Phonetic Manifestation and Influence of Zero Anaphora in Chinese Reading Texts

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Abstract

The present paper conducts a pioneering study on the phonetic manifestation and influence of zero anaphora in Chinese reading texts. The stress degree of the boundary syllable and the duration of the pause at the anaphoric position are examined. The results show: i) the boundary syllable after zero anaphoric form is more accented; for the two types of zero anaphora concerned in this study, the boundary syllable after distant zero anaphoric form is more accented than that after immediate zero anaphoric form; ii) the boundary syllable before immediate anaphoric form is more accented than that before distant anaphoric form; iii) the pause before immediate zero anaphoric form is shorter than that before other types of anaphoric forms. Based on these results, the study further proposes that the syllable weight of the underlying anaphoric form is projected to the following syllable in the surface representation. Moreover, semantic distance and relation can account for the differences between distant and immediate zero anaphora.

Index Terms: zero anaphora, Chinese reading texts, stress, pause, duration, projection

1. Introduction

Anaphora, in contemporary linguistics, is commonly used to refer to a relation between two linguistic elements, wherein the interpretation of one is in some way determined by the interpretation of the other [1]. As an essential device to achieve cohesion, coherence and concision in discourse, *textual anaphora* is a widely focused topic in linguistic field. With regard to Chinese, anaphoric forms are further categorized into three types: zero anaphora, pronominal anaphora and nominal anaphora [2]. These three types of anaphora have been investigated from various perspectives by syntacticians, pragmaticians, rhetoricians and cognitive linguists [3-6], whose works have greatly deepened our understanding of anaphora both in Chinese and in general.

In spite of the flourishing literature, few studies, however, have dealt with Chinese textual anaphora from the phonetic point of view. Hou and Jia [7] have studied the phonetic manifestation and influential factors of pronominal anaphoric word "ta" in Chinese reading texts. As for zero anaphora, which is regarded as a distinct feature of Chinese [8, 9], it is universally accepted that there is no phonetic manifestation as there is no explicit anaphoric form. Therefore, this study exclusively focuses on zero anaphora in Chinese reading texts to see whether this is true.

According to the distance between the zero anaphoric form and its antecedent, this study further subcategorizes zero anaphora into distant zero anaphora and immediate zero anaphora. Distant zero anaphora is defined as that there are other components between the zero anaphoric form and its antecedent, while immediate zero anaphora is defined as that the zero anaphoric form is right after its antecedent: there are no other components between the zero anaphoric form and its antecedent except for a pause.

2. Methodology

Phonetic experiments and statistical analysis are adopted to approach the research goal. Specifically, the phonetic manifestations of the adjacent components of the zero anaphoric form and those of other types of anaphoric forms have been selected for phonetic examination and comparison. In this research, stress degree and duration are taken as parameters to investigate the phonetic variations induced by zero anaphora.

2.1. Materials

The materials selected in the study are reading texts. There are 10 Chinese texts chosen from the Annotated Speech Corpus of Chinese Discourse (ASCCD), which are developed by the Phonetic Lab, Institute of Linguistics, Chinese Academy of Social Sciences (CASS). These texts cover common genres such as narration, argumentation, news report and essay. The phonetic data are collected from 10 Standard Mandarin speakers (5 male and 5 female) in Beijing. The prosodic annotation is based on Chinese ToBI (Tones and break indices) system, which is developed based on the English ToBI system by the Phonetic Lab, CASS. The annotation files include four tiers, namely, the onset and rhyme tier, the Chinese Pinyin tier, the break index tier, and the stress tier. In the current research, the stress tier is used for analysis, in which four stress degrees of each prosodic unit are annotated: 0 means non-accented syllable in prosodic word, 1 means most-accented syllable in prosodic word, 2 means most-accented syllable in secondary prosodic phrase, and 3 means most-accented syllable in primary prosodic phrase.

2.2. Research Design

The stress degree of the surrounding syllables of the zero anaphoric form and the duration of the pause before the zero anaphoric form are investigated. By comparing the above information for zero anaphora with that for other types of anaphora, it can be explored whether zero anaphora can be expressed phonetically.

