



How Does Topicality Affect the Choice of Referential Form? Evidence From Mandarin

Suet-Ying Lam,^{a,b} Heeju Hwang^a

^a*Department of Linguistics, The University of Hong Kong*

^b*Department of Linguistics, University of Massachusetts Amherst*

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Abstract

Many models of reference production suggest that speakers tend to use a reduced referential form, such as a pronoun, to signal the topicality of a particular referent, that is, the Topichood Hypothesis. However, little is known about the precise nature of the mapping between topichood and referential form and the mechanisms by which topichood affects referential form. The current study aims to address these issues by investigating how topicality influences different kinds of reduced expressions, namely, null and overt pronouns in Mandarin. We manipulated topicality using a left-dislocation structure in Experiment 1. We found that topicality increased the use of null pronouns, but not overt pronouns. This suggests that topicality may increase only the most reduced expression available in a given language. Experiment 2 examined whether the topicality effect was related to predictability. We found that participants used more null pronouns for less predictable referents. We suggest that the topicality effect could be better explained by an accessibility mechanism.

Keywords: Chinese; Null pronoun; Overt pronoun; Predictability; Reference production; Topicality

1. Introduction

When referring to an entity, people need to decide on a suitable expression from a variety of choices—explicit expressions like names (e.g., *Ada*), less specific expressions like pronouns (e.g., *she*), or even complete omission of expressions like null pronouns. A critical question in reference production is what contributes to the speaker's decision to use a particular referential form.

Correspondence should be sent to Heeju Hwang, Department of Linguistics, The University of Hong Kong, Centennial Campus, Pokfulam, Room 916 Run Run Shaw Tower, Hong Kong, China. Email: heejuhwang@gmail.com

One well-established factor that affects reference production is the grammatical role. Speakers tend to use reduced forms if the referent is in the grammatical subject position of the preceding sentence (e.g., Ariel, 1990; Arnold, 1998, 2008; Brennan, 1995; Brennan, Friedman, & Pollard, 1987; Gundel, Hedberg, & Zacharski, 1993; Reinhart, 1981). For example, in (1), people are more likely to pronominalize a re-mention of the preceding subject *Ada* than the non-subject *Eva*.

(1) Ada chatted with Eva. She laughed a lot in the chat.

A possible explanation for the grammatical role effect is that the grammatical subject usually encodes the sentence topic, that is, what the sentence is about. Many models of reference production suggest that speakers use reduced forms like pronouns to signal a continuation of the current topic and select a referential form based on how likely a referent is to be the topic of the sentence, that is, the topicality of a referent (e.g., Ariel, 1990's Accessibility Hierarchy; Givón, 1983; Grosz, Joshi, & Weinstein, 1995's Centering Theory; Gundel et al., 1993's Givenness Hierarchy). Given that subject position is the canonical place for a sentence topic to appear in many languages (Lambrecht, 1996), the subject entity is often considered as more topical than entities in other grammatical roles, and thus more likely to be pronominalized. According to this view, the strong bias to pronominalize the subject referent is a result of high topicality associated with subject position rather than subjecthood itself. Following Rohde and Kehler (2014), we refer to this idea as the Topichood Hypothesis.

The primary support for the Topichood Hypothesis comes from Rohde and Kehler (2014). Rohde and Kehler used passivization to manipulate the topicality of subject referents. Previous research suggests that one function of English passives is to promote a non-agent to subject position as a sentence topic (e.g., Givón, 1984; Shibatani, 1985). Therefore, passivized subjects are assumed to have a higher likelihood to serve as the sentence topic than active subjects. For example, the passive subject *Brittany* (2b) is considered more topical than the active subject *Amanda* (2a).

- (2) a. Amanda amazed Brittany.
b. Brittany was amazed by Amanda.

Rohde and Kehler (2014) found that English speakers used more pronouns to refer to passive subjects than active subjects. The pronominalization rate did not differ for non-subject referents, whose topicality does not vary between actives and passives. These findings provide support for the Topichood Hypothesis, which suggests that reduced expressions are used to refer to more topical referents.

1.1. The nature and mechanisms of the Topichood Hypothesis

Although Rohde and Kehler (2014) provide evidence for the validity of the Topichood Hypothesis in English, little is known about the precise nature of the mapping between topichood and referential form and the mechanisms by which topichood affects referential form.

For example, is topicality linked to a specific form (e.g., overt pronoun) in a specific language (e.g., English) or the most reduced forms in all languages? What mechanisms lead to such effects of topicality? These questions are important to examine because they provide insights into fundamental questions of why reduced forms such as pronouns are available in many or all languages, and how they emerge. However, English is not suitable for answering these questions because pronouns are often the only and the most reduced forms available. Here we address these questions by investigating how topicality affects coreference production in Mandarin, which is typologically different from English and offers two different kinds of reduced expressions, namely, overt and null pronouns. As shown in (3), in Mandarin, *Xiaoming* can be referred to with an overt pronoun *ta* ‘he’ or a null pronoun.

- (3) Xiaoming_i jinu-le Xiaogang. Tai/Ø_i daoqian-le.
 Xiaoming_i annoy-PFV Xiaogang. He_i/Ø_i apologize-PFV
 ‘Xiaoming_i annoyed Xiaogang. He_i/Ø_i apologized.’

There are several possibilities about how topicality may work under different referential systems across languages. One possibility is that topicality effects are language specific, such that the Topichood Hypothesis is only valid in English or languages that have a similar referential system to English. That is, topicality may only affect the use of overt pronouns in English or typologically similar languages and have no effect on referential form production in other languages.

Another possibility is that topicality is specific to overt pronouns cross-linguistically. Previous work suggests that overt pronouns are more susceptible to certain semantic or pragmatic factors than other types of reduced expressions in the same language. For instance, in German, the interpretation of overt pronouns was more sensitive to coherence relations than demonstrative pronouns (Kaiser, 2011). If the production of overt pronouns similarly exhibits a greater degree of sensitivity to topicality than other types of expressions, topicality may only increase the use of overt pronouns.

