and the focused syllable is extremely elongated. Whereas, when the placement does not agree with that of lexical stress, i. e., in the case of a lexically unstressed syllable in NM type word happened to be assigned as the contrastive focus, then the change is not only presented as a global elongation of this syllable and the whole word, but also a transformation in durational pattern of the word, namely, from the NM type changes to the NT type, like the situation of "zhe shuang" taken place in S3.

According to Table V, the durational ratio of "zhe" vs. "shuang" in word "zhe shuang" of S3 is (1) 54:46 in isolation and (2) 52:48 in connected speech, such a temporal structure appears not to be matched with its regular stress type. Since in normal case, "zhe shuang" is a NM type word, in which "zhe" is relatively unstressed, and should be slightly shorter than, in stead of longer than "shuang". Actually, however, "zhe" in S3 has become a stressed syllable due to the assignment of contrastive accent, hence the lexical stress pattern of "zhe shuang" has been changed in this case. It can be proved by its pitch contour shown in Fig.1, where we can see that, the contour of syllable "zhe" in C is strongly accented and phonologically appeared as a full fourth tone pattern of SC; while that of syllable "shuang" is neutralized correspondingly and appeared as a neutral-tone pattern (Cao, 1992d), thus, the tone contour of the whole word has become a typical one for NT type of word. It means that the stress pattern of "zhe shuang" in this case has transferred from NM type to NT type. Therefore, the temporal pattern of the word presented here is still matched with its stress type, rather than an exact exception at all.

The phenomenon described above further indicates that, the durational variation of each syllable in sentence is not disordered, but systematically organized. In most of the case, it is varied alternatively under the patterns of NM type word or NT type word. Consequently, we would claim that the temporal patterns of disyllabic words are the basic frame in build-up the temporal structure of a sentence in the SC.

4.2 The identity among different speakers on durational distribution of certain units in the same sentence environment.

A brief comparison on durational ratio of various speech units in the same sentence environment but spoken by different speakers is shown in Table VI, the corresponding data show that for certain speech units, the durational ratio is quite close to one another among these different speakers, this phenomenon is very interesting. From one point of view, as we mentioned before, the Mandarin speakers employed in this study are come from different

dialect regions, so their speech materials are mingled with considerable dialectal accent, including the characteristics expressing in segmental and suprasegmental aspects. However, in spite of this fact, their speech is still identified as Mandarin Chinese, rather than any other dialects. It indicates that, these speakers do have mastered the major features of Mandarin, at least in the domain of metrical structure according to the identity shown in durational property of their speech materials; from the other point of view, durational relation found in this investigation should be a reflection of the objective temporal rule existed in SC speech, so it is followed naturally by different speakers, no matter which dialect area who comes from and whether comprehend this rule or not, so long as they speak in Mandarin. Consequently, the phenomenon described above reveals an important fact that, temporal distribution as a predominant constituent of the metrical structure may be the most characteristic feature in identifying of certain language or differentiating one language from the others.

5. CONCLUSION

Summarizing the results of this study, some basic impressions about temporal structure of Chinese sentence and the related influence upon durational distribution in the sentence can be briefly drawn as follows.

(1) Syllables as the minimal unit examined in this study is the most active constituent on durational variation of Chinese speech. The manifestations of syllable duration is most multiplex with an extremely wide range dependent on its stress status in a sentence.

(2) The temporal pattern of disyllabic word is a relationally invariant frame which is based on the contrast of lexical stress. As one of the most powerful constituents, its temporal pattern is presented at all speech levels in the sentence.

(3) Durational distribution between the subunits in polysyllabic constituent seems to follow a relatively fixed pattern that resembled to the frame of disyllabic words. It is executed through certain inner adjustment in terms of the variation of syllable duration. In this sense, the temporal pattern of disyllabic word is the basic frame of temporal structure of the sentence, and the variation of syllable duration is the basic factor of inner adjustment.

(4) The contributions upon durational distribution from contrastive accent in sentence level and lexical stress in word level is different but not completely independent, they are related with and restricted to each other.

(5) All the durational properties mentioned above is expressed not only in the speech materials that spoken by three native SC speakers, but also fairly consistent in that spoken by nine Mandarin speakers with different dialect background. This phenomenon indicates that, these features should be the objective reflection of essential temporal rule that acted in SC speech, so they are naturally to be followed by all the Mandarin speakers.