Reading texts are different from strictly controlled materials in the sense that there are various factors which may influence the phonetic manifestations of anaphora, such as the discourse level, rhetorical structure, conjunction words, the position of anaphora in a complex sentence, etc. To avoid these various influential factors, only the anaphoric forms that occurred right after the first pause in a sentence are investigated in this research. However, the above constraint was not strictly applied to intermediate zero and pronominal

25 – 29 August 2013, Lyon, France

anaphora, as the cases of the two types in the materials are relatively rare. Cases that occurred in quotations, rhetorical structures and that co-occurred with conjunction words were excluded. These constraints have reduced the potential influential factors to a minimal extent.

The positions of the four types of the anaphoric forms are roughly matched and they are all syntactic subjects. Therefore, they are directly comparable. Table 1 shows the examples of different types of anaphora concerned in the study: distant zero anaphoric form (Z1), immediate zero anaphoric form (Z2), pronominal anaphoric form (P) and nominal anaphoric form (N). The cases of Z1, Z2, P and N in the materials are 19, 15, 12 and 14 respectively. For the materials are natural texts, these cases are limited but still enough for investigation.

Table 1. *Examples of Different Types of Anaphora in Chinese Reading Texts*

Z1 (Distant zero anaphora)	先生　　自　愧　　　邋遢， *husband self ashamed sluttish* (Z1)点头　称　　是。 　　*nod say yes* My husband was ashamed of his appearance, (Z1) **(he)** nodded with agreement.
Z2 (Immediate zero anaphora)	日　前　　忽然　　看到一　篇　　文章， *day before suddenly see a　piece article* (Z2)让　人　　茅塞顿开。 　　*let　man　suddenly see the light* The other day I read an article, (Z2) **(which)** made me realize the truth suddenly.
P (Pronominal anaphora)	孙庆福　　兄　　妹　7　个， *Sun Qingfu brother sister 7　(a measure word)* (P)他　是　老　大。 　　*he　is　old　big* Qingfu Sun has 6 siblings, (P) **he** is the eldest.
N (Nominal anaphora)	1975　年 5　月，　(N)孙庆福　　　和 *1975 year 5　month　Sun Qingfu　and* 宋素梅　　经 人　　介绍　　　相识了。 *Song Suimei by man introduce　acquainted* In May, 1975, (N) **Qingfu Sun** and Sumei Song were introduced to each other.

2.3. Data Annotation and Analysis

An anaphora tier is added in the annotation files, in which the different anaphoric forms are annotated. The following information is extracted: i) the stress degree of the syllable PP right after the pronominal anaphoric form P (PP is used to represent the post-P syllable), which represents the phonetic prominence of the syllable after the pronominal anaphoric form. This syllable is the counterpart of the boundary syllable after the zero anaphoric form. This information is used to investigate the influence on the component after the anaphoric form induced by the absence of a concrete anaphoric form. ii) The stress degree of the boundary syllable after the distant zero anaphoric form Z1 and intermediate anaphoric form Z2, as well as the stress degree of the boundary syllable of pronominal anaphoric form P and nominal anaphoric form N, which represent the phonetic prominence of the boundary syllable at the positions of Z1, Z2, P and N. By comparing the phonetic prominence of the boundary syllables at different anaphoric positions, the potential influence on the boundary syllable at the anaphoric position is investigated whether a

concrete anaphoric form is present or not. iii) The stress degree of the boundary syllable before Z1, Z2, P and N, which represents the phonetic prominence of the component before different types of anaphora. These data are used to investigate the phonetic difference before different types of anaphoric forms. iv) The duration of the pause before Z1, Z2, P and N, which is used to investigate the influence on the boundary pause induced by different types of anaphoric forms. Praat 4.6 is used for data annotation and extraction, and SPSS 19 is employed for statistic analysis.

