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Disambiguate or not? – The role of prosody in unambiguous and potentially ambiguous anaphora production in strictly Mandarin parallel structures

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Abstract

It has been observed that the interpretation of pronouns can depend on their accentuation patterns in parallel sentences as "John hit Bill and then George hit him", in which 'him' refers to Bill when unaccented but shifts to John when accented. While accentuation is widely regarded as a means of disambiguation, some studies have noticed that it also extends to unambiguous anaphors [7-10]. From the perspective of production, however, no strong experimental confirmation was found for the 'shift' function of accented pronouns, which is due to the fact that production research has mainly focused on corpora [5, 6]. Hence, the nature of the accent on anaphors still remains obscure. By manipulating *referential shift* and *ambiguity*, this study explores the role of prosody in anaphora production in strictly Mandarin parallel structures. The results reveal a significantly higher F_0 and longer duration for anaphors in referentially shifted conditions, suggesting that anaphoric accentuation signals a referential change in strictly parallel structures in Mandarin. No evidence was found that ambiguity plays a role in anaphoric accentuation. This finding challenges the general view on accented pronouns and will deepen our understanding on semantics-prosody relationship.

Index Terms: pronoun, anaphora, production, ambiguity, accent, prominence, F_0

1. Introduction

1.1. Background

It has been noted that the interpretation of pronouns may depend crucially on prosody in spoken language [1]. As illustrated in (1) – a coordinated sentence with a parallel structure, the potentially ambiguous pronoun 'him' has different antecedents under different accentual patterns (capitalization indicates accentuation): it refers to 'Bill' when unaccented but to 'John' when accented.

(1) John hit Bill and then George hit him (Bill).
John hit Bill and then George hit HIM (John).

Studies on pronoun resolution propose that listeners employ a *parallel function strategy*: an unaccented pronoun co-refers with a prior constituent in the same syntactic position, while an accented pronoun shifts this preference to the competitor in a different position [2-4]. Since listeners are unable to resolve the correct antecedent of a pronoun in sentences like (1) via cues other than prosody, pronominal accentuation is pervasively assumed to be a disambiguation strategy [5-12]. Different from this ambiguity-oriented view, some studies point out from a generalized perspective that accentuation also extends to unambiguous anaphors [13-15], as illustrated in Lakoff's example (2) [16] with unambiguous pronouns and (3) with full NP. Moreover, it is argued that disambiguating information cannot surpass prosodic cue in resolution [2, 14], as shown in (4), in which the unaccented 'he' cannot be identified with 'Bill' and listeners are forced to associate 'he' with 'Mary'. These examples show that the connection between prosody and ambiguous pronouns may be an instance of a broader relationship between prosody and *referential shift*, which is defined as the anaphor and its antecedent being in different syntactic positions.

(2) John insulted Mary and then SHE insulted HIM.

(3) John hit Bill and then George hit JOHN.

(4) Mary hit Bill, and then he hit HARRY.

Though *referential shift* is a more plausible trigger of accentuation on pronouns than *ambiguity*, the role and the exact nature of anaphoric accentuation in parallel structures still remain obscure.

On the one hand, the possibility has not been ruled out that *ambiguity* jointly plays a role with *referential shift*. Moreover, the disambiguation effect of prosody seems so self-evident that accented unambiguous anaphors has been much ignored, and many studies have modified Lakoff's example by only using ambiguous pronouns, which runs the risk of establishing and reinforcing a causal relationship between *ambiguity* and accentuation. Hence, experimental work is needed to assess the respective contributions of *referential shift* and *ambiguity*. To our knowledge, *ambiguity* has never been investigated as a potential factor in anaphora production.

On the other hand, though intuitively convincing, experimental evidence is still lacking relating accentuation and *referential shift*. Most experimental studies on production have failed to find a distinct 'shift' function of accented pronouns [9, 17]. A major reason is that almost all those studies used corpus materials, in which there may be limited cases of *referential shift* and there exist many uncontrolled confounding factors. Studies on perception have demonstrated various strategies and factors in pronoun resolution. For instance, some evidence indicates that a *subject assignment preference* is the dominant strategy other than *parallel function strategy* [18, 19]. Smyth's result [2] shows that lack of control over parallelism accounts for the conflicting results. Besides sentence structure, there are other factors involved such as *discourse coherence* [8, 20, 21] and *causality* [22] introduced by the verb or conjunctions. For example, in 'John hit Bill and then he fell', contrary to either the parallelism or the subject assignment account, 'he' refers to 'Bill' due to coherence; in 'John impressed Bill because he …' and 'John admired Bill because he …', 'he' is more expected to refer to 'John' in the first sentence but to 'Bill' in the second sentence due to the direction of causality implied within the verbs. Factors affecting resolution may also

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influence production. Hence, in order to check for the role of *referential shift*, it is necessary to use strictly controlled parallel structures.