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Table 1. Durational manifestation of each syllable in test clauses S1, S2, S3 and S4 in isolation: three speakers' mean duration(ms) and relative ratio(%)

表一. 测试小句 S1、S2、S3 和 S4 单念时各个音节的时长实现:三个说话人的平均时长(ms 毫秒)及时长比例(%)

syllable \ clause duration	S1		S2		S3		S4		general mean	
	ms	%	ms	%	ms	%	ms	%	ms	%
zhi	190	14.5	200	13.8	280	21.4	230	15.3	225	16.3
shuang	220	16.8	240	16.6	240	18.3	260	17.3	240	17.3
xie	230	17.6	250	17.2	210	16.0	380	25.3	268	19.0
bu	110	8.4	270	18.6	100	7.6	80	5.3	140	10.0
jie	330	25.2	310	21.4	280	21.4	320	21.3	310	22.3
shi	230	17.6	180	12.4	200	15.3	230	15.3	210	15.2
syll. mean in each clause:	218		242		218		250			
sd:	71.1		47.1		67.5		101.6			
syll. mean in all clauses:232 sd:70.8										
focused syll. mean in all clauses:315 sd:57.0										

Table II. Durational manifestations of (1)“zhe shuang xie bu jie shi”, (2)“zhe shuang xie”, (3)“bu jie shi”, (4) “zhe shuang”, (5)“jie shi” in isolated clauses: three speakers mean(ms) and ratio(%).

表二. 音节以上语音单元(1)“这双鞋不结实”, (2)“这双鞋”, (3)“不结实”, (4)“这双”, (5)“结实”在测试句单念时的时长实现:三个说话人的平均值(ms 毫秒)、时长比例(%)

speech units \ clauses	(1)		(2)		(3)		(4)		(5)	
	ms	%	ms	%	ms	%	ms	%	ms	%
S1	1310	100	640	48.9	670	51.1	410	31.3	560	42.7
S2	1450	100	690	47.6	760	52.4	440	30.3	490	33.8
S3	1310	100	730	55.7	580	44.3	520	39.7	480	36.6
S4	1500	100	870	58.0	630	42.0	490	32.7	550	36.7

Table III. Mean duration of each syllable in different speech surroundings: nine speakers' mean (ms) and relative ratio(%)

表三. 不同的连读语句环境里测试小句中音节的平均时长(ms 毫秒)及时长比例(%)

sylla duration	surroundings				general mean &ratio of each syll. ms %					
	A		B			C		D		
	11		11			13		16		
	ms	%	ms	%	ms	%	ms	%		
zhe	149	12.8 *	160	11.4	244	19.5	164	12.4	179	14.0
		(7.4) *		(7.5)		(10.2)		(5.7)		
shuang	225	19.4	212	15.1	221	17.6	220	16.6	220	17.2
		(11.3)		(9.9)		(9.2)		(7.6)		
xie	235	20.2	274	19.5	219	17.5	392	29.6	280	21.7
		(11.8)		(12.8)		(9.1)		(13.6)		
bu	158	13.6	288	20.5	152	12.1	159	12.0	189	14.6
		(7.9)		(13.5)		(6.3)		(5.5)		
jie	307	26.4	280	20.0	256	20.4	265	20.0	227	21.7
		(15.4)		(13.1)		(10.7)		(9.2)		
shi	215	18.5	192	13.7	181	14.4	208	15.7	199	15.6
		(10.8)		(9.0)		(7.6)		(7.2)		
syll. mean										
in each clause:										
	185		195		184		180			
	sd: 11.9		sd: 16.9		sd: 11.3		sd: 14.6			
syll. mean in all clauses:186 sd:14.3										
focused syll. mean in all clauses:292 sd:36.3										

* The figures in brackets are the ratio of each syllable to the whole utterance, and the ones without brackets are that to certain clause.

Table IV. Durational manifestations of speech units (1) "zhe shuang xie bu jie shi" and (2) "zhe shuang xie", (3) "bu jie shi", (4) "zhe shuang", (5) "jie shi" in different speech surroundings: nine speakers' mean(ms) and ratio(%).

表四. (1)测试小句“这双鞋不结实”、(2)“这双鞋”、(3)“不结实”、(4)“这双”、(5)“结实”在不同连读语句里的时长实现:九个人的平均值(ms)和时长比例(%)

speech units surroundings	(1)		(2)		(3)		(4)		(5)	
	ms	%	ms	%	ms	%	ms	%	ms	%
in A	1162	100	563	48.5	599	51.5	379	32.6	515	44.3
in B	1402	100	650	46.4	752	53.6	377	26.9	472	33.7
in C	1254	100	684	54.5	630	45.5	465	37.1	415	33.1
in D	1326	100	751	56.6	575	43.4	384	29.0	463	34.9

Table V. Comparison on temporal structure in terms of durational ratio between words or word-compounds in different clauses: (1) in isolation, (2) in connected speech.