3. Contrastive Analysis on Stress Degree

3.1. The Stress Degree after Zero Anaphoric Form

Five groups of data are compared in this section, namely, the stress degree of the boundary syllables after Z1 and Z2, the stress degree of syllable PP, and the stress degree of the boundary syllables of P and N for each speaker. Figure 1a shows the mean stress degree of the five groups for each speaker, while Figure 1b illustrates the contrastive means distributions of the data groups Z1, Z2, PP, P and N for the 10 speakers. Paired t-test is further conducted to examine the differences between the zero anaphoric groups and other types of anaphoric groups, and the difference between Z1 and Z2.
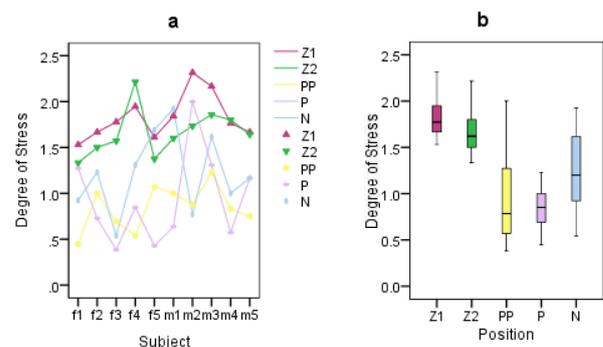

Figure 1: *Mean Stress Degree Distribution of Syllables at positions of Z1, Z2, P, PP and N.*

From the statistic analysis, the following observations can be obtained:

A) The means of stress degree of the boundary syllables after Z1 and Z2 are significantly higher than that of PP and the boundary syllables of P and N ($p < 0.05$), which shows that the boundary syllable after the zero anaphoric form is more accented than the syllable after the pronominal anaphoric word, and the boundary syllable of the pronominal and nominal anaphoric forms. The boundary syllable after the zero anaphoric forms Z1, Z2 and the syllable PP after the pronominal anaphoric form P are syntactically counterparts, showing that the absence of the explicit anaphoric form makes its following syllable more accented. Moreover, the boundary syllable after Z1, Z2 and the boundary syllable of P, N are all boundary syllables at the sub-sentence initial positions, the additional accent of the boundary syllable after Z1, Z2 shows that the significant difference between the stress degree of the syllable after Z1, Z2 and PP is not caused by boundary effect.

It can be inferred from the above analysis that the absence of an explicit anaphoric form in the case of zero anaphora can

significantly raise the phonetic prominence of the following syllable. In other words, the boundary syllable after the zero anaphoric form wears an additional stress. Therefore, the obtained results are inconsistent with the widely-accepted view that there is no phonetic manifestation for zero anaphora. Based on these results, a view of the underlying syllable weight projection for zero anaphora is proposed as that the deletion of the explicit form of an anaphoric form doesn't have all its phonetic features deleted; its underlying syllable weight is left behind and projected to the following syllable in the surface representation. Figure 2 illustrates the process of the underlying syllable weight projection for zero anaphora. First, the connection between the anaphoric form and its syllable weight is cut off by deleting the explicit anaphoric form, and its syllable weight becomes floating. Then the floating syllable weight is attached to the following syllable, which makes the latter more accented in the surface representation. The additional phonetic prominence of the following syllable carries the information of the deleted anaphoric form and exhibits its existence, as well as its underlying meaning.
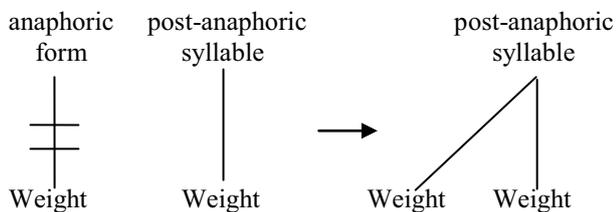

Figure 2: *The Process of Zero Anaphora Projection.*

B) The means of the stress degree of the boundary syllables after Z1 are significantly higher than those after Z2 ($p < 0.05$), indicating that the boundary syllable after distant zero anaphoric form is more accented than that after immediate zero anaphoric form. The difference between the boundary syllables after Z1 and Z2 shows the influence on the phonetic manifestation of zero anaphora by semantic distance and relation between zero anaphoric form and its antecedent. For Z2, there are no other components between zero anaphoric form and its antecedent, and there is a higher continuity between them. However, there are other components between Z1 and its antecedent, thus the antecedent of Z1 is harder to locate than that of Z2 and may need more phonetic prominence to compensate the heavier load, which can account for the higher stress degree of the boundary syllable of Z1 than that of Z2. This fact also demonstrates the pragmatic role of stress in reading texts. A higher stress degree can indicate the presence of the zero anaphoric form and is helpful to the listeners in zero anaphora resolution. Therefore the listeners can receive the information conveyed by Chinese reading texts more effectively.