A third possibility is that topicality only increases the use of the most reduced expression in a language. For example, Givón (1983) suggests that referential forms are more reduced if the referent is more topical in the discourse. The most reduced forms like null pronouns are used to refer to the most topical entities, whereas explicit descriptions like names are used for the least topical entities. Givón suggests that this is because topical entities are more accessible and predictable (more likely to be mentioned again), and thus are coded with less linguistic material. Although Givón’s account is about discourse topics, it is possible that the most reduced expressions are also used for the most topical entities at the sentence level.

Finally, it is also possible that topicality increases the frequency of all reduced expressions. For example, Gundel et al. (1993)’s Givenness Hierarchy suggests that both overt and null pronouns in Chinese are used to refer to the most activated referents (entities in focus), which typically include the topic of the preceding sentence. According to this account, topicality could increase the use of both overt and null pronouns in Mandarin.

There is mixed evidence in the literature about how topicality contributes to the use of different referential expressions in languages other than English. Existing studies manipulated topicality in two ways—via passivization or topic markers. For example, following Rohde and Kehler (2014), Ngo (2019) (Exp. 2) manipulated active versus passive voice to investigate topicality effects in Vietnamese. She found that for both subject and non-subject referents, null pronouns were more frequent for referents in passive sentences, while overt pronouns were more frequent for referents in active sentences. Although Ngo did not provide any statistical analysis, these findings are consistent with the possibility that topicality increases the use of the most reduced form only.

Zhan, Levy, and Kehler (2020) (Exp. 2) also manipulated the topicality of referents via passivization, but they did not find any effect of topicality in Mandarin. In contrast to Vietnamese speakers in Ngo (2019), Mandarin speakers did not use more reduced forms to refer to passive subjects than active subjects. However, Zhan et al. collapsed over overt and null pronouns, and thus do not inform how topicality affects different types of referring expressions. Nevertheless, the insignificant effect of topicality is consistent with the possibility that the Topichood Hypothesis is language specific and not valid in typologically different languages.

Apart from passivization, studies in languages with a morphological topic marker manipulated topicality using a topic marker. For example, Kim, Grüter, and Schafer (2013) varied the topicality of the grammatical subject with the topic marker *-(n)un* and the nominative marker *-i/ka* in Korean (see also Ueno & Kehler, 2016, for the manipulation of topic versus nominative markers in Japanese). They found that Korean speakers did not use more overt or null pronouns for topic-marked subjects than nominative-marked subjects (see also Hwang, 2016, for similar findings in Cantonese). Although Kim et al. (2013) did not statistically analyze the effect of topic markers on referential form, their findings are consistent with the possibility that the Topichood Hypothesis is language specific.

In sum, previous studies provide mixed evidence for the mapping between topicality and referential form. Yet the mixed findings in the literature are rather puzzling. Given that topicality plays a central role in many models of reference production (e.g., Ariel, 1990; Givón, 1983; Grosz et al., 1995; Gundel et al., 1993; Rohde & Kehler, 2014), one would expect that topicality would have a robust effect on referential form across languages. That is, topicality should promote the use of overt pronouns, as found in English, the most reduced form in a language, as found in Vietnamese, or both types of forms.

Previous studies, however, do not provide an adequate basis for a systematic evaluation of the Topichood Hypothesis. This is because they did not provide statistical analysis for the choice of referential forms (e.g., Kim et al., 2013; Ngo, 2019) or collapsed over the choice of different pronouns (Zhan et al., 2020).

There are also methodological issues about the effectiveness of passivization and topic markers for manipulating topicality. Studies using passivization assume that passives are constrained by the same factors and serve similar functions across languages. Yet research suggests that passives work differently and may serve different functions cross-linguistically. For example, whereas English passives are used to promote more accessible patient entities

to the subject position (e.g., Gleitman, January, Nappa, & Trueswell, 2007), the accessibility of patient entities did not affect passive production in Korean (Hwang & Kaiser, 2015). In addition, passives in languages such as Chinese, Japanese, Korean, and Vietnamese are commonly used to express the meaning of affectedness that patient entities are physically or psychologically affected (LaPolla, 2010; Li & Thompson, 1989; Oshima, 2006; Shibatani, 1985). Thus, even though passives may serve the function of topicalization in these languages, it is not clear how these differences influenced the manipulation of topicality.

Topic markers have similar issues. It is often assumed that topic markers like *-(n)un* in Korean and *-wa* in Japanese mark the topic in the sentence. However, some scholars suggest that topic markers do not necessarily indicate the sentence topic (Kuroda, 2005; Kim, 2015). For example, Kuroda (2005) argues that Japanese topic markers show a judgment-proposition distinction rather than a topic-nominative distinction. Similarly, Kim (2015) showed that topic markers can occur on non-topic entities in Korean. In a recent study, Hwang (2022a) showed that the choice of nominative and topic markers in Korean was sensitive to a number of factors including grammatical role, connective, and verb semantics. As a whole, a topic marker may not provide a strong signal of topicality without context (Song & Kaiser, 2020).

Taken together, the results of existing studies and their methodological issues prevent us from drawing any conclusion about the mapping between topicality and referential form, without which the mechanisms of topicality effects might not be determined.

1.2. *The present study*

The present study aims to investigate the nature and mechanisms of the Topichood Hypothesis by examining how topicality affects referential form production in Mandarin. Mandarin provides a good testing ground for testing hypotheses about the mapping between topicality and referential form for several reasons.