表五. (1)单念与(2)连读时测试句内部时长结构(字组间及词间时长比)比较

item \ clause	S1	S2	S3	S4
zhe shuang xie	(1)46:54	44:56	54:46	54:46
/bu jie shi	(2)47:53	46:54	54:46	55:45
zhe shuang	(1)64:36	65:35	71:29	56:44
/xie	(2)67:33	58:42	75:29	51:49
bu/jie shi	(1)16:84	36:64	17:83	13:87
	(2)26:74	38:62	24:76	28:72
zhe/shuang	(1)46:54	48:52	54:46	47:53
	(2)40:60	43:57	52:48	43:57
jie/shi	(1)59:41	63:37	58:42	58:42
	(2)60:40	59:41	61:39	57:43

Table VI. Comparison on durational ratio(%) of (1)sentence “wo shuo zhe shuang xie bu jie shi”, (2)clause “zhe shuang xie bu jie shi”, (3)word “zhe shuang” and (4)“jie shi” in the same speech surrounding but spoken by different speakers.

表六. 同一语境下不同人所说的(1)句子“我说这双鞋不结实”、(2)小句“这双鞋不结实”、(3)两字组“这双”和(4)“结实”占语句总时长比例(%)的比较

speakers \ units	Sun	Li	Hua	Cao	Chen	Yan	Cai	Zu	Lin	mean	sd
(1)	71.7	67.4	71.6	71.5	67.5	73.7	72.6	72.9	74.2	71.4	2.5
(2)	55.1	55.7	56.3	59.4	56.1	56.1	58.1	59.1	55.6	56.8	1.6
(3)	17.5	18.5	19.6	20.4	17.0	17.2	16.2	20.3	18.7	18.4	1.5
(4)	24.5	23.6	23.2	26.7	26.4	27.8	25.8	29.6	29.6	25.9	2.0

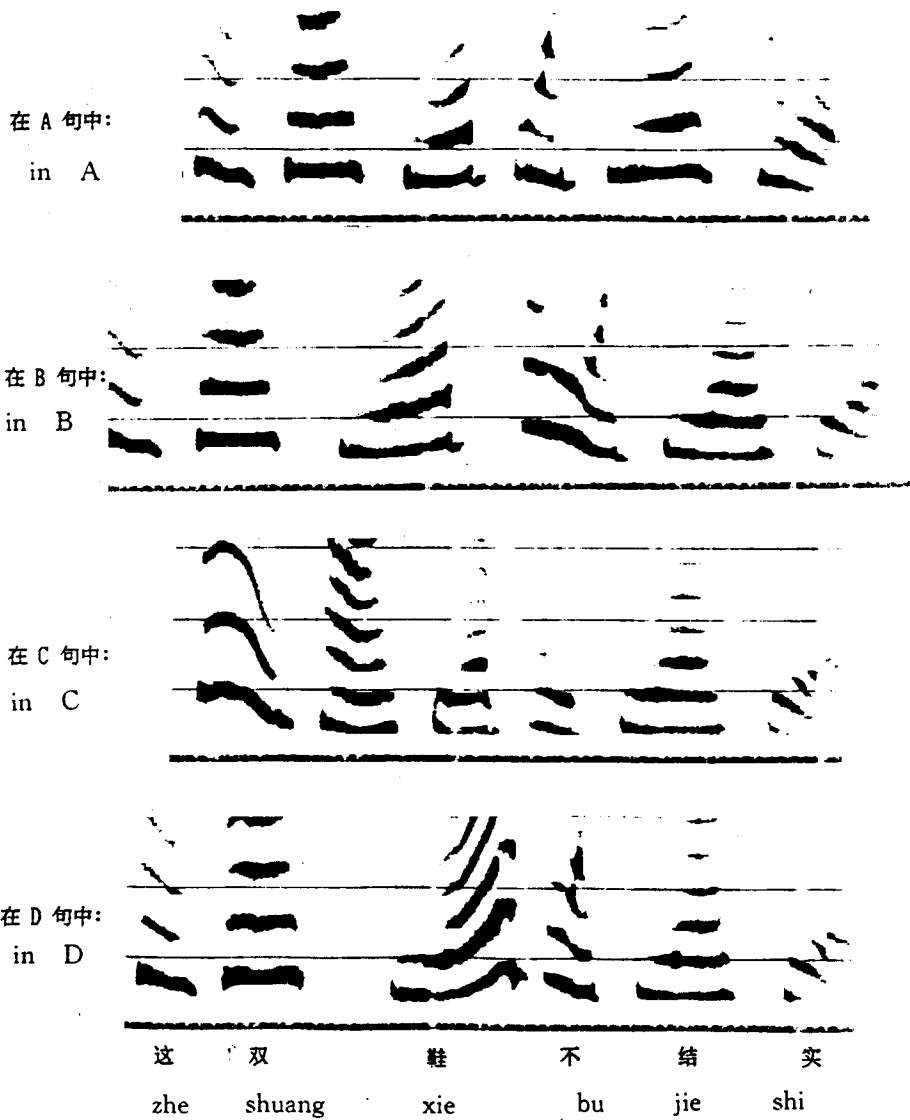


图 1. 不同语境(A, B, C, D)下测试小句音调变化轮廓的比较
Fig. 1. Comparison on tone contours of the clauses in different speech surroundings of A, B, C and D.