

The Role of Accentuation in Spoken Discourse Comprehension *

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Abstract Three experiments were carried out to investigate the role accentuation plays in spoken discourse comprehension. The first experiment examined how accentuation influenced on-line processing speed during discourse comprehension, using sentence-by-sentence auditory moving window technique. The second and third experiments explored the effect of accentuation on the immediate results of discourse processing (namely the activation of information in discourse representation), using word recognition task. The results showed that: compared to neutral accentuation, appropriate accentuation speeded up discourse processing and inappropriate accentuation slowed discourse processing; compared to neutral accentuation, appropriate accentuation enhanced the activation of new information in discourse representation; however, inappropriate accentuation suppressed the activation of important new information although it enhanced the activation of old information it marked. Therefore, appropriate accentuating accelerated discourse comprehension and inappropriate accentuation impeded discourse processing, both were exhibited both in on-line processing time and in the immediate result of discourse processing.

Key words accentuation, spoken discourse, information structure, facilitating effect, inhibiting effect.

1 Preface

Recently, psycholinguists have placed increasing importance on researches on spoken language processing, especially the contribution of prosody to language comprehension. At discourse level, one important function of prosody, especially accentuation, is to signal information state of discourse constituents. Based on perception experiments and corpus analysis, considerable research has shown that there is some correspondence between accentuation and information structure. Speakers tend to place pitch accent on new information, while leaving given information deaccented^[1~5].

Not only does accentuation correlate to information structure, but also it plays a role in discourse processing. For example, a series of studies found that: listeners consider a sentence as inappropriate when new information is unaccented and old information accented; they are more likely to indicate that a sentence is appropriate when new information is accented and old information unaccented; compared to inappropriate accentuation, appropriate accentuation

speeds up sentence processing during discourse comprehension^[1, 5~8].

These studies all contributed to the understanding of how correspondence between accentuation and information structure influences spoken discourse processing. However, there are still questions needing to be explored further. First, most of these studies used off-line methods, such as end-of-discourse comprehension time or appropriateness judgment, hence not being able to examine the role accentuation plays in on-line discourse processing. Second, most of these studies used question-answer pairs or a series of spoken instructions as experimental materials. However, the discourses read or heard in every day life usually consist of more sentences and unfold around a central topic. Previous studies could not indicate whether accentuation has the same effect on the processing of these relatively large-scale discourses.

Third, these studies only used inappropriate accentuating as control condition to explore the effect of appropriate accentuation. Therefore, they could not clarify the processing advantage of appropriate accentuation over inappropriate accentuation came from the

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facilitating effect of appropriate accentuation or the inhibiting effect of inappropriate accentuation.

Fourth, most of these studies examined the effect of accentuation on discourse comprehension through measuring processing time. However, the time taken to process a sentence is not an adequate measure. That is, if a sentence is understood in the same amount of time in two conditions, it might be that the sentence is more efficiently understood in one condition and more difficult to understand in the other condition, hence the result of discourse processing being different. Therefore, except measuring processing time, we should also measure the activation level of different information in discourse representation to examine the result of discourse processing.

To address the problems mentioned above, the main goal of our study was to investigate, given different information state of discourse constituent, how accentuation influences discourse comprehension. We pay attention to three points in our study. First, relatively large-scale discourses were constructed. Every discourse consisted of 5 sentences and unfolded around a central topic. The third sentence was target sentence. Second, in order to separate the facilitating and inhibiting effect, we systematically varied the relationship between accentuation and information structure in target sentence, including three conditions: appropriate accentuation, inappropriate accentuation, and neutral accentuation. Third, on-line methods were used to investigate the effect of accentuation on on-line discourse processing. Experiment one used auditory moving window technique to explore this question from the aspect of on-line processing time. Meanwhile, experiment two and experiment three used word recognition task to explore this question from the aspect of the activation information in discourse representation (namely the result of discourse processing).

2 Experiment One

The purpose of experiment one was to examine, compared to neutral accentuation, how inappropriate accentuation and appropriate accentuation influence on-line spoken discourse processing. One experiment we carried out previously had already explored this question^[9]. However, it only revealed the inhibiting effect of inappropriate accentuation. In order to examine whether this result was due to speaker's par-

ticular speaking style, experiment one in this study further investigated this question using materials read by different speaker.

