

The Interpretation of Chinese Plurals: Experimental Evidence by Chinese Children and Adults

Yi Liu and Kook-Hee Gil

1. Introduction

This paper investigates how native Chinese children and adults compute inclusive (*one or more than one*) and exclusive (*more than one*) readings associated with plurality in Mandarin Chinese. Recent research has reported that children and adults differ with respect to these two types of readings for bare plural DPs, and these results were used in support of the scalar implicature approach (Tieu et al. 2014; Renans, et al., 2018; Renans, et al., 2020). This finding has been only tested in languages with obligatory plural marking, such as English, Greek, and Turkish. The current study extends this finding to Chinese, an optional plural marking language. We tested 30 Chinese children and 66 Chinese adults on bare nouns (without a plural marker, *-men*) and *-men* plurals (with the overt plural marker), two expression types that can yield plural interpretations. The results show that bare nouns receive inclusive readings from both children and adults, in support of number neutrality (Krifka, 1995; Rullmann and You, 2006). However, the results also show that, unlike previous observations (Li, 1999; Li, 2020), *-men* plurals receive both inclusive and exclusive readings, and that children and adults showed a different preference, which patterns together with those results in obligatory plural marking languages. That is, plurality inferences (i.e., exclusive readings) associated with plural marking are scalar implicatures.

The remaining sections of this paper are organized as follows. Section 2 discusses the inclusive and exclusive interpretations of bare plurals in obligatory plural marking languages (English). In Section 3, we discuss previous theoretical assumptions on the readings associated with *men* plurals. We also provide a quick review of bare nouns first, which are far more commonly used than *men* plurals in Mandarin Chinese. Section 4 introduces the Truth Value Judgment Test (TVJT) used in the current research and Section 5 presents the results. We discuss the main findings in Section 6 and summarise this paper in Section 7.

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2. Plurality in obligatory plural marking languages