3.2. The Stress Degree before Zero Anaphoric Form

The stress degree of the boundary syllables before the anaphoric form is used to represent the phonetic prominence of the component before the anaphoric form. Figure 3a shows the means of the stress degree of the boundary syllable before Z1, Z2, P, and N for each speaker, while Figure 3b demonstrates the contrastive means distribution.
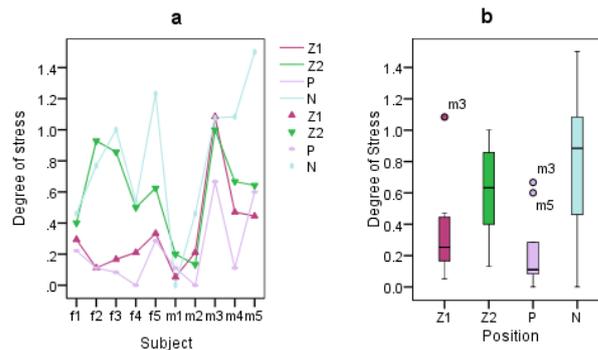

Figure 3: *Mean Distribution of Stress Degree of Syllables before Z1, Z2, P and N.*

The results exhibit significant differences between following comparative pairs, i.e., Z1 & N, Z2 & P, Z1 & Z2, P & N ($p < 0.05$), while the differences between pairs Z1 & P, Z2 & N are not significant ($p > 0.05$). The result patterns before anaphoric forms shows that the boundary syllables before Z2 and N are more accented than those before Z1 and P. For N, it usually introduces a new topic and is less related with its preceding component, which may have a higher stress degree because of the boundary effect. As for the significant differences between Z2 and Z1, P, it is inferred that the information structure plays a prominent role. As for Z2, the antecedent is right before the zero anaphoric form and usually serves as the object of the preceding sub-sentence and semantically co-refers with Z2, the subject of its following components. Thus the antecedent of Z2 is usually the newly introduced component. According to the universal principal that the new information is accented [10], the antecedent of Z2 tends to be accented. Furthermore, the pre-anaphor component is mostly likely to be a content word, while it is not the case for Z1 and P. The component before Z1 and P is related to the content of the text and follows no distinct patterns. According to the principle that the content word is more accented [11], the component before Z2 should be more accented, which is another aspect that accounts for the stress difference.

4. Contrastive Analysis on Duration

The Medians of duration of pauses before Z1, Z2, P and N for each speaker are shown in Figure 4a. Figure 4b is the contrastive illustration of medians distribution.
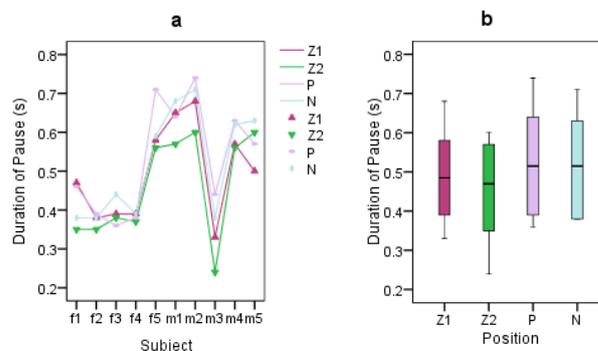

Figure 4: *Median Distribution of Duration of Pauses before Z1, Z2, P and N*

. The most obvious observation is that the duration of pause ($p < 0.05$) before Z2 is significantly shorter than that before P and N. Although the difference between Z1 and Z2 is not significant ($p = 0.059$), the value of p is very close to 0.05, which shows an obvious tendency that pause before Z2 is shorter than that before Z1, which can be observed in Figure 4.