First, Mandarin allows two different types of referential forms for a human referent, namely overt pronouns and null pronouns. Although languages such as Korean and Japanese also allow both types of pronouns, overt pronouns are rare (Clancy, 1980; Hwang, 2022b) and show a noun-like behavior in these languages (Hinds, 1975, 1983; Kuroda, 1965). In Mandarin, both pronouns are common (Christensen, 2000), and overt pronouns are argued to behave like English overt pronouns. For example, in both English and Mandarin the production of overt pronouns exhibits a preference toward subject referents (Hwang, Lam, Ni, & Ren, 2022), and their interpretation is sensitive to both grammatical role and semantic factors, including verb semantics and coherence relation (Kehler, Kertz, Rohde, & Elman, 2008; Lam & Hwang, 2021; Simpson, Wu, & Li, 2016). Thus, testing the topicality effect on Mandarin reference production will provide a clear illustration of how topicality is mapped onto different types of reduced expressions.

Second, Mandarin has a topical structure that allows the manipulation of topicality, while avoiding the aforementioned issues of passivization and topic markers. Consider the following sentences:

- (4) a. yinwei Waner darao-le Meina, suoyi ta hen baoqian
 because Waner bothered Meina, so she very apologize
 ‘Waner bothered Meina, so she felt sorry.’
- b. Waner yinwei darao-le Meina, suoyi ta hen baoqian
 Waner because bothered Meina, so she very apologize
 ‘Waner bothered Meina, so she felt sorry.’

Sentences in (4) express the cause–effect relationship with compound connectives like *yinwei...suoyi...* ‘because...so...’. These sentences allow flexibility in the ordering of the subject and the first connective. The subject character *Waner* appears after the first connective *yinwei* ‘because’ in the canonical structure in (4a), but before the connective in (4b). Xu (2003) suggests that the left-dislocation structure in (4b) places the subject in a more topical position, and thus highlights the topic status of *Waner* in the sentence. We refer to (4a) as the canonical structure and (4b) as the topical structure.

Consistent with the topic analysis of the fronted subject in (4b), the fronted subject can occur with a pause particle *ne* (also referred to as a topic particle). Topics in Chinese can optionally separate from the rest of the sentence by a pause particle *ne* (Tsao, 1977). As can be seen in (5), the subject is compatible with *ne* when it is placed before the connective (5b), but not when it is placed after the connective (5a).

- (5) a. ?? yinwei Waner *ne*, darao-le Meina, suoyi ta hen baoqian
 because Waner *ne*, bothered Meina, so she very apologize
 ‘As for Waner, she bothered Meina, so she felt sorry.’
- b. Waner *ne*, yinwei darao-le Meina, suoyi ta hen baoqian
 Waner *ne* because bothered Meina, so she very apologize
 ‘As for Waner, she bothered Meina, so she felt sorry.’

The manipulation of topicality using these structures offers several advantages over passivization and topic markers. First, since the topicality of subject referents is manipulated structurally, the topicality effect can be elicited without context, unlike the manipulation of topic markers in Japanese and Korean. Second, it allows for the control of the order of thematic roles. Although passivization affects the topicality of subject referent, it also alters the order of thematic roles. For example, in (2), the active subject *Ada* is in the stimulus role, while the passive subject *Eva* is in the experiencer role. This could be problematic because thematic roles were found to influence pronoun production (Arnold, 1998, 2001; Kaiser, Li, & Holsinger, 2011; Rosa & Arnold, 2017; Weatherford & Arnold, 2021). Since the thematic role of subject referents does not vary in (4a) and (4b) (the subject *Waner* is the stimulus in

both 4a and 4b), these structures allow us to manipulate the topicality of subject referents while avoiding the confounding of thematic role in passivization.

In sum, the properties above make Mandarin a good test case for exploring topicality effects in a cross-linguistic context. Below we report two sentence-continuation experiments. Experiment 1 investigates how topicality affects the use of overt and null pronouns in Mandarin. In Experiment 2, we test a potential mechanism of the topicality effect, namely, whether predictability (the likelihood to remention a referent in the upcoming clause) influences the likelihood to pronominalize topical referents.

2. Experiment 1

Experiment 1 manipulated the topicality of subject referents by placing the subject before *yinwei* ‘because’ in a topical structure as in (4b) or after the connective in a canonical structure as in (4a). Previous work found that a topical structure increased subject mentions in the upcoming clause (Xu, Ni, & Chen, 2013). To prevent the analysis of referential form for object references from being based on a small number of observations, we constructed experimental sentences using stimulus-experiencer (SE) verbs that are known to increase object mentions after *so* (Crinean & Garnham, 2006; Stevenson, Crawley, & Kleinman, 1994). Below are sample stimuli:

- (6) a. Topical condition
- | | | | |
|-------|---------|----------|--------------|
| Waner | yinwei | darao-le | Meina, suoyi |
| Waner | because | bothered | Meina, so |
- ‘Waner bothered Meina, so...’
- b. Non-topical condition
- | | | | |
|---------|-------|----------|--------------|
| yinwei | Waner | darao-le | Meina, suoyi |
| because | Waner | bothered | Meina, so |
- ‘Waner bothered Meina, so...’

We assume that the topical structure (6a) only increases the topicality of subject referents, but not object referents. Thus, if topicality affects the choice of referential form, we predict this effect to be found only in subject references, resulting in an interaction effect between sentence structure (topical vs. canonical) and grammatical role (subject vs. object).

If the Topichood Hypothesis is language specific and is not valid in languages other than English, we predict that topicality would not affect referential form choice in Mandarin. If the Topichood Hypothesis is specific to overt pronouns cross-linguistically, topicality should increase the use of overt pronouns only. If the Topichood Hypothesis applies to the most reduced form in a language, we expect that topicality would increase the use of null pronouns only. If topicality promotes the use of all reduced expressions, both overt and null pronouns are expected to be more frequent in the topical condition than in the non-topical condition.

2.1. Methods

2.1.1. Participants

Seventy-six native Mandarin speakers participated in the study in exchange for CNY30 ($\approx$ USD4.65). The experiment lasted about 30 minutes.