2.1 Method

2.1.1 Subjects 27 subjects from nearby universities participated in the experiment for a minimal sum. All of the subjects were Chinese speaker. They had normal eyesight and had no reading impairment.

2.1.2 Materials 24 experimental discourses were constructed and recorded at the sampling at of 22050HZ, read by a female speaker. Every discourse included 5 sentences. The third sentence was target sentence which included a critical word (new word) conveying new information and a critical word (old word) conveying old information. Every experimental discourse had three versions: appropriate accentuation (in the target sentence, only new word was accented), inappropriate accentuation (in the target sentence, old word was accented, but new word was not accented) and neutral accentuation (in the target sentence, no word was specially accented).

Since the acoustic correlates of accentuation are mainly the variation of duration and the high point of pitch in Chinese^[10,11]. Acoustic analyses were performed at the high point of pitch and duration for old and new words respectively, with correspondence between accentuation and information structure as independent factor. The results confirmed that target sentences were read in the way as intended. In the following two experiments, similar acoustic analyses were also performed, which also confirmed that the speaker read target sentences in the manner as she was instructed to.

Experimental discourses were grouped into three lists. In each list, each discourse occurred only once and there were equal number of discourses in each of the three conditions. Across the three lists, each discourse appeared once in all of the three conditions. In addition to experimental discourse, there were also 20 filler discourses in each list. The structure of filler discourses was similar to that of experimental discourses.

2.1.3 Design In this experiment, there was one independent factor (correspondence between accentuation and information structure: appropriate accentuation; inappropriate accentuation; neutral accentuation) which was a within-subject factor.

Example discourses for experiment 1

| | |
|-------------------|---|
| Introduction : | Now we all use toothbrushes to clean and protect our teeth. 现代人通过刷牙来清洁和保护牙齿。 |
| Pre-target : | It was recently found that primitive peoples also had their own tooth-cleaning tools. 最近发现原始人也有自己独特的洁牙工具。 |
| Target sentence : | They probably used (culms) as cleaning tools for their 'teeth'. (appropriate accentuation) 他们很可能以(草秆)作为'牙齿'的清洁工具。 They probably used (culms) as cleaning tools for their <u>'teeth'</u> . (inappropriate accentuation) 他们很可能以(草秆)作为' <u>牙齿</u> '的清洁工具。 They probably used (culms) as cleaning tools for their 'teeth'. (neutral accentuation) 他们很可能以(草秆)作为'牙齿'的清洁工具。 |
| Post-target : | As there were tiny flutes in their tooth fossils. |
| The end : | It was proved that these flutes were the result of the long-term use of culms. |

(What is in brackets is new information ; what is in quotes is old information ; the underline indicates accentuation.)

2.1.4 Procedure Discourses were presented in a self-paced, sentence-by-sentence fashion. Subjects were instructed to press space-key to initiate presentation of every sentence at a speed they feel comfortable and correct. They were told to listen to each discourse for comprehension. At the end of each discourse, they answered a question as accurately as possible. The computer automatically recorded the time duration (DT) between the offset of target sentence and the onset of the subject's key-press response to initiate the presentation of next sentence as dependent factor.

2.2 Results and discussions

24 subjects whose data were included in the analysis answered the end-of-discourse questions with an accuracy rate of no less than 75%. DTs greater than 2 standard deviations away from an individual subject's mean were omitted, which occupied 6.25% of all data.

Analyses of variance were performed with DT as dependent factor and "correspondence between accentuation and information structure" as independent factor. The main effect was significant, $F_1(2, 46) = 13.37, p < 0.001$; $F_2(2, 46) = 12.56, p < 0.002$. As Figure 1 illustrated, DTs for appropriately accented target sentences were shorter than those for neutrally accented target sentences ($F_1(1, 23) = 5.03, p < 0.035$; $F_2(1, 23) = 7.44, p < 0.012$) and shorter than those for inappropriately accented sentences ($F_1(1, 23) = 19.00, p < 0.000$; $F_2(1, 23) = 25.58, p < 0.000$). However, DTs for inappropriately accented target sentences were longer than those for neutrally accented target sentences, $F_1(1, 23) = 5.03, p < 0.035$; $F_2(1, 23) = 5.20, p < 0.035$.

