Research Article

The Third Person Pronoun and Demonstrative Resolution in Mandarin Chinese and Discourse Prominence

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A B S T R A C T

Introduction: The third person pronoun and demonstrative resolution are influenced by multiple factors in Mandarin Chinese. The factors influencing reference choice and the relations between discourse prominence and pronoun resolution are discussed. It suggests discourse prominence is an essential organizational principle in reference resolution. The factors that influence pronoun resolution in Mandarin Chinese might be studied and explained from the perspective of discourse prominence.

Methodology: A formal operational scheme with conditional inference recursive partitioning tree and random forest analysis analyzing discourse data collected from a picture-sequence-based narrative elicitation method is provided.

Results: The results confirmed the idea that the discourse prominence-lending cues, including thematic role, animacy, grammatic role, topic, referential distance, and mentioned number, influence pronoun resolution in Mandarin Chinese. Animacy and reference distance might be involved in the important variances, and reference distance relates to topic maintenance, discourse dynamicity, and structural attracting.

Conclusion: The findings demonstrated that the discourse prominence-lending cues influence pronoun resolution in Mandarin Chinese. The third person pronouns often signal topic maintenance and high discourse prominence, while demonstratives often signal topic shift and low discourse prominence. Moreover, demonstratives often signal focus reinforcement. Therefore, topic and focus are also considered as the two crucial elements affecting pronoun resolution in Mandarin Chinese.

1. Introduction

Numerous referential forms are available for referring to a discourse entity in utterance. One influential approach directly relates reference pronoun resolution to the salience of the entities in discourse (Givón, 1983; Gundel et al., 1993). According to this approach, the reduced referential device, such as the pronoun, has a higher cognitive status and often marks the salient discourse entities. Full noun phrases (NPs) often have a lower cognitive status and mark the less salient discourse entities.

However, many studies have demonstrated that a unified salience-based model cannot account for the choice of different pronouns to date (Colonna et al., 2012; Kaiser, 2013; Kibrik, 1996; Kaiser & Trueswell, 2008). A more detailed account than a single factors-driven theory is needed to explain reference resolution (Chamber & Smyth,

1998). Salience is related to distinctive factors, including order of mention (Gernsbacher et al., 1990), grammatical roles (Chambers & Smyth, 1998), thematic roles (Arnold, 2001; Stevenson et al., 1994), and semantics (Hobbs, 1979).

Therefore, the purely salience-based one-factor explanation is not adequate, and following Chen (1986), pronoun resolution is influenced by plenty of distinctive factors, including discourse-level aspects. Until now, the consensus about the importance of different factors and how the distinctive factors interact with each other and compete during reference resolution has not been reached. Hint et al. (2020) proposed that the combinations of the factors influence the reference resolution by comparing three close languages, namely Estonian, Finnish, and Russian. The three most important factors that influence

reference resolution in the three languages are the case of the referential expressions, syntactic roles, and referential distance with the previous mention of the same referent.

According to the viewpoint of Himmelmann and Primus (2015), discourse prominence is a structure-building principle. Their insight is acknowledged here to suppose discourse prominence is characterized by relational, dynamic, and structural attracting.

From the perspective of Himmelmann and Primus (2015), prominence is a relational notion that suggests the entity is ranked as relating to other entities. That is to say, prominence is in line with activation status; the most activated entity is more prominent than less activated entities. Various prominence-lending cues can drive the discourse prominence (Himmelmann & Primus, 2015). Prominence-lending cues contribute to the identification of prominent discourse entities. Among these features are grammatical role, thematic role, and topicality. Prominence-lending cues establish a ranking hierarchy of discourse entities. Furthermore, prominence-lending cues are combined and compete during reference resolution. The discourse unit with more prominence-lending cues is more prominent with respect to other discourse entities. The more prominence-lending features a discourse unit carries, the more high-ranked and evident it is.

Discourse prominence is dynamic due to the status changing over time in discourse representation depending on its context (Himmelmann & Primus, 2015). This means that the most prominent entity may change its prominence status to be less prominent in discourse updating. This converse process to maintenance might shift the focus and change the prominence structure. The operation of topic shift might elevate a discourse unit to a higher prominence status. Meanwhile, according to Gordon et al. (1993), topic shift elicits longer reading times over topic maintenance, and changes in ranked discourse units in discourse representation are computationally demanding. It implies that topic maintenance is efficient without prominence changing, while topic shift is intricate to elevate the prominence of the discourse entity.

Discourse prominence is structural-attracting, indicating that a prominent entity attracts more structures or operations. The prominent discourse entities are more likely to be varied and re-mentioned in the discourse representation. The prominent discourse entity might be more varied compared with less prominent entities because a prominent entity is not only limited to being the focus, but also activated or familiar. Thereby, the prominent entities are likely to recur in subsequent discourse and result in referential persistence (Givón, 1983).

Demonstratives (pronominal and adnominal demonstratives) and personal pronouns are the two main reference devices in Chinese (Wang, 1989). Both pronominal and adnominal demonstratives are recruited to refer to objects, concepts, and events in Mandarin Chinese. Yet, demonstrative pronouns normally cannot be used to refer to animate entities. The followings are ungrammatical Mandarin Chinese examples (1 and 2). When adnominal

demonstratives or third person pronouns are interpreted as referring to the animate entities in the examples, they become grammatical.

(1)*这（这孩子/他）真可爱。
Zhe (zhe haizi/ta) zhen keai.
Dem (Dem kid/ he) really lovely
This (This kid/ He) is so lovely.
(2)*他不喜欢这（这孩子/他）。
Ta bu xihuan zhe (zhe haizi/ta).
He NEG like Dem (Dem kid/ he)
He doesn't like this (this kid/him).