2.1.2. Materials and procedure

We constructed 30 experimental items using 30 distinct SE verbs. All verbs were taken from previous studies that used SE verbs with the connective ‘so’ in Mandarin Chinese (Cheng, 2016; Hwang et al., 2022; Zhang, 2019). All items contained two same-gender characters, in the roles of stimulus and experiencer. Each item was in the topical structure in one condition and the canonical structure in another condition. In addition to experimental items, we constructed 36 filler items. Similar to experimental items, filler items described events involving two characters but used different types of verbs and compound connectives (e.g., *Suiran Hongyang shu-le yikuaiqian gei Tianming, danshi...* ‘Although Hongyang lost a dollar to Tianming, but ...’).

Using a Latin Square design, we constructed two lists so that each participant was exposed to each item in only one condition, but encountered all conditions across different items. Participants were randomly assigned to one of the two lists.

The study was performed via the online survey platform *Credamo*. Participants were instructed to provide a natural continuation about one of the characters in the first clause, avoiding humor. Before the main experiment, they were familiarized with the task with four example trials and four practice trials.

2.1.3. Scoring

Chinese is a topic-prominent language and allows a topic-comment structure in addition to a subject–predicate structure (e.g., Li & Thompson, 1976). For example, *daozi* ‘rice’ is the grammatical subject in both (7a) and (7b); the predicate *zhang de hen da* ‘grow very big’ describes the property of ‘rice.’ The extra component *nei kuai tian* ‘that piece of land’ preceding “rice” in (7a) is the topic of the sentence, which indicates that the sentence is about that piece of land.

- (7) a. Topic-comment construction
 Nei kuai tian daozi zhang de hen da.
 that piece land rice grow de very big
 ‘Speaking of that piece of land, rice grows very big (in it).’
- b. Subject-predicate construction
 Daozi zhang de hen da.
 rice grow de very big
 ‘Rice grows very big’

[adapted from Tsao, 1979]

For each response, we coded the first element of the sentence, which was either the sentence topic in a topic–comment structure or the grammatical subject in a subject–predicate structure (see also Hwang et al., 2022; Hwang, 2022b). Responses were coded for (a) the grammatical role of the referent in the preceding clause (subject or object) and (b) the choice of referential form (name, overt pronoun, or null pronoun). The data were double-coded by the first author and an undergraduate research assistant who was blind to the experimental manipulation and the original coding. Cohen’s kappa for the intercoder agreement was 0.97.

We excluded responses if (a) participants referred to both characters (e.g., *Waner yinwei shuofu-le Meina, suoyi tamen yiqi qu lvxing le* ‘Waner convinced Meina, so they went traveling together’); (b) they referred to the entities other than the characters in the preceding sentence (e.g., *suoyi mimi meiyou bei shuo-chuqu* ‘so the secret was not disclosed’); (c) they produced ambiguous continuations in which the intended referent could not be determined (e.g., *suoyi ta fangxin le* ‘so she was at ease now’); or (d) they provided erroneous continuations that did not match the meaning of the provided sentence (e.g., *Tingting yinwei jinu-le lili, suoyi bei tingting lahei le* ‘Tingting because annoyed Lili, so $\emptyset$ was blocked by Tingting’). We adopted a conservative approach for ambiguous responses and excluded any responses that were considered ambiguous by one of the coders. About 4.4% of trials (101 out of 2280 trials) were removed for one of the above reasons, resulting in 2179 trials in the analysis.

2.1.4. Analysis

We analyzed referential forms (names vs. overt pronouns vs. null pronouns) as a function of grammatical role (subject vs. object), sentence structure (topical vs. canonical), and the interaction between the two. The three-way choice of referential form was analyzed using a mixed-effects categorical logistic regression model.

We implemented a Bayesian model using the *brms* R package (Bürkner, 2017). We chose a weakly informative prior, using the Cauchy distribution with center 0 and scale 2.5, as recommended by Gelman, Jakulin, Pittau, and Su (2008). We fitted the model with maximal random structure justified by design first and then compared it with less complex models using leave-one-out cross-validation. Only results of the best-fitted model are reported. The Bayesian regression model provided a posterior distribution of the outcome. We report the estimated mean, the estimated error, and the 95% Credible Interval (CrI) of this posterior distribution in log odds. The 95% CrI represents a 95% of probability that the outcome lies in the boundary of this interval (Van de Schoot et al., 2014). If the interval does not contain zero and the limits of the interval are all positive or negative, it is considered to be equivalent to a significant effect in frequentist statistics.

2.2. Results

Participants continued sentences with subject referents more in the topical condition (62.5%) than in the non-topical condition (26.2%) (Xu et al., 2013). Fig. 1 shows the distribution of referential forms (names, overt pronouns, and null pronouns) for subject and object referents in topical and non-topical conditions. In both conditions, participants used more reduced expressions such as overt and null pronouns to refer to subjects, whereas they

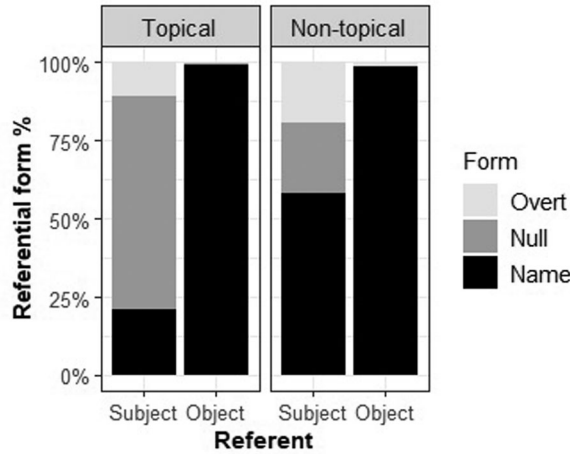


Fig. 1. The distribution of referential forms by topicality and grammatical role in Exp. 1.

used more names to refer to objects. Critically, they used more null pronouns for subjects in the topical condition (68.2%) than in the non-topical condition (22.9%). In contrast, overt pronouns were more frequent for subject referents in the non-topical condition (19.1%) than in the topical condition (10.8%).