1.2. The Current Study

The current study aims to answer the much-neglected questions about anaphoric accentuation in production in strictly parallel structures: first, does ambiguity play a role in the prosodic patterns? Specifically, does the degree of accentuation differ when other strong disambiguating cues are present? Second, is there a systematic correlation between accentuation and *referential shift*?

Previous studies are based on intonational languages such as English. It is noted that the interaction between prosody and anaphors may be universal [14]. To add cross-linguistic data, this study tackles the above questions via a production experiment in a tonal language – Mandarin. Results on the interaction of tone and information structure in Mandarin show that Mandarin indicates prosodic prominence by use of duration, intensity and F_0 range. Especially, F_0 is raised for high tone at varied focal positions as in English [23]. Hence, this paper restricts all concerned anaphors to high tone, which, combined with the same canonical word order as English, makes it directly comparable with previous observations on English. For this reason, this paper will continue to use 'accent' to denote prosodic prominence at phrase level in Mandarin to avoid terminological confusion, though it remains an issue of debate. Meanwhile, the interaction between tone and accentuation is eliminated, making it also directly comparable among different anaphors and conditions.

To minimize confounding factors, experimental materials are strictly controlled. Elicited sentences are always triplets of short sentences. The first sentence sets the scene, and the other two sentences depict certain actions that happened in temporal order in strictly parallel structures, in which the verbs are identical, as shown in (5) (S-subject; V-verb; O-object). In previous studies, negative verbs such as 'hit' and 'insult' were most frequently used. To achieve a semantic balance, three verbs with no perceived causal bias are selected: one positive verb '帮' (help), one neutral verb '背' (carry) and one negative verb '推' (push). '然后' (and then) is used as the conjunction. All the verbs have a high tone so that different verbs will not influence the prosodic pattern of the sentence frame (5).

(5) 大家 在……。 开始 S_1VO_1，然后 S_2VO_2。
everyone(present article)first S_1VO_1 then S_2VO_2
Everyone was doing… First S_1VO_1, and then S_2VO_2.

Three types of anaphors are under investigation, including the third person singular pronouns '他 /t^ha/' (he/him) and '她 /t^ha/' (she/her), the plural pronoun '他们 /$t^hamən$/' (they/them) and proper names. In Mandarin, the third person singular pronouns share exactly the same pronunciation with a high tone, thus this paper treats them as the same pronoun. There are five characters involved – '小刚 /kɑŋ/' (Xiao Gang, male), '小当 /tɑŋ/' (Xiao Dang, male), '小汤 /$t^hɑŋ$/' (Xiao Tang, male), '小芳 /fɑŋ/' (Xiao Fang, female) and '小康 /$k^hɑŋ$/' (Xiao Kang, female). 'Xiao' indicates hypocorism, while 'Gang' 'Dang' 'Tang' 'Fang' and 'Kang' are either first names or surnames. The selection of these names meets the following criteria: 1) they are all typical Chinese names; 2) their last syllables share the same rhyme; 3) the last syllables share the same tone with the third person singular pronouns'.

To approach the research goal, *Referential Status* and *Ambiguity* are manipulated in both subject and object positions for three types of *Anaphoric Form* (the third person singular pronouns, plural pronoun and proper names):

Referential Status is defined as the relative syntactic position of an anaphor and its antecedent. It has three values: *Unchanged* means that an anaphor remains in the same position as its antecedent; *Shifted* means that an anaphor and its antecedent are in opposite positions; *Switched* means that the syntactic positions of anaphors in the last sentence and their antecedents are switched. The reason for making a distinction between *Shifted* and *Switched* is that information structure may influence the prosodic patterns. In the *Shifted* condition there is one anaphor and a new character in the last sentence, while there are two anaphors and no new characters in the last sentence in the *Switched* condition. *Referential shift* is involved in both *Shifted* and *Switched* conditions.