As indicated from the beginning, prominence-lending cues, such as grammatical role, thematic role, and topicality, interact with each other and compete during reference resolution to help to establish a complex ranking hierarchy of discourse entities. As mentioned earlier, demonstrative pronouns prefer subject position to object position for reference in Mandarin Chinese for the prominence-lending cues of grammatic roles. However, the third person pronouns might appear in subject and object positions. When they occupy subject positions, they are normally more prominent.

Pronominal demonstrative pronouns, adnominal demonstratives are more likely to refer to concrete entities due to specialization for deictic meanings. Adnominal demonstratives are typically used to refer to concrete entities, whereas pronominal demonstratives are more commonly used for abstract entities and events. It may be illustrated in the following examples in Mandarin Chinese.

(3) 这姑娘真漂亮。
Zhe guniang zhen piaoliang.
Dem girl really beattiful
This girl is so beautiful.
(4) 这可不行。
Zhe ke bu xing.
Dem may NEG all right
This may not work.

Consequently, demonstratives (pronominal and adnominal demonstratives) and third person pronouns are affected by the interactions of multiple prominence-lending cues to different degrees. Furthermore, adnominal demonstratives, which appear to be more and more prevalent in Mandarin Chinese, might be more shaped by the conceptualization of figure and focus rather than background and topic.

Apart from the broad preliminary functions, demonstratives and third person pronouns have distinctive extended discourse uses related to discourse dynamicity and structural attraction. As the following example (5) shows, the pronominal demonstratives extend to be used as discourse framing devices. The adnominal demonstratives are used as focus reinforcement in example (6).

(5) 那可不是闹着玩儿的。
Na ke bu shi nao zhe wanr de.
Dem may NEG be play ZHE joke PRT
That is not joke.

(6) 这个杀手不太冷。

Zhege shashou bu tai leng.

Dem killer not very cool

The killer is not very cool.

In a nutshell, discourse prominence is an essential organizational principle represented in discourse representation. Provided with this framework, it is proposed that the factors that influence the third person pronoun and demonstrative in Mandarin Chinese might be studied from the perspective of discourse prominence. A range of prominence-lending cues is chosen to investigate the relation between Discourse prominence and the third person pronoun and demonstrative resolution on the referential properties of Mandarin Chinese.

With this introduction in mind, the present study intended to investigate the factors affecting the choice of third-person pronouns and demonstratives in Mandarin Chinese and explore the relations between discourse prominence and the third-person pronoun and demonstrative resolution in Mandarin Chinese from the perspective of discourse prominence. Moreover, the current study examine the choice between the third person pronouns and demonstrative pronouns, the choice between adnominal demonstratives and pronominal demonstratives. For the purpose of examining the factors affected, a picture-sequence-based narrative elicitation method is used to collect and analyze narrative discourse data.

Consequently, in addressing the objective, The present study has three closely related research questions:

1. Which factors influence the third person pronoun and demonstrative resolution in Mandarin Chinese?

2. Which factors influence the choice of demonstrative pronouns and demonstratives as determiners, i.e. pronominal demonstratives and adnominal demonstratives in Mandarin Chinese?

3. What are the relations between discourse prominence and the third person pronoun and demonstrative resolution in Mandarin Chinese?

2. Methodology

2.1. Participants

Initially, 20 native Mandarin Chinese speakers participated in this study, of whom 14 were female and 6 were male. The participants were within the age range of 18-48 years (mean age 28). They were all postgraduate students of Shanghai Normal University. Moreover, all participants got Mandarin Proficiency Test Certificates of Level II, Grade A.

2.2. Instruments

For the special focus on examining the choice of adnominal demonstratives and the third person pronouns in Mandarin Chinese, a picture-sequence-based narrative elicitation method was used to collect and analyze narrative discourse data. This method has been widely used since Pear Stories Project (Chafe, 1980). The approach of Hint et al. (2020) and their three picture books with six pictures in each book (Figure1) to elicit and collect the discourse data
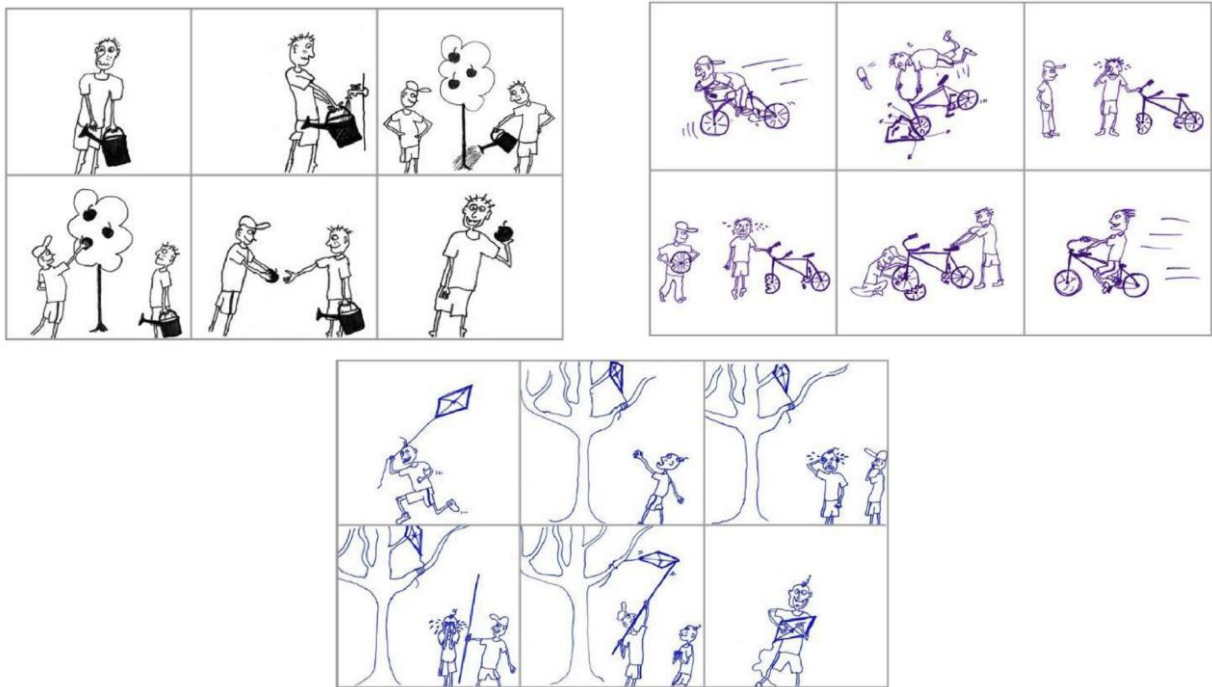