We analyzed the choice of referential form (names vs. overt pronouns vs. null pronouns) as a function of grammatical role (sum-coded: subject = 0.5, object = -0.5), sentence structure (sum-coded: topical = 0.5, canonical = -0.5) and the interaction between the two predictors. Names were chosen as the reference level in the model. We used a full model which included grammatical role, sentence structure, and their interaction as fixed predictors, random intercepts for participants and items, and random slopes of grammatical role, sentence structure, and its interaction with the grammatical role for both participants and items. It was fitted using six chains, each with iterations of 3000 of which the first 1000 are warmup to calibrate the sampler, resulting in 12,000 posterior examples.

We found the main effect of grammatical role on overt pronouns (Table 1, panel a) and null pronouns (Table 1, panel b) compared to names. Both pronouns were more frequently used for subject referents than object referents. More importantly, we found the main effect of sentence structure on null pronouns. Participants used more null pronouns in the topical condition than in the non-topical condition. Such a difference was not found in the use of overt pronouns although overt pronouns were numerically more frequent in the non-topical condition. The interaction effect between grammatical role and sentence structure was not significant for both overt and null pronouns.

However, note that the difference in the rate of overt pronouns between topical and non-topical conditions was relatively small compared to that of null pronouns and overt pronouns rarely occurred for object referents. To see if we could detect any topicality effect on overt pronouns, we analyzed referential form choice for subject referents only. The results revealed a significant effect of topicality on both overt and null pronouns (overt pronouns: estimated

Table 1

Summary of the Bayesian mixed-effects categorical logistic regression model for the choice of referential form in Experiment 1

Predictor	Estimated Mean	Estimated Error	95% CrI
a: Overt pronouns vs. names			
Intercept	−4.96	0.64	[−6.38, −3.86]
Grammatical role	5.69	1.00	[3.93, 7.92]
Sentence structure	1.28	0.81	[−0.26, 2.92]
Grammatical role * Sentence structure	0.74	1.33	[−1.74, 3.56]
b: Null pronouns vs. names			
Intercept	−5.43	1.08	[−7.95, −3.75]
Grammatical role	10.43	2.04	[7.31, 15.29]
Sentence structure	3.66	1.22	[1.50, 6.30]
Grammatical role * Sentence structure	0.42	2.30	[−4.43, 4.79]

Note. 95% Credible interval (CrI) that does not contain zero (equivalent to significance in frequentist statistics) is given in bold.

mean = 1.67; estimated error = 0.68; 95% CrI = [0.47, 3.18]; null pronouns: estimated mean = 3.77; estimated error = 0.56; 95% CrI = [2.76, 4.98]). Whereas overt pronouns were more frequent in the non-topical condition, null pronouns were more frequent in the topical condition. Overall, these results are consistent with the hypothesis that topicality increases the use of the most reduced form available in a language.

2.3. Discussion

Experiment 1 showed that the manipulation of topicality only promoted the use of null pronouns in Mandarin. Participants used significantly more null pronouns for more topical subject referents, but at the same time used fewer overt pronouns. These results provide support for the possibility that topicality only increases the use of the most reduced expression when a language offers more than one type of reduced referential form.

The results of Experiment 1 can also explain why Zhan et al. (2020) did not find any topicality effect. In their study, they collapsed over overt and null pronouns to analyze the topicality effect. Since participants in the study produced mostly overt pronouns, collapsing the two could have obscured any potential effect of topicality on null pronouns.

Although null pronouns were sensitive to topicality, we did not find a significant interaction between sentence structure (topical vs. canonical) and grammatical role (subject vs. object). This is inconsistent with our assumption that the topicality should affect referential form for subjects, but not for objects. We suspect that this could be because the occurrences of null pronouns for object referents were too low for detecting and reliably testing the interaction effect (there were only two occurrences of null pronouns and 12 occurrences of overt pronouns out of 1216 object references). Given that null pronouns were rarely used for non-subject referents in other studies (e.g., Hwang et al., 2022), we expect that the interaction effect would

be difficult to detect. It is important for future research to replicate our results using a larger sample size.

The effect of topicality on null pronouns is consistent with Givón (1983), which suggests that the most topical entities tend to be referred to with the most reduced expression in a given language. Givón suggests that this is because topical entities are more accessible and predictable in the discourse. Consistent with Givón's account, we found that topical entities were indeed more predictable in Experiment 1. Participants were more likely to remention subjects in the topical condition than in the non-topical condition. Thus, the topicality effect in the study could be driven by the predictability of topical referents.

Yet whether predictability affects referential form is debated. On the one hand, some models of pronoun production argue that predictability plays a role in determining referential form (e.g., Expectancy Hypothesis by Arnold, 1998, 2001; Givón, 1983). For example, in (8), the experiencer role *Eva* is more predictable than the stimulus role *Ada*. Models that incorporate predictability as a predictor of reference form suggest that speakers tend to use more pronouns when referring to *Eva* than *Ada*.

- (8) a. Ada scared Eva, so...
- b. Eva feared Ada, so...

On the other hand, there are a number of studies that did not find a relationship between predictability and pronoun production. For instance, Fukumura and van Gompel (2010) found that English speakers did not use more pronouns when referring to more predictable thematic roles (see also Hwang et al., 2022; Kehler et al., 2008, for similar findings). They argue that referential form choice is primarily driven by structural factors like grammatical role but not by semantic factors like predictability.

Given the mixed evidence for the predictability effect in the literature, Experiment 2 investigates whether the topicality effect in Experiment 1 could be explained in terms of predictability.

3. Experiment 2

Experiment 2 investigates whether the higher rate of null pronouns in Experiment 1 was driven by predictability. If topical entities are more predictable and speakers use more reduced expressions for more predictable entities, we predict that speakers should use even more null pronouns for more predictable topical referents, compared to less predictable topical referents.