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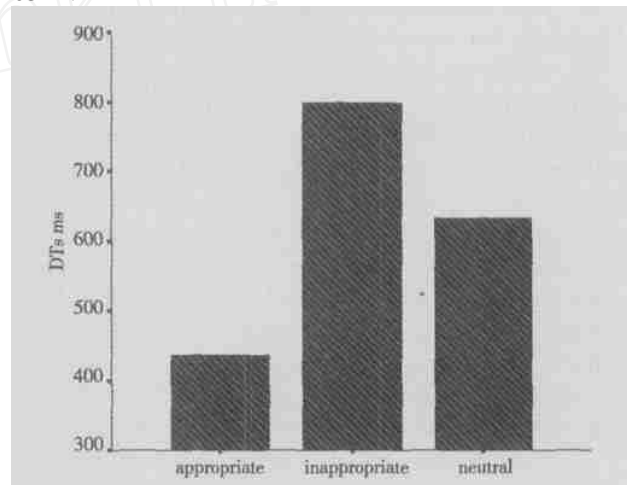


Figure 1 Subjects' average DTs for target sentence.

The results suggested that accentuation did play a role in discourse processing. Different from previous studies, this experiment further found that the advantage of appropriate accentuation over inappropriate accentuation in processing time came both from the inhibiting effect of inappropriate accentuation and the facilitating effect of appropriate accentuation, hence deepening insight into the role of prosody in spoken language processing.

3 Experiment Two

Experiment one investigated how accentuation affects discourse processing from the aspect of processing time. The subsequent two experiments further explored this question from the aspect of the immediate result of discourse processing.

The purpose of experiment two was to explore: compared to neutral accentuation, how and when appropriate accentuation affects the activation of new information during discourse processing. To explore this question, word recognition task was used.

3.1 Method

3.1.1 Subjects 68 subjects from nearby universities participated in the experiment for a minimal sum. They were recruited with the same standard as experiment one.

3.1.2 Materials 20 experimental discourses were constructed and recorded in the same way as those in experiment one. Every discourse had two versions: appropriate accentuation and neutral accentuation. Experimental discourses were grouped into two lists. In each list, each discourse occurred only once and there were equal number of discourses in each version. Across the two lists, each discourse appeared once in all of these two versions. There were also 32 filler discourses in each list.

For experimental discourses, the test words were all new words in target sentence. We varied the temporal relationship of new words in discourse and the test words (including four kinds of ISI: 500ms; 1000ms; 1500ms; 2000ms) in order to provide a window on the pattern of activation over time.

For filler discourses, there were 6 test words which had occurred in their corresponding discourses and 26 test words which had never occurred in any of these discourses, in order to equal the number of yes and no responses across experimental and filler discourses.

3.1.3 Design In this experiment, there were two independent factors: correspondence between accentuation and information structure (appropriate accentuation; neutral accentuation) and ISI (500ms; 1000ms; 1500ms; 2000ms). The former was a within-subject factor and the latter was a between-subject factor.

3.1.4 Procedure 68 subjects were randomly and averagely assigned to one of the four ISI conditions. All discourses were presented to subjects with no interruption. Subjects' primary task was to listen to each discourse for comprehension and answer a question at the end of each discourse. Meanwhile, subjects were asked to decide rapidly and accurately whether the word appearing on the screen of computer had occurred in the discourse they were currently listening to by pressing the designated key. Computer

automatically recorded their response latency as dependent variable.

3.2 Results and discussions

Data from 4 subjects whose question-answer error rates were equal to or above 25% were deleted. As a result, only data from 64 subjects were included in analysis, with each ISI condition having 16 subjects. Response latencies that were wrongly recognized and that were greater than 2 standard deviations away from an individual subject's mean were omitted, occupying 2.80% and 1.90% of all data respectively.