Figure 1.
Picture-sequences Used for Eliciting the Narratives

were used. The event organization of the six pictures was similar. One human performs an action, then another same-gender human enters and has an active agent, while the first human has a passive role. Finally, the first human is alone again.

Each participant was shown three picture books and was asked to tell three short stories about the pictures. The participants were informed that the stories were told to the listeners who did not see the pictures in order to prevent text-external reference.

2.3. Data analysis

The reference to discourse entities in the pictures was coded for 18 narratives using discourse data. Two male participants were excluded because they only used proper names to refer to entities in the pictures and used first and second person pronouns in direct speech.

After collecting the data, it was coded and analyzed using a formal operational scheme that employed conditional inference recursive partitioning trees and random forest analysis to analyze the discourse data.

3. Results

3.1. Results of reference devices

In total, 735 reference expressions were coded from the discourse data collected. The NPs of the discourse data collected were divided into three major types, namely full NPs, different pronominal forms, and NPs with determiners.

Full NPs include bare NPs and NPs with attributes and proper names. Different pronominal forms include personal pronouns, demonstrative pronouns, i.e., pronominal demonstratives and zero reference. The NPs with determiners include NPs with indefinite determiners and NPs with definite determiners ie. the form of adnominal demonstratives.

The results indicated that bare full NPs were the most used NPs to refer to entities in discourse representation in Mandarin Chinese, followed by pronouns and then NPs with determiners. Mandarin Chinese used bare full NPs, pronouns, and adnominal demonstratives at 37.7%, 30.3%, and 32.0%, respectively (see Table 1).

Regarding the overall frequencies of different pronouns and different NPs with determiners, the proportions are presented in tables 2 and 3. The use of pronominal demonstratives was comparatively sparse, compared to personal pronouns, and only used as subjects of equative clauses in my data; thus, pronominal demonstratives was excluded from consideration and discussion in the next section (see Table 2).

Taken together, personal pronouns and adnominal demonstratives were most used referential expressions besides bare NPS and zero references in Mandarin Chinese. The distribution of personal pronouns and adnominal demonstratives would be of focus in the next section. The proportion of personal pronouns, zero references and adnominal demonstratives are presented in Table 4.

Table 1.
The Overall Frequencies of Different Referential Expressions

Bare full NPs	Pronouns	NPs with determiners	Referential expressions total
37.7% (n=277)	30.3% (n=223)	32.0% (n=235)	100% (n=735)

Note. NPs = Noun phrases

Table 2.
The Overall Frequencies of Different Pronouns

Personal Pronouns	Demonstrative pronouns (pronominal demonstratives)	Zero references	Pronouns total
21.1% (n=155)	0.8% (n=6)	8.4% (n=62)	30.3% (n=223)

Note. NPs = Noun phrases

3.2.2. Conditional inference recursive partitioning tree 1

Since the use of first and second person pronouns, especially in direct speech, was very distinct from the third person pronouns in the obtained data, the first and second pronouns from were excluded from the statistical table, and the remaining 130 third person pronouns were analyzed. The frequency of third person pronouns, zero references, and adnominal demonstratives (247 in total) is presented in Table 5.

Still following the approach of Hint et al. (2020), the 247 referential expressions were coded by the presence and absence of a range of syntactic factors and semantic/pragmatic factors, including the syntactic role of the referent (SyntRole), animacy of the referent (Animacy), the presence of other animate referents (OtherAnim), referential distances from the preceding mention of the same referent (RefDist), number of mentions in a row for the same referent (MentionNO) and previous NP referring to the same entity (PrevRefNP). These factors were chosen based on the referential properties of Mandarin Chinese.

The conditional inference recursive partitioning tree (Hothorn et al., 2006) was employed by the open source statistical environment R package *party* to analyze the data collected and the conditional inference tree 1 as presented in Figure 2.

Table 3.
The Overall Frequencies of Different NPs with Determiners

NPs with definite determiners (adnominal demonstratives)	NPs with indefinite determiners	NPs with determiners total
7.5% (n=55)	24.5% (n=180)	32.0% (n=235)

Note. NPs = Noun phrases

Table 4.
The Frequencies of Personal Pronouns, Zero References, and Adnominal Demonstratives

Personal pronouns	Zero references	Adnominal demonstratives
21.1% (n=155)	8.4% (n=62)	7.5% (n=55)

In the first right branch of the tree, the first split was animacy. The further left split was based on reference distance. When the referential distance was small (≤1), zero references were preferred, while referential distance was big (>1), adnominal demonstratives were preferred. The right split was based on syntactic role, presence/absence of other animate entities, and number of mentions in sequence. There were about 80% non-subject third person pronouns and 20% adnominal demonstratives. When other animate entities were present, the main reference device of the 49 referential expressions was zero reference, and the rest were the third person pronoun and adnominal demonstrative. When there was only one animate entity, the tree could move on to mention number. When the mention number was small (≤2), the third person pronouns were more frequent than adnominal demonstratives in the 76 referential expressions. On the contrary, when the mention number was big (>2), the third person pronoun and zero reference were preferred in the 41 referential expressions.