To test this possibility, we manipulated the predictability of topical referents with verb semantics using experiencer–stimulus (ES) verbs (e.g., *xihuan* ‘like’) and stimulus–experiencer (SE) verbs (e.g., *jīnu* ‘annoy’) in a topical structure (Crinean & Garnham, 2006; Fukumura & Van Gompel, 2010; Rohde & Kehler, 2014). In (9), both *Jingyi* in (9a) and

Xiaoyu in (9b) are topics, but the experiencer role *Jingyi* is more predictable than the stimulus role *Xiaoyu* following the connective *suoyi* ‘so’ (see Section 4.3).

- (9) a. Experiencer-Stimulus (ES) verb
 Jingyi yinwei xihuan Minghui, suoyi...
 Jingyi because like Minghui, so...
 ‘*Jingyi liked Minghui, so...*’
- b. Stimulus-Experiencer (SE) verb
 Xiaoyu yinwei fandao-le Laoli, suoyi...
 Xiaoyu because bother-PFV Laoli, so...
 ‘*Xiaoyu bothered Laoli, so...*’

Although connectives also allow for the manipulation of predictability (Cheng & Almor, 2017; Fukumura & Van Gompel, 2010; Stevenson et al., 1994), we chose to manipulate predictability via verb semantics rather than connectives. This is because we wanted to avoid the potential effect of connectives on reference production. Fukumura and van Gompel (2010) found that pronouns were more common after *because* than *so* using SE verbs. In a recent study, Hwang (2022b) further demonstrated that null pronouns were sensitive to connectives, in Korean. Thus, the manipulation of predictability using connectives could confound the predictability effect with the connective effect.

If the use of null pronouns for topical referents was driven by predictability in Experiment 1, we predict that participants should use more null pronouns for more predictable topical referents. That is, topical referents in experiencer roles are more predictable than those in stimulus roles, and thus participants should use more null pronouns when referring to topical referents following ES verbs (9a) than SE verbs (9b).

3.1. Methods

3.1.1. Participants

Forty native Mandarin speakers were recruited over the Internet in exchange for CNY50 (≈ USD7.75). The experimental session lasted about 50 minutes.

3.1.2. Materials and procedure

We constructed 36 experiment items. Eighteen items were designed with ES verbs (e.g., *xihuan* ‘like’), and 18 items with SE verbs (e.g., *darao* ‘bother’). SE verbs were taken from Experiment 1, and ES verbs were taken from Zhang (2019). Note that SE and ES verbs differed in terms of aspect in Experiment 2. In Mandarin, most ES verbs cannot occur with the perfective marker *le*. In contrast, most SE verbs must be accompanied by *le*. Thus, in Experiment 2 SE verbs were followed by a perfective marker *le*, whereas ES verbs were not. Although aspects may influence predictability (Ferretti, Rohde, Kehler, & Crutchley, 2009; Rohde, Kehler, & Elman, 2006), this is not a concern in the current experiment. This

is because the aim of the experiment was to manipulate predictability between ES and SE verbs regardless of whether the perfective marker contributed to predictability or not and our manipulation was successful (see Section 3.2). We did not control other factors such as verb frequency and number of strokes across verbs, as there is no evidence that they contribute to predictability or reference form production.

Each prompt contained two same-gender characters. In addition to experimental items, we also constructed 48 filler items using intransitive and transfer verbs. They described events involving a single character (e.g., *Minyi yinwei wan-le youxi...*, *suoyi...* ‘Minyi because played the game, so...’) or two characters of different gender (e.g., *Yuejuan yinwei mai-le yijian yifu gei Yuyong*, *suoyi...* ‘Yuejuan because sold a cloth to Yuyong, so...’). The procedure of Experiment 2 was identical to that of Experiment 1.

3.1.3. Scoring and analysis

The criteria for scoring were the same as those used in Experiment 1. Data were double-coded by the same coders as in Experiment 1. Cohen’s kappa for the intercoder agreement was 0.92. Following the criteria in Experiment 1, about 3.9% of trials (56 out of 1440) were removed. This left 1384 trials in the analysis.

To ensure that our manipulation of verb semantics affected predictability, we first analyzed referent choice as a function of verb type (ES vs. SE). This was done by a mixed-effects logistic regression model from the *brms* R package. We then analyzed the effect of predictability on the referential form (names vs. overt pronouns vs. null pronouns) as a function of verb type (ES vs. SE). However, we performed the analysis only on subject references because object references were infrequent (380 out of 1371), and both overt and null pronouns were rarely used for object referents (three occurrences of overt pronouns and no occurrence of null pronouns). The results were analyzed using the mixed-effects categorical logistic regression model from the *brms* R package. Both models were constructed and fitted using the same prior as in Experiment 1. We report the results of the best-fitted model.

3.2. Results

Fig. 2 illustrates the choice of the referent (subject vs. object) by verb type (ES vs. SE). Participants referred to topical subjects more often following ES verbs (94.6%) than SE verbs (50.0%) consistent with the results of previous research (e.g., Crinean & Garnham, 2006; Zhang, 2019).

We analyzed referent choice (subject = 1, object = 0) as a function of verb type (sum-coded: ES = 0.5, SE = -0.5). The model included verb type as the fixed predictor, random intercepts for participants and items, and a random slope of verb type for participants. The analysis confirmed that verb type had a significant main effect on referent choice (estimated mean = 4.39; estimated error = 0.69; 95% CrI = [0.69, 3.08]), and our manipulation of verb semantics was effective in manipulating predictability.