Like the stress degree patterns before Z1 and Z2, the syntactic distance and semantic relation between anaphoric form and its antecedent may account for this tendency. In the case of Z2, there are no other components between anaphoric form and its antecedent, so there is a higher continuity; and the antecedent equals to the subject of the following components semantically, therefore, the pause before Z2 is shorter. This pattern shows that the pause level is related to the tightness between the phonetic units at both ends of the pause [12].

5. Discussion

The obtained results in this paper show that boundary syllable after zero anaphoric form is more accented, based on which a view of zero anaphora projection is proposed: although zero anaphoric form lacks explicit form, the underlying syllable weight can be projected to the following syllable and be exhibited by the realization of accent. This phenomenon is similar to the feature spreading in the theory of auto-segmental phonology, in which the deleting of the X-slot doesn't have all the features deleted, the auto-segmental features can be reserved and become floating features, and can be exhibited by attaching to its adjacent segments. There is some difference for the underlying syllable weight projection proposed by the current study. The underlying anaphoric form is uncertain. It could be a pronoun; it could also be a complete form or an extended form of its antecedent. Therefore, the underlying syllable weight mentioned here is a general feature belonging to a Chinese word which has either one or more syllables. It is neither on the segmental level, nor the intonatioal level. This phenomenon shows a phonetic compensation effect: the deleted component could be compensated by accenting its surrounding component. For the phonetic difference between Z1 and Z2, the result patterns reflect the interactive relationship between syntax and phonetics, i.e., syntax influences the phonetic manifestation and the phonetic manifestation reflects syntactic distance and semantic relation.

In spite of the overall consistent pattern of the results we obtained, several aspects that may introduce errors should be stated. First, as we mentioned before, the selecting constraints are not consistent due to the different frequencies of different types of anaphora. Second, since the reading Chinese text is concerned in this research, the experimental materials are uncontrolled texts; certain factors couldn't be excluded thoroughly. The third problem is the accuracy and consistency of the annotation of stress degree, which was done manually based on perception. Other various aspects may also contribute to the perception of stress degree, such as the quality, lexical tone of a syllable [13], which were not controlled either.

On the other hand, despite the potential influential factors in the random materials and the different styles of the 10 speakers, the obtained results exhibit an overall significantly consistent pattern for all the speakers, which lay a solid basis for the proposed explanations. Factors such as context and individual characteristics may account for the exceptions.

6. Conclusions

Through contrastive analysis of stress degree and pause duration, the present study explores the phonetic manifestation and influence of zero anaphora in Chinese reading texts. Based on the consistent patterns of the results, the following conclusions can be drawn for zero anaphora which is at the sub-sentence initial position: i) the boundary syllable after the zero anaphoric form is more accented. The underlying anaphoric form can be projected to the surface representation by attaching its syllable weight to the following syllable. For the two types of zero anaphora concerned in this study, the stress degree of the boundary syllable after immediate zero anaphoric form is significantly lower than that after distant zero anaphoric form. Syntactical distance and semantic relation can account for this pattern. ii) For the component preceding the zero anaphoric form, the stress degree of the boundary syllable before immediate anaphoric form are higher than that before distant zero anaphoric form and pronominal anaphoric form, representing the principles that the new information is accented and the content word is accented. iii) For the boundary pause before anaphoric forms, the duration of the pause before immediate zero anaphoric form tend to be shorter than that before distant zero anaphora, and is significantly shorter than that before other types of anaphoric forms. Semantic distance and relation also accounts for the differences.

7. Perspectives

The present research, which is on the interface between the phonetic level and the levels of syntax, semantics and pragmatics, fully exhibits the role of experimental phonetics in the study of phonology, syntax and higher levels in linguistics. It can deepen our knowledge of zero anaphora and lead to a reconsideration of zero anaphora from the phonetic point of view. Also, it shows that the underlying meaning can be exhibited on the surface representation through phonetic approach, which may further the understanding of the relationship between speech and meaning. Furthermore, it can promote the research of discourse prosody in Chinese and the results can be applied in the speech synthesis of Chinese texts.

We hope this research could further promote the research on the interface between different levels in linguistics. Since there are various potential influential factors due to the materials, the results and conclusions obtained in this study need to be verified and extended to natural speech in further research by designing well-controlled experimental materials and applying more accurate measurements.

8. Acknowledgements

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