Table 5.
The Frequencies of Third Person Pronouns, Zero References, and Adnominal Demonstratives

Third person pronouns (Prs)	Zero references (0)	Adnominal demonstratives (Dem)
17.7% (n=130)	8.4% (n=62)	7.5% (n=55)

3.2.3. Random forest analysis

According to Strobl et al. (2009), recursive partitioning tree model might be unstable and variable; therefore, a random forests analysis was also conducted on the same data following the approach of Hint et al. (2020). The random forest analysis is presented in Figure 3 as a variable importance graph.

In the above variable importance graph, the further the variable was from the leftmost coordinate axis, the more important the variable was in predicting reference choice. Thus, the mean decrease accuracy analysis of the result suggested the five important factors influencing the choice of reference devices in Mandarin Chinese as animacy, other animate entities in the utterance, syntactic role, referential distance to the previous mention, and number of mentions. The mean decrease Gini analysis of the result indicated the five important factors affecting the choice of reference devices in Mandarin Chinese were animacy, referential distance to the previous mention, other animate entities in the utterance, syntactic role, and number of mentions. It seems that referential resolution is more related to semantic and pragmatic factors in Mandarin Chinese.

3.2.3. Conditional inference recursive partitioning tree 2

The conditional inference tree 1 conducted by R package *party* was based on the mean decrease Gini in Mandarin Chinese. Due to the mean decrease, Gini analysis tended to ignore other related features, and recursive partitioning tree model might be unstable and variable. The recursive partitioning tree model was conducted based on the mean decrease accuracy manually. The conditional inference tree 2 is presented in Figure 4.
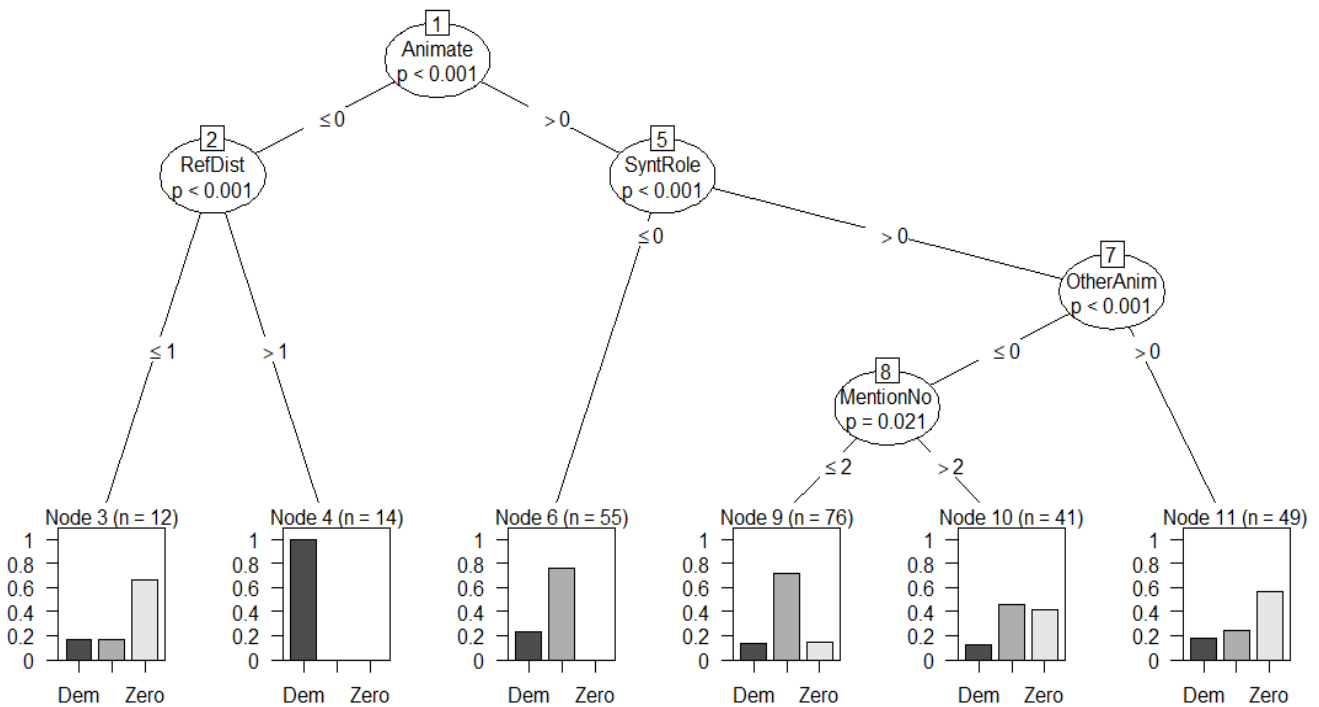