Fig. 3 plots the distribution of referential expressions (names, overt, and null pronouns) by grammatical role (subject vs. object) and verb type (ES vs. SE). As was found in Experiment 1, participants used more reduced expressions (overt and null pronouns) for subject referents

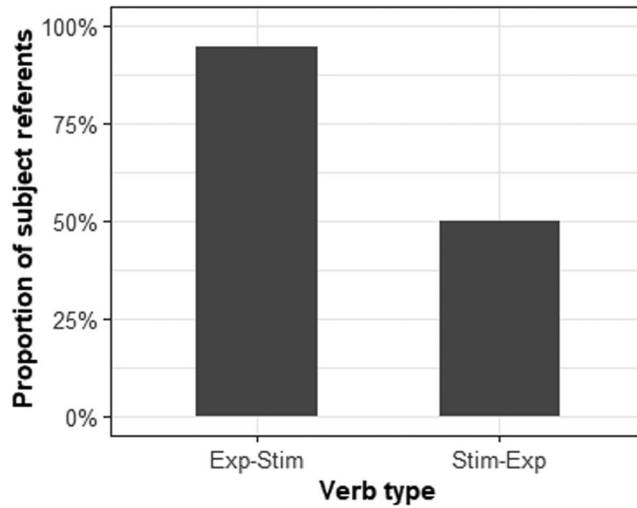


Fig. 2. The choice of referent by verb type in Exp. 2.

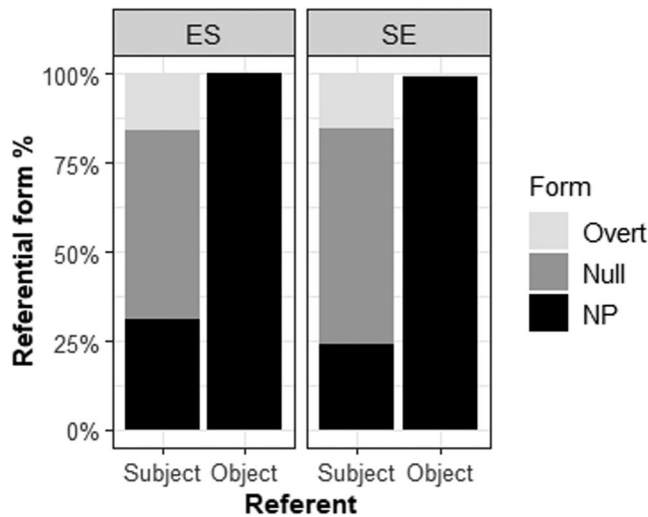


Fig. 3. The distribution of referential forms by grammatical role and verb type in Exp. 2.

than object referents for both verb types. Critically, participants used more null pronouns for topical subjects following SE verbs (60.4%) than ES verbs (53.2%) contrary to what is expected by the predictability account. We analyzed referential form choice (names vs. overt pronouns vs. null pronouns) for subject referents as a function of verb type (sum-coded: ES verbs = 0.5, SE verbs = -0.5), with names as the reference level in the regression model. The final model included verb type as a fixed predictor and random intercepts for participants and items.

Table 2

Summary of the Bayesian mixed-effects categorical logistic regression model for the choice of referential form in Experiment 2

Predictor	Estimated Mean	Estimated Error	95% CrI
a: Overt pronouns vs. names			
Intercept	−0.89	0.78	[−2.46, 0.60]
Verb type	0.50	0.40	[−0.27, 1.31]
b: Null pronouns vs. names			
Intercept	0.38	1.15	[−1.97, 2.62]
Verb type	1.13	0.48	[0.20, 2.10]

Note. 95% Credible interval (CrI) that does not contain zero (equivalent to significance in frequentist statistics) is given in bold.

The results of the analysis revealed a significant main effect of verb type on null pronouns (Table 2, panel b) compared to names. This effect, however, was in the opposite direction of the predictability effect. When referring to topical subject referents, Mandarin speakers used more null pronouns for *less* predictable stimulus topics. We did not find any effect of verb type on the use of overt pronouns (Table 2, panel a).

3.3. Discussion

The results of Experiment 2 demonstrate that predictability is not a likely mechanism that underlies the topicality effect. Although topical subject referents in experiencer roles were more predictable than those in stimulus roles, participants did not use more null pronouns for experiencer topics. Rather, they used more null pronouns for *less* predictable stimulus topics. These results strongly suggest that the use of null pronouns for topical referents in Experiment 1 is not likely to be driven by predictability.

Although we presume that verb semantics between ES and SE verbs was primarily responsible for our manipulation of predictability, it is possible that factors other than verb semantics have contributed to predictability (e.g., use of perfective marker *le*, verb frequency, number of strokes, etc.). Critically, regardless of whether other factors affected predictability or not, the predictability of the topical referent was different between ES and SE verbs and this difference in predictability did not increase the use of null pronouns.

Our findings are compatible with the models of pronoun production that suggest a dissociation between predictability and pronoun production (e.g., Fukumura & van Gompel, 2010; Kaiser et al., 2011; Kehler et al. (2008)'s Bayesian model; Rohde & Kehler, 2014), but not with models that suggest predictability as a mechanism of pronoun production (e.g., Expectancy Hypothesis by Arnold 1998, 2001). In particular, the significant topicality effect in our study supports models that suggest that information-structural factors like topicality play a central role in determining referential form (e.g., Kehler et al. (2008)'s Bayesian model, also see Kehler & Rohde, 2013, 2019; Rohde & Kehler, 2014). Note, however, that these models often discount the effects of semantic factors on referential form production. Yet the

results of Experiment 2 suggest that semantic factors such as verb bias could play a role in referential form choice.

Our successful manipulation of predictability independent of topicality further points to a dissociation between topicality and predictability in line with Guan and Arnold (2021). In implicit causality contexts in which the stimulus character is more predictable than the experiencer character, Guan and Arnold found that participants selected the grammatical subject as the most topical referent but the stimulus character as the most predictable referent. In a corpus analysis, they also found that the predictable stimulus character did not occur in topical positions. Instead, the less predictable experiencer character tended to be human and topical. Our results, taken together with the findings of Guan and Arnold (2021), provide evidence against models of reference production that consider predictability and topicality as overlapping properties (e.g., Givón, 1983).