In every ISI condition, T test was conducted respectively with "correspondence between accentuation and information structure" as independent factors and response latency as dependent factor. As Figure 2 illustrated, when ISI was 1000ms, 1500ms or 2000ms, the effect of "correspondence between accentuation and information structure" was significant ($t_1(1,15) = 4.02, p < 0.001, t_2(1,19) = 2.82, p < 0.011; t_1(1,15) = 2.73, p < 0.016, t_2(1,19) = 2.92, p < 0.009; t_1(1,15) = 2.10, p < 0.053, t_2(1,19) = 2.76, p < 0.013$), indicating that response time for test words following accented new words was faster than those following unaccented new words. But when ISI was 500ms, there were no significant difference between appropriate and neutral accentuation.

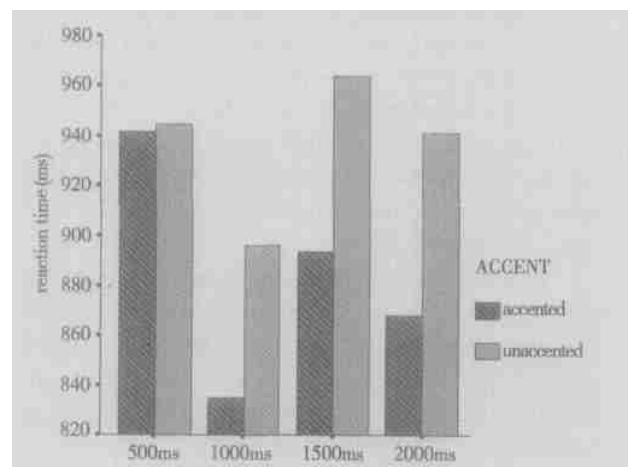


Figure 2 Subjects' average reaction times to test words

The results indicated that, compared to neutral condition, appropriate accentuation did enhance the activation of new information in the representation of discourse, hence the most important information gaining a privileged status in listeners' working mem-

ory. About 1000 ms after the offset of accented words this effect had already taken place and lasted for a relatively long time.

4 Experiment Three

In experiment two, we only examined and found that appropriate accentuation facilitated the activation of information it marked (namely new information) during discourse comprehension. What remains unknown is whether inappropriate accentuation also facilitates the activation of information it marks (namely old information), and whether inappropriate accentuation at the same time suppresses the activation of new information.

Therefore, the purpose of experiment three was to explore the following: compared to neutral accentuation, how and when inappropriate accentuation affects the activation of old and new information respectively.

4.1 Method

4.1.1 Subjects 51 subjects from nearby universities participated in the experiment for a minimal sum. They were recruited with the same standard as experiment one and two.

4.1.2 Materials In this experiment, there were 24 experimental discourses which have similar structure as those of experiment one and experiment two. Every discourse had two versions: inappropriate and neutral accentuation. For all experimental discourse, in the target sentence, new word was in the front of old word. Every experimental discourse had two kinds of test words: new words and old words. Therefore, there were four experimental conditions that were resulted from crossing the two variables: "correspondence between accentuation and information structure" (inappropriate *vs.* neutral) and "test word" (old *vs.* new). Based on those four conditions, experimental discourses were grouped into four lists according to Latin Square. In every list, there were also 24 filler discourses.

In order to explore the pattern of 'activation over time, we also varied the temporal relationship of old word in target sentence and the test word, including three kinds of ISI: 500 ms; 1000 ms; 1500 ms.

For filler discourses, the test words had never occurred in any of these discourses in order to equal the number of yes and no responses across experimental and filler discourses.

4.1.3 Design In this experiment, there were three independent factors: correspondence between

accentuation and information structure (inappropriate accentuation; neutral accentuation); test word (new; old) and ISI (500 ms; 1000 ms; 1500 ms). The former two factors were within-subject factors and the latter was a between-subject factor.

4.1.4 Procedure 51 subjects were randomly and averagely assigned to one of the three ISI conditions. The procedure of this experiment was similar to that of experiment two. Computer automatically recorded subjects' response latency as dependent variable.