Figure 2.
Conditional Inference Tree 1 for the Distribution of Third Person Pronouns, Zero References, and Adnominal Demonstratives
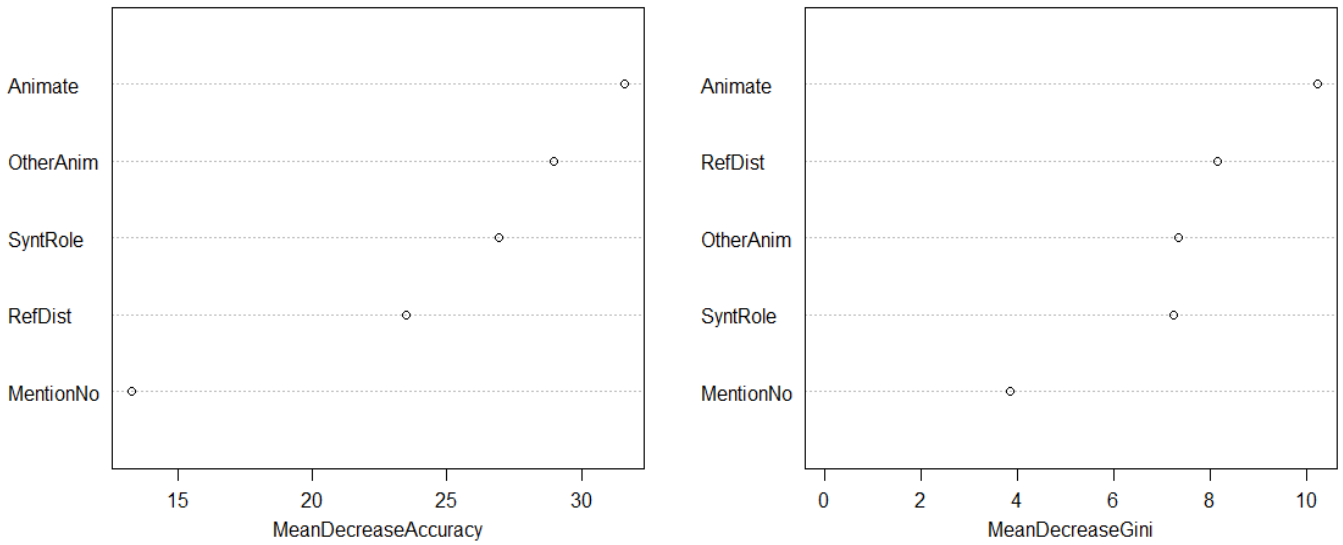
Figure 3.
Conditional Variance Importance in Predicting Third Person Pronouns, Zero References, and Adnominal Demonstratives

In the first right branch of the tree, the first split was animacy which separates 8% rarely used third person pronouns for referring to inanimate referents from other reference devices. The proportion of third person pronouns, adnominal demonstratives and zero references to refer to animate entities were 58%, 18%, and 24%, respectively. The further split was based on the presence/absence of other animate entities. When there were other animate
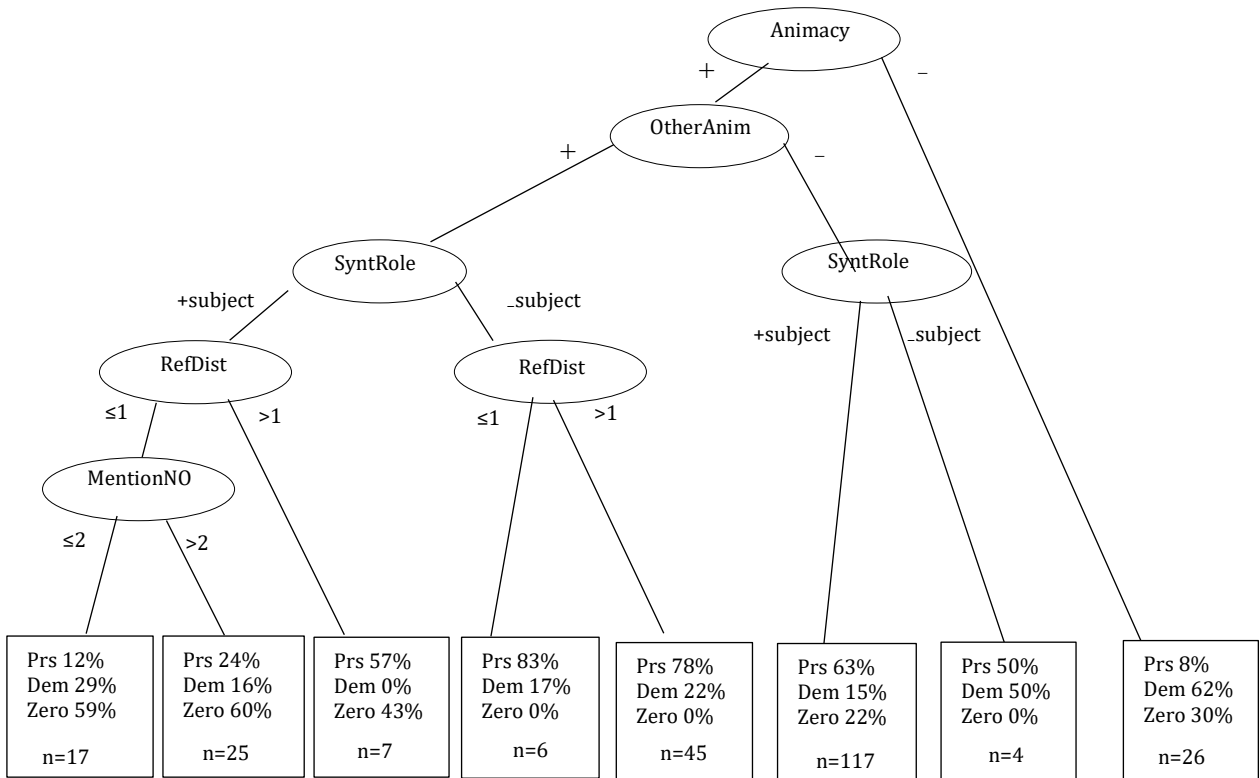