4. General discussion

Many models of reference production suggest that a central function of pronouns is to signal the topicality of a referent (e.g., Ariel (1990)'s Accessibility Hierarchy; Givón, 1983; Gundel et al. (1993)'s Givenness Hierarchy; Rohde & Kehler, 2014). However, it has been unclear how topicality is mapped onto the referential form and what mechanisms underlie topicality effects. To examine the nature and mechanisms of the Topichood Hypothesis, we investigated how topicality affected referential form choice in Mandarin. We manipulated sentence topicality using a topical structure, which preposes the grammatical subject before the first connective of a compound connective.

In line with previous research, we found that Mandarin speakers were more likely to use both overt and null pronouns for subject referents than object referents (Hwang, 2021; Hwang et al., 2022; Zhan et al., 2020). Critically, we found that participants used more null pronouns for topical subject referents than non-topical subject referents. Overt pronouns were more frequent for non-topical subjects than topical subjects. These results suggest that topicality increases the frequency of the most reduced expression available in a given language.

Givón (1983) suggests that the topicality effect on pronoun production could be because topical entities are more accessible and predictable. However, we found that participants did not use more null pronouns for more predictable topical subjects. In fact, null pronouns were more common for less predictable topical subjects. These findings are consistent with models that suggest a dissociation between predictability and pronoun production (e.g., Fukumura & van Gompel, 2010; Kaiser et al., 2011; Kehler et al., 2008) and provide evidence against the claim that predictability contributes to pronominalization toward topical referents (Arnold, 1998, 2001; Givón, 1983).

Then how might topicality influence the choice of referential form? Apart from predictability, Givón (1983) suggests that topical referents tend to be more accessible. Similarly, Ariel's (1990) Accessibility Hierarchy argues that discourse topics are more prominent and accessible in memory and are subsequently more likely to be pronominalized. If accessibility

underlies the topicality effect, there are at least two possibilities about how topicality affects referential form choice.

One possibility is that topical entities are more accessible to the speaker. Previous research suggests that how accessible entities are to the speaker plays an important role in their linguistic choices. For example, at the syntactic level, speakers tend to choose syntactic structures that put more accessible referents earlier in an utterance, and postpone the production of less accessible referents (e.g., Arnold, Losongco, Wasow, & Ginstrom, 2000; Bock, 1982; Bock & Warren, 1985; Ferreira, 1994; Ferreira & Dell, 2000; but see Hwang & Kaiser, 2014, Hwang & Kaiser, 2015). Some models of pronoun production instantiate accessibility in terms of activation and assume that the activation level in the speakers' non-linguistic representation of discourse determines referential form: The more activated the referent, the more reduced the referential form (Arnold & Griffin, 2007; Van Rij, Van Rijn, & Hendriks, 2011). According to this view, if topical referents are more activated than non-topical or less topical referents, they are more likely to be referred to by reduced expressions.

Another possibility, which is not mutually exclusive to the first one, is that topical referents are more accessible to the listener. Research suggests that speakers are sensitive to the perspective of listeners (e.g., Brennan & Clark, 1996; Clark & Krych, 2004; Fussell & Krauss, 1989; Glucksberg, Krauss, & Weisberg, 1966; Hoek, Kehler, & Rohde, 2021). In terms of referential form production, this could mean that speakers choose referential forms to facilitate comprehension for their listeners (Ariel, 1990). That is, speakers use null pronouns to signal the listener to look for referents that are most topical and accessible in their memory. In fact, there is evidence that null pronouns can facilitate the listener's interpretation of topical referents. For example, Shoji, Dubinsky, and Almor (2017) found that Japanese speakers were faster to read sentences when topic-marked subjects were referred to by null pronouns, compared to names or overt pronouns. These findings are consistent with the possibility that speakers use null pronouns for topical referents because they facilitate listeners' interpretation of topical entities. Future research could test these two possibilities to shed light on the cognitive mechanisms underlying the topicality effect.

Although the current study demonstrates that topicality increases the use of the most reduced null pronouns, there are a number of open questions about how topicality influences referential forms other than overt and null pronouns. Some languages offer reduced forms that do not differ in terms of informativeness. For example, in German human referents can be referred to by personal pronouns (*er* 'he,' *sie* 'she,' *es* 'it') or demonstrative pronouns (*die* [male], *der* [female], *das* [neuter] 'that') (Bosch, Katz, & Umbach, 2007; Kaiser, 2011). Although null pronouns provide no information about a potential referent, demonstratives in German encode grammatical gender and number of a potential referent similar to overt pronouns. Yet German demonstratives and overt pronouns are suggested to differ in terms of interpretation preferences (e.g., Bosch et al., 2007; Hinterwimmer, 2014; Tomaszewicz-Özakin & Schumacher, 2022). While overt pronouns are used for topics, demonstratives have a strong preference against topics. It remains unknown if this bias would hold in production, with overt pronouns being used for topical referents and demonstratives for non-topical referents.

Furthermore, even within languages that allow both overt and null pronouns, their referential biases may differ. In languages without agreement morphology such as Mandarin, overt and null pronouns share a similar interpretation bias and exhibit a bias toward subject referents (Kim et al., 2013; Ngo, 2019; Ueno & Kehler, 2016). In languages with agreement morphology such as Spanish and Italian, however, null pronouns prefer subject referents, whereas overt pronouns prefer object referents (Alonso-Ovalle, Fernández-Solera, Frazier, & Clifton, 2002; Filiaci, Sorace, & Carreiras, 2014). Since grammatical role distinguishes two types of pronouns in these languages, it is possible that topicality may not have a significant effect on the use of null pronouns in these languages. To see how topicality affects referential form in languages with rich agreement morphology, further research is needed.

In sum, our results suggest that topicality increases the use of the most reduced expression in a language and this effect is not likely to be driven by predictability. These results contribute to our understanding of reference production by demonstrating how topicality influences the choice of referential form in a broader cross-linguistic context, and whether the effect of topicality on referential form production is related to predictability.

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