4.2 Results and discussions

Data from 3 subjects whose question-answer error rates were equal to or above 25% were deleted. As a result, only data from 48 subjects were included in analysis, with each ISI condition having 16 subjects. The data with response time which was wrongly recognized and which was greater than 2 standard deviations away from an individual subject's mean were omitted, occupying 1.60% and 0.87% of all data respectively.

In every ISI condition, analyses of variance were performed with "correspondence between accentuation and information structure" and "test word" as independent factor. As *Figure 3* illustrated, in all ISI conditions, there was a significant interaction between these two factors, $F_1(1, 15) = 13.43, p < 0.002$, $F_2(1, 23) = 17.62, p < 0.000$; $F_1(1, 15) = 24.70, p < 0.000$, $F_2(1, 23) = 10.32, p < 0.004$; $F_1(1, 15) = 7.74, p < 0.014$, $F_2(1, 23) = 14.07, p < 0.001$ respectively, but all of the main effects were not significant. Further simple analysis found that: when ISI was 500ms, 1000ms and 1500ms, reaction to old test word following inappropriate accentuation was significantly faster than that following neutral accentuation, $F_1(1, 15) = 9.15, p < 0.009$, $F_2(1, 23) = 12.86, p < 0.002$; $F_1(1, 15) = 21.70, p < 0.000$, $F_2(1, 23) = 6.80, p < 0.016$; $F_1(1, 15) = 19.51, p < 0.000$, $F_2(1, 23) = 11.20, p < 0.003$ respectively; when ISI was 500ms or 1000ms, reaction to new test word following inappropriate accentuation was significantly slower than that following neutral accentuation, $F_1(1, 15) = 10.20, p < 0.006$, $F_2(1, 23) = 4.47, p < 0.045$; $F_1(1, 15) = 13.13, p < 0.003$, $F_2(1, 23) = 4.75, p < 0.040$ respectively; but when ISI was 1500ms, reaction to new test word between inappropriate and neutral accentuation was not significantly different.

The results indicated that, compared to neutral condition, inappropriate accentuation enhanced the activation of old information in the representation of discourse; however inappropriate accentuation sup-

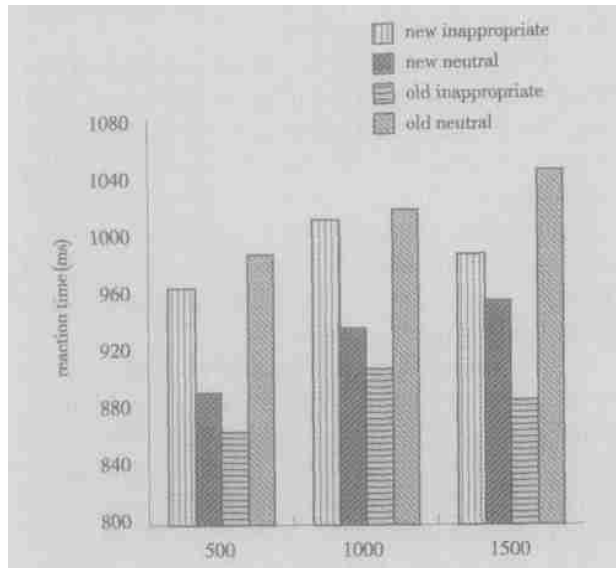


Figure 3 Subjects' average reaction times to test words

pressed the activation of new information, hence status of the most important information being weakened in listeners' working memory. About 500ms after the offset of accented old words, those effects had already begun, but inappropriate accentuation's facilitating effect to old words lasted longer than its inhibiting effect to new words.

5 General discussions

Three experiments in this study were carried out to investigate how correspondence between accentuation and information structure influences spoken discourse comprehension. The first and the latter two experiments explored this question from the aspect of on-line processing time and the immediate result of processing, using moving-window technique and word recognition task respectively.