Figure 4.
Conditional Inference Tree 2 for the Distribution of Third Person Pronouns, Zero References, and Adnominal Demonstratives

entities present, the proportion of third person pronouns, adnominal demonstratives and zero references for referring to animate entities were 52%, 20%, and 28%, respectively. When there was only one animate entity, third person pronouns were mostly used, and the proportion of third person pronouns, adnominal demonstratives, and zero references for animate referents were 63%, 16%, and 21%, respectively. The tree could move on to syntactic role, the importance of subject/non-subject syntactic roles for choosing reference forms became apparent. When there was only one animate entity in the utterance, 117 subject roles were expressed mainly by the third person pronouns in the proportion of 63%, while only 4 non-subject roles were introduced by the referential system. However, after the syntactic role split, the influence of other factors, such as referential distance, number of mentions, and previous NP referring to the same entity, might not be very strong. When there were two or more animate entities in the utterance, after the syntactic role split, the tree could move on to referential distance and the number of mentions, but the function of the previous NP referring to the same entity was unclear. In the leftmost branch of the tree, the split of animate subject referents was then made by referential distance. When there was a big referential distance (>1), the third person pronouns but not adnominal demonstratives occured. When there was a small referential distance (≤1), the factor of number of mentions became important. When the mention number was small (≤2), the third person pronouns were more frequent than adnominal demonstratives. On the contrary, when the mention number was big (>2), adnominal demonstratives were more frequent than the third person pronouns. In the middle branch of the tree, the split of animate non-subject referents was further made by referential distance and mention number was deemed to be an unimportant variable. When referential distance was small (≤1), adnominal demonstratives were rarely used, while referential distance was big (>1), the third person pronouns were preferred.

4. Discussion

4.1. Discourse prominence-lending cues and choice of adnominal demonstratives and the third person pronouns

The factors that influence the choice of the third person pronouns and adnominal demonstratives in Mandarin Chinese from the perspective of discourse prominence were examined by taking the conditional inference tree and random forest analysis results obtained into consideration to provide an operational frame.

As stated previously, prominence-lending cues, such as grammatic roles, animacy, and topicality, were often interacted with affected demonstratives and the third person pronouns to different degrees. Adnominal demonstratives were less prominent than the third person pronouns in the discourse data collected.

Animacy was involved in the most important prominence-lending cues with high conditional variance

importance in predicting reference choice. In conditional inference tree 2, animacy was the first split which separated 4% rarely used third person pronouns for referring to inanimate referents from other reference devices. Thus, animacy might be the first important variable that affected pronoun choice in Mandarin Chinese. Third person pronouns and adnominal demonstratives used to refer to animate entities were used at 58% and 18%, respectively, while third person pronouns and adnominal demonstratives were employed to refer to unanimated entities at 4% and 67%%, respectively. The following example supports animate agent is referred to with third pronoun ta while inanimate apple is referred with adnominal demonstrative zhe. The example is provided below.

(7) 他把这个苹果送给了我。

Ta ba zhege pingguo song gei le wo.

He BA Dem CL apple present give LE I

He gave the apple to me.

When two or more animate entities were present in the same utterance, the third person pronouns and adnominal demonstratives were used at 52% and 20%, respectively. Adnominal demonstratives and personal pronouns are often referred to two referents. Moreover, the third person pronouns and adnominal demonstratives used as subjects in the utterance with two or more animate entities were 25% and 18%, respectively. Here, thematic role information might be assumed to represent a powerful cue to cause personal pronouns to prefer the proto-agent more than adnominal demonstratives since agents frequently occur in subject position, for example:

(8) 他就从树上摘下一个苹果，递给这个人。

Ta jiu cong shushang zhaixia yige pingguo, digei zhege ren.

He then,s from tree pick off one CL (measure word) apple, hand over Dem CL person

Then he picked one apple off from the three and hand to the person.

However, it is only a tendency for personal pronouns to prefer the proto-agent because more than one referential option is possible in discourse. Both example (9) and example (10) are acceptable.

(9) 有一个人看到他，就拿来一个轮子，这个人帮他修好了车

You yige ren kan dao ta, jiu nalai yige lunzi, zhege ren bang ta xiu hao le che.

Have one CL person see arrive he, then bring one CL wheel, Dem CL person help he repair well LE bicycle

A person saw it, then brought a wheel, and helped him repaired the bicycle.

(10)有一个人路过，看到了，就拿来一个新的车轮给这个人，帮他把车修好了。

You yige ren luguo, kan dao le, jiu na lai yige xinde chelun gei zhege ren, bang ta ba che xiu hao le.

Have one CL person pass by, see arrive LE (particle), then bring one CL new DE wheel give Dem CL person, help him BA (preposition)bicycle repair well LE.

A person passed by and saw it, then he brought a new

wheel to the person, and help him repair the bicycle.

For prominence-lending cues of grammatic roles, syntactic role has high conditional variance importance in predicting reference choice (Figure 2). In conditional inference tree 2, when there were two animate entities, the proportions of subject positions occupied by third person pronouns and adnominal demonstratives were 25% and 18%, respectively. When only one animate entity occurred, the proportions of subject positions occupied by third person pronouns and adnominal demonstratives were 63% and 15%, respectively. So, personal pronouns preferred subject position over adnominal demonstratives. The following example presents the use of third person pronoun as subject from the data collected.

(11) 一个人买了一个新水壶，……他想试试这个新水壶好不好用。

Yige ren mai le yige xin shuihu, ……ta xiang shishi zhege xin shuihu hao bu hao yong.

One CL person buy LE one CL new kettle, ……he want try Dem CL new kettle good NEG good use

One person bought a new kettle, ……he wanted to try if it works well.