Ambiguity has two values: *Ambiguous* and *Unambiguous*. *Ambiguity* is manipulated by anaphoric form and number agreement of a pronoun: in the *Ambiguous* condition the antecedent of a pronoun and its competitor (S_1 and O_1) are of the same number, while in the *Unambiguous* condition the antecedent of a pronoun and its competitor are of different number, or S_1 and O_1 are both proper names.

Table 1 illustrates the examples for the last two sentences under different conditions within each factor (the bolded elements are co-referential):

Table 1. *Examples under different conditions.*

Proper name: *Subject*; *Unchanged*; *Unambiguous*
开始 **小刚** 帮 了 小芳， *first Xiao Gang help PERF Xiao Fang* 然后 **小刚** 帮 了 小当 *then Xiao Gang help PERF Xiao Dang.*
First **Xiao Gang** helped Xiao Fang, and then **Xiao Gang** helped Xiao Dang.
Singular pronoun: *Object*; *Switched*; *Ambiguous*
开始 小当 背 了 **小刚** *first Xiao Dang carried PERF Xiao Gang* 然后 **他** 背 了 小当。 *then he carried PERF Xiao Dang*
First Xiao Dang carried **Xiao Gang**, and then **he** carried Xiao Dang.
Plural pronoun: *Object*; *Shifted*; *Unambiguous*
开始 **小当** **和** **小芳** 推 了 小刚 *first Xiao Dang and Xiao Fang pushed PERF Xiao Gang* 然后 小汤 推 了 **他们**。 *then Xiao Tang push PERF them*
First **Xiao Dang and Xiao Fang** pushed Xiao Gang, and then Xiao Tang pushed **them**.

Fundamental frequency F_0 and duration are taken as parameters indicating prosodic prominence. In accordance with previous observations on accentuation of unambiguous anaphors [7-10], it is hypothesized that accentuation occurs whenever there is a referential shift regardless of ambiguity; hence higher F_0 and longer duration are expected for the *Shifted* and *Switched* conditions. For the potential influence of ambiguity, if ambiguity does play a role, it is anticipated that anaphors in the *Ambiguous* condition have a higher F_0 and longer duration than anaphors in the *Unambiguous* condition.

2. Methodology

2.1. Experimental Design

To elicit utterances as naturally as possible, a cooperative story-telling-and-understanding game is designed. The speaker first looks at three pictures on the screen and then describes what happened to a listener using the fixed sentence frame (5). The three pictures correspond to the three sentences in (5): the first picture sets the scene – climbing a mountain, playing basketball or playing a game; the other pictures depict certain actions with different agents and patients. The occurrence of the five characters is balanced. The presentation of stimuli and auto-recording are achieved using ZEP [24], a system for implementing and running (psycholinguistic) experiments.

All anaphors are balanced in both subject and object positions. For pronouns, there is only one concerned pronoun in the last sentence in conditions *Unchanged* and *Shifted*, but it is possible to have two pronouns in the *Switched* condition. This study focuses on cases with maximally one pronoun in the last sentence. There are 53 stimuli for the purpose of this study. These stimuli (together with 10 other stimuli for a related study) are divided into four tasks, in which the speakers are instructed to follow a specific constraint on using a certain type of anaphors in a fixed syntactic position.

2.2. Data Collection

2.2.1. Participants

36 Mandarin Chinese speakers (18 male and 18 female; ages 18-26, mean age 20.4) at Beijing International Studies University and Communication University of China participated in the experiment. All the speakers began to speak Mandarin Chinese before or when they entered primary school (7 native speakers of Mandarin, 22 native speakers of Beijing dialect, 7 native speakers of other dialects in north China). An experiment assistant acted as the listener throughout the 36 experimental sessions. Participants received a financial compensation.

2.2.2. Procedure

The participants were tested in a quiet room. In the experimental setting, the speaker sat in front of the screen and the listener sat back to back with the speaker so that they could not see each other, which prevented other non-verbal communications such as eye contact and gestures. There was a short oral introduction before the experiment. The listener was asked to fill in an answer sheet based on the descriptions and the participants were told that their cooperation would be graded based on both the speaker's fluency and the listener's correct rate. In this way, the speakers would be more involved. No communication was allowed between the speaker and the listener throughout the experiment.

The experiment began with a familiarization practice. The images of the five characters were presented followed by two rounds of a name-figure mapping test. Then the tasks began. In the first task, the speaker was asked to use full names to refer to all the characters; in the last two tasks, the speaker was asked to use a pronoun to refer to either the agent or the patient in the last picture, respectively (the second task is irrelevant to this study). In each trial, three pictures were firstly presented. When the speaker clicked the start button, the pictures disappeared and the audio recording began. There were four practice trials in each task. The whole experiment was self-paced.

2.3. Data extraction and analysis

The obtained audio recordings (in wav format) were annotated and labelled via Praat [25]. Since the names share the same rhyme, only the rhymes in the second syllables were annotated to reduce the duration difference introduced by different onsets. The same method also applied to pronouns. Mean F_0 and duration of annotated syllables were extracted after manual correction of F_0. In order to eliminate individual difference, the mean F_0 was normalized into Z-score. SPSS was employed for statistical analysis and the Generalized linear mixed model (GLMM) was adopted, which suits best to the categorical data in current study (random effects factors are *speaker ID* and *sentence ID*; fixed effects factors are *Referential Status*, *Ambiguity* and *Anaphoric Form*, which is not a concerned factor in this study but needed for GLMM).

3. Results

3.1. F_0 analysis

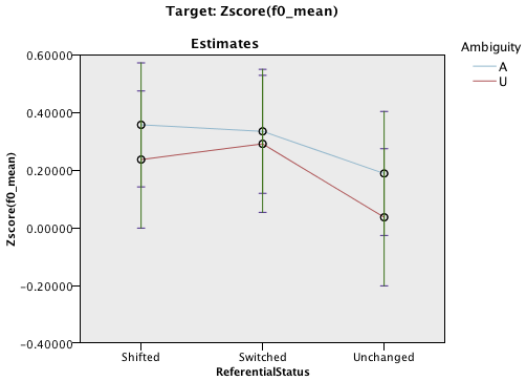

Figure 1: *Interaction between Referential Status and Ambiguity for normalized F_0 in Subject.*

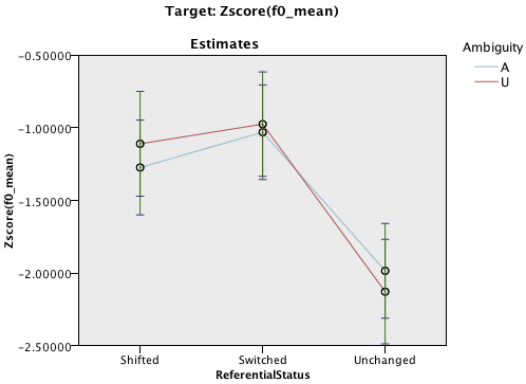

Figure 2: *Interaction between Referential Status and Ambiguity for normalized F_0 in Object.*

GLMM analysis of the normalized F_0 mean of subject anaphors shows: 1) F_0 for *Shifted* and *Switched* is significantly higher than *Unchanged* ($p < 0.001$) and there is no significant difference between *Shifted* and *Switched* ($p = 0.331$). 2) No significant difference is found between the *Ambiguous* (A) and *Unambiguous* (U) conditions ($p = 0.431$). The results for

object anaphors show: 1) F_0 for *Shifted* and *Switched* is significantly higher than for *Unchanged* ($p < 0.001$) and F_0 for *Switched* is significantly higher than for *Shifted* ($p = 0.012$). 2) No significant difference is found between the *Ambiguous* and *Unambiguous* conditions ($p = 0.361$). No interaction ($p > 0.05$) between *Referential Status* and *Ambiguity* is found for either subject or object, as illustrated in Figures 1 and 2.

3.2. Duration analysis

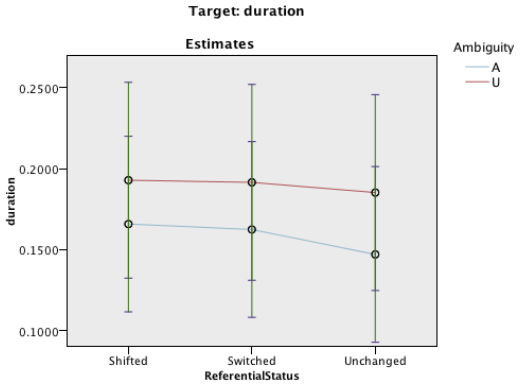

Figure 3: *Interaction between Referential Status and Ambiguity for Duration in Subject.*