5.1 The effect of accentuation on on-line processing time during discourse comprehension

The results of experiment one showed that: compared to neutral accentuation, inappropriate accentuation slowed discourse processing and appropriate accentuation accelerated discourse processing. Previous studies have already found that compared to inappropriate accentuation, appropriate accentuation speeds up discourse processing^[1, 7, 8]. By establishing neutral accentuation as control condition, this experiment further proved that the processing advantage of appropriate accentuation over inappropriate accentuation came both from the facilitating effect of appropriate accentuation and from the inhibiting effect of inappropriate accentuation.

5.2 The effect of accentuation on information's activation in discourse representation

Not only did accentuation influence the speed or difficulty of on-line discourse processing, but it also affected the result of processing, namely the activation of information in discourse representation. The results of experiment two showed that appropriate accentuation enhanced the activation of new information. This effect occurred about 1000 ms after the offset of accented new words and lasted for a relatively long time. Experiment three found that although inappropriate accentuation enhanced the activation of information it marked, namely old formation, it suppressed the activation of new information. About 500 ms after the offset of accented old words those effects had already occurred. Therefore, with respect to new information which was important to discourse comprehension, appropriate accentuation had a facilitating effect and inappropriate accentuation had an inhibiting effect.

The results of experiment two and three also showed that the facilitating effect of inappropriate accentuation occurred earlier than the facilitating effect of appropriate accentuation. This result might have much to do with the role information structure plays in language processing. According to Hornby (1974) and Carpenter & Just (1977)^[12, 13], information structure is one of the main factors controlling listener's attention in language comprehension; they initially direct their attention to new information of a sentence. Subsequently, considerable experimental studies also indicated that new information is very important in language comprehension, so subjects allocate more attention to the processing of words conveying new information in sentence or discourse^[14~16]. Therefore, even in the absence of appropriate accentuation, new information itself can attract listener's attention, thus leaving less room for appropriate accentuation to take its facilitating effect. However, listeners usually allocate less attention to old information during language comprehension, so inappropriate accentuation could have an obvious facilitating effect on the processing of old information. Therefore, the facilitating effect of inappropriate accentuation to old information could occur relatively earlier than the facilitating effect of appropriate accentuation to new information.

5.3 The contribution of this study to understanding accentuation's effect on spoken discourse comprehension

Together, the current study provided a compre-

hensive picture of the effect accentuation had on spoken discourse comprehension. Meanwhile it made important new contribution to our understanding of the role prosody plays in language comprehension.

First, it has already been established that prosody, especially accentuation, influences language processing. We established that those results could be generalized to our materials (relatively large-scale discourses rather than question-answer pairs or spoken instructions) and tasks (just listening for comprehension rather than making judgments).

Second, previous studies only found appropriate accentuation's processing advantage over inappropriate accentuation. The current study deepened this insight by providing evidence that this processing advantage came both from the inhibiting effect of inappropriate accentuation and the facilitating effect of appropriate accentuation.

Third, the results of this study showed that the effect of accentuation on spoken discourse comprehension not only exhibited in on-line processing time but also in the immediate result of processing, namely the activation of information in discourse representation.

In summary, compared to neutral accentuation, appropriate accentuation has a facilitating effect and inappropriate accentuation has an inhibiting effect on spoken discourse processing.

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重读在口语语篇理解加工中的作用

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摘要 用三个实验探索了重读在口语语篇理解加工中的作用。其中实验 1 利用以句子为单位的口语动窗法,考察了重读如何影响语篇的临场加工速度。实验 2 和实验 3 利用词汇再认任务,考察了重读对语篇临场加工效果(即信息在语篇表征中的激活水平)的影响。结果表明:与控制条件相比,一致性重读加快语篇的临场加工,不一致性重读减慢语篇的理解加工;与控制条件相比,一致性重读提高了新信息在语篇表征中的激活水平;不一致性重读虽然促进了所标示的旧信息的激活,但是对于相对重要的新信息的激活具有抑制作用。从而说明一致性重读对语篇理解具有促进作用,而不一致性重读阻碍语篇理解。这一促进和抑制作用不仅体现于语篇的临场加工过程中,而且表现在即时的语篇加工效果中。

关键词 重读, 口语语篇, 信息结构, 促进效应, 抑制效应。

分类号 B842