Related to prominence-lending cues of thematic roles and animacy, adnominal demonstratives were more likely to refer to definite, concrete, and mobile entities than pronouns because of specialization of the deictic meanings, for instance;

(12)有一个小孩拿了一个风筝在跑，然后这个风筝被挂在树上了。

You yige xiaohai na le yige fengzheng zai pao, ranhou zhege fengzheng bei gua zai shushang le.

Have one CL child take LE one CL kite ZAI run, then Dem CL kite BEI hang at tree LE

There was a child running with a kite, then the kite was hung on the tree.

It seems adnominal demonstratives were more affected by the interactions of multiple prominence-lending cues than personal pronouns. For instance, in conditional inference tree, the proportion of third person pronoun and adnominal demonstrative used in the first split for animate entities were 58% and 18%, respectively. The third person pronouns and adnominal demonstratives in subject position with big reference distance, indicating more operation on combined pragmatic features at the bottom of Figure 3 were 57% and 0%, respectively. It reveals the interplay of multiple prominence-lending cues might result in more variation for adnominal demonstratives than the third person pronouns.

4.2 Topic shift and focus reinforcement

The important conditional variance importance in predicting third person pronouns and adnominal demonstratives is referential distance to the previous mention which might contribute to topic maintenance. The data indicated personal pronouns were inclined to refer to the same entity in a series of discourse. In conditional inference tree 1, the proportion of third person pronouns

and adnominal demonstratives used as subject with big reference distance were 57% and 0%, respectively. Moreover, third person pronouns and adnominal demonstratives were used as subject with small reference distance and more mentioned numbers at 24% and 16%, respectively. The factor of big reference distance and more mentioned numbers were often related to the recurrence of discourse entity with the more pragmatic operation. Thereby, pronouns always lead to referential maintenance of topic, which might imply personal pronouns were topic biased and structural attracting. It also reveals that personal pronouns are more neutral and pragmatically unmarked than adnominal demonstratives. Consider the example below, the consecutive use of the third person pronoun ta results in referential maintenance of topic.

(13) 他摘下一个苹果，他把苹果送给那个人。

Ta zhaixia yige pingguo, ta ba pingguo songgei nage ren.

He pick off one CL apple, he BA apple give Dem CL person

He picked one apple off, and gave it to that person.

On the other hand, when the topic shift occurred in the utterance, adnominal demonstratives were often used for reference. As described above, adnominal demonstratives were used as subjects with big reference distance. In conditional inference tree 2, the proportion of third person pronouns and adnominal demonstratives used as subject with small reference distance and few mentioned numbers were 12% and 29%, respectively. The factor of small reference distance and few mentioned numbers were often related to the alternation of discourse entity in utterance. Thus, this means adnominal demonstratives are anti-topic biased and often signal a topic shift. Example (14) shows the topic shifts from he to the other people in subsequent utterances when the adnominal demonstrative na is used.

(14)他摘下一个苹果，他把苹果送给那个人，那个人就吃了起来。

Ta zhaixia yige pingguo, ta ba pingguo songgei nage ren, nage ren jiu chi le qilai.

He pick off one CL apple, he BA apple give Dem CL person, Dem CL person then eat LE QILAI

He picked one apple off, he gave the apple to that person, and then the person began to eat it.

In addition, adnominal demonstratives always present before personal pronouns when topic shift occurs. For instance, the following example (15) is accepted while (16) is unacceptable. That further suggests, adnominal demonstratives have the important function to signal topic shift and this operation might elevate a discourse unit to a higher prominence status.

(15)这时有一个人路过，就拿来一个新的车轮给这个人，帮他把车修好了。这个人就又可以骑着车飞奔了。

Zheshi you yige ren luguo, jiu na lai yige xinde chelun gei zhege ren, bang ta ba che xiu hao le. Zhege ren jiu you keyi qizhe che feiben le.

This time have one CL person pass by, then bring one CL new DE wheel give Dem CL person, help he BA bicycle repair well LE. Dem CL person right again may ride ZHE bicycle run LE.

Now a person passed by, he brought a new wheel to this person, helped him repair the bicycle. The person then may

run fast with the bicycle.

(16)*这时有一个人路过，就拿来一个新的车轮给他，帮这个人把车修好了。这个人就又可以骑着车飞奔了。

Zheshi you yige ren luguo, jiu na lai yige xinde chelun gei ta, bang zhege ren ba che xiu hao le. Zhege ren jiu you keyi qizhe che feiben le.

This time have one CL person pass by, then bring one CL new DE wheel give he, help Dem CL person BA bicycle repair well LE. Dem CL person right again may ride ZHE bicycle run fast LE

Now a person passed by, he brought a new wheel to this person, helped him repair the bicycle. The person then may run fast with the bicycle.

It is worth noting that adnominal demonstratives tended to mark topic shift in discourse updating with unusual word order. Example (17) illustrate the use of topic shift in unusual word order utterance. Adnominal demonstratives elicited more interpretive biases and are pragmatically marked than the third person pronouns.

(17)然后呢，那个风筝下来了。然后呢，这个小孩高兴极了。

Ranhou ne, nage fengzheng xialai le. Ranhou ne, zhege xiaohai gaoxing ji le.

Then PRT, Dem CL kite come down LE, then PRT, Dem CL child happy extreme LE

Then, the kite came down. Then, the child was very happy.

Additionally, Mandarin Chinese displayed the usage pattern in which adnominal demonstratives were in conceptualization focus as determiners. That is, adnominal demonstratives are frequently used as part of a specificity marking strategy, for focus reinforcement and joint attentional focus in discourse data collected as well. However, it is hard to find variables concerned with focus that can be coded in the operational frame above. The following example illustrates the focus reinforcement, and the apple tree is highlighted.

(18) 可是发现呢，这苹果树长得很高。

Keshi faxian ne, zhe pingguo shu zhang de hen gao.