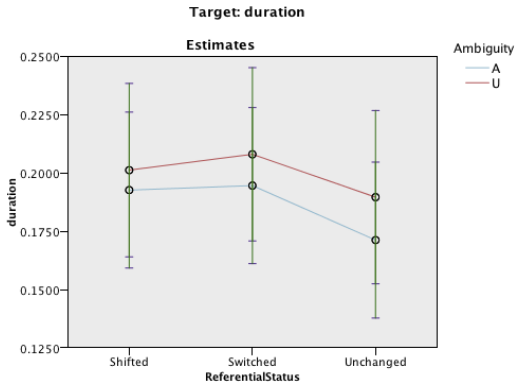

Figure 4: *Interaction between Referential Status and Ambiguity for Duration in Object.*

The results for duration demonstrate a similar pattern. For subject anaphors: 1) Duration in the *Shifted* and *Switched* conditions is significantly higher than *Unchanged* ($p = 0.005$) and there is no significant difference between *Shifted* and *Switched* ($p = 0.911$). 2) There is no significant difference between the *Ambiguous* and *Unambiguous* conditions ($p = 0.322$). For object anaphors: 1) There is no significant difference the *Ambiguous* and *Unambiguous* conditions ($p = 0.619$). 2) Duration in the *Shifted* and *Switched* conditions is significantly higher than in the *Unchanged* ($p < 0.001$) condition; and there is no significant different between *Shifted* and *Switched* ($p = 0.141$). No interaction ($p > 0.05$) between *Referential Status* and *Ambiguity* is found for both subject and object, as illustrated in Figures 3 and 4.

4. Discussion

In F_0 analysis, the main effects and interactions for both subject and object demonstrate that anaphors receive an accent in the referentially shifted (*Shifted* and *Switched*) conditions, and no evidence shows that *ambiguity* plays a role in the accent assignment. The results for duration exhibit the same pattern: both subject and object anaphors are significantly longer in referentially shifted conditions, and *ambiguity* does not influence duration. These results provide evidence from Mandarin for the observations (1) – (3): anaphors undergoing a *referential shift* acquire an accent. Since no significant difference is found between the *Ambiguous* and *Unambiguous* conditions for both F_0 and duration, the 'disambiguation effect' of accent on ambiguous pronouns in strictly Mandarin parallel structures comes from a generalized relationship between prosody and referential status. There are several accounts of this correlation between prosody and *referential shift*, such as repetition-based account [26], centering-based account [27] and stress-shift account [28], but no consensus has been made as to why *referential shift* triggers anaphoric accentuation. Hence, more theoretical work is needed in future studies.

Despite the consistent patterns in both syntactic positions, both F_0 and duration exhibit a distinct asymmetry in different positions, as illustrated in Figures 1-4. Subject anaphors have an overall higher F_0 and a shorter duration than object anaphors, which we attribute to the declination effect and boundary tone. In addition, F_0 differences in subject position are much smaller than in object position, which indicates that subject anaphors have a narrower range in signalling accentuation while object anaphors have a wider range. In the *Unchanged* condition, the anaphor becomes given information and thus is de-accented. Because a subject anaphor is at the beginning of a sentence, F_0 cannot be lowered to a large extent, whereas for object anaphors, the subject in the utterance is contrastive focus, and object anaphors become attached to the verb and F_0 is much lowered due to post-focus F_0 drop [29]. This implies that *referential shift* of object anaphors may be more easily indicated by prosody, which is supported by the significant F_0 difference between *Switched* and *Shifted* in object position. Whether this asymmetry also influences perception calls for further study.

5. Conclusions

Through a production experiment, this study explores the role of prosody on anaphors in Mandarin. On the basis of the findings, it can be concluded that in strictly Mandarin parallel structures, accent on anaphors is introduced by a referential shift. No evidence was found that ambiguity plays a role in anaphoric accentuation influence accentuation, hence the role of prosody in anaphora production is not to disambiguate but to signal different referential statuses. Whether this is a language universal conclusion needs further investigation in other languages. This finding challenges the general view on accented pronouns and will deepen our understanding on semantics-prosody relationship. Considering the possible wide misunderstanding on accented ambiguous pronouns, it is time to reconsider the nature of accented anaphors, and future studies should treat the interaction between prosody and pronouns with more caution.

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