But find PRT, Dem apple tree grow DE very high

But found, the apple tree is very high.

Given the discussion, the current results indicated that the third person pronouns and adnominal demonstratives were most used in Mandarin Chinese data. The findings confirm that adnominal demonstratives and personal pronouns have distinct behavior and are sensitive to prominence-lending cues to different degrees. Furthermore, personal pronouns are topic biased, while adnominal demonstratives are anti-topic biased, and demonstratives often signal topic shift and focus reinforcement, while the third person pronouns often signal topic maintenance. It might be addressed that topic and focus are the two preliminary elements impacting reference resolution in Mandarin Chinese.

The results demonstrated that prominence-lending cues such as grammatical role, thematic role, topicality, interact with each other and compete during reference resolution to help to establish a complex ranking hierarchy of discourse entities. These findings contributing to the three questions above to investigate factors affected and the relations between discourse prominence and pronoun resolution in Chinese contradicted the purely salience-based one-factor explanations but supported the multiple factors approach.

Regarding the first question asking about the factors influence the third person pronoun and demonstrative resolution in Mandarin Chinese, the factors that can explain the speaker's choice of referential expression include different prominence-lending cues, such as thematic role, animacy, grammatical role, topicality, focus are illustrated. The findings showed that semantic and pragmatic factors, such as animacy, thematic role information could represent a more powerful cue during reference resolution in Mandarin Chinese, consistent with German findings (Schumacher et al., 2016). Animate entities are often referred to with most prominent pronouns, while inanimate entities are often referred to with full NPs (Dahl & Fraurud, 1996). This research also indicated that animacy was involved in the most important prominence-lending cues. The findings are different from the three languages's result of Hint et al. (2020) that the most three important factors influence reference resolution are the case of the referential expressions, syntactic roles and referential distance with the previous mention of the same referent. Given the proposal that referential forms are sensitive to different factors in different languages (Hint et al., 2020), the findings in Mandarin Chinese provide more typological evidence.

Regarding the second question addressing the factors influence the choice of pronominal demonstratives and adnominal demonstratives in Mandarin Chinese, factors involved in the choice include thematic role, animacy, grammatical role, and topicality. Due to specialization for deictic meanings than pronominal demonstrative pronouns, adnominal demonstratives often refer to animate, concrete, and mobile entities. Extended to discourse uses, the pronominal demonstratives are often used as a discourse framing device, while the adnominal demonstratives are often employed as part of a specificity marking strategy to signify focus. These findings support the proposal that demonstratives frequently occur at a sentence-initial topic position, used as a scene-setting device and a means to analyze information structure (Diessel, 2019).

Regarding the third question on the relations between discourse prominence and the third person pronoun and demonstrative resolution in Mandarin Chinese, the findings suggest prominence plays an important role in reference resolution. Firstly, reference resolution is related to interwoven prominence-lending cues, including thematic role, animacy, grammatical role, topicality, focus status, etc. Similar results have been obtained in the study by Hint et al. (2020), indicating that not only the individual factors, but also the combinations between the factors influence the reference resolution. Moreover, in the present study, demonstratives were not the most prominent and, at the same time, were more affected by the interactions of multiple prominence-lending cues than the third person pronouns. Meanwhile, the third person pronouns are more neutral and pragmatically unmarked. The present study showed adnominal demonstratives were less prominent than the third person pronouns ground on the conditional

inference tree and random forest analysis. The above Mandarin Chinese data is consistent with the proposal of Comrie (1997), claiming that demonstrative pronouns typically are not the most prominent in reference resolution. Secondly, prominence is dynamic, and demonstratives have the important function of signaling topic shift, and this operation might elevate a discourse unit to a higher prominence status. In brief, anti-topic biased demonstratives often signal a topic shift, while topic biased the third person pronouns often signal topic maintenance and focus reinforcement. Topic and focus might be the two crucial elements that affected reference resolution in Mandarin Chinese. According to the research of Schumacher et al. (2015), the demonstrative pronoun der marks a topic shift, while the personal pronoun er leads to referential maintenance in German. The findings revealed that adnominal demonstratives had the important function of signaling topic shift, and this operation might elevate a discourse unit to a higher prominence status in Mandarin Chinese. Finally, prominence is structural attracting, and prominent discourse entities are more varied and re-mentioned in the discourse representation. The analysis results showed that the third pronoun occurred more and led to referential maintenance more than demonstratives.

Finally, reference resolution is influenced by plenty of distinctive factors in Mandarin Chinese and can be seen as additional evidence against one-factor explanations, which is not adequate.

4. Conclusion

In conclusion, discourse prominence is an essential organizational principle in reference resolution and discourse representation. The factors influence reference choice and illustrate the relations between discourse prominence and the choice of adnominal demonstratives and the third person pronouns in Mandarin Chinese are examined. The factors that influence reference resolution were studied and explained from the viewpoint of discourse prominence by taking the conditional inference tree and random forest analysis into consideration to provide an operational frame. The results suggest reference resolution is influenced by plenty of interwoven prominence-lending cues, including thematic role, animacy, grammatical role, topicality, focus status, etc. Thus, the results can be seen as typological evidence against one-factor explanations but support the multiple factors approach.

Although this current study attempts to contribute to the reference resolution research on the multiple factors approach, it still left some issues unaddressed. For instance, the third person pronoun and demonstrative resolution should be focused, while zero reference does not receive adequate attention. Since the use of reference is closely related to discourse contexts, different discourse contexts should be taken into account. Further research should be conducted into the issues of zero reference and how the prominence-lending cues interact with each other in different discourse contexts.

Declarations

Competing interests

None.

Availability of data and materials

Data are shared at http://osf.io/57cw9/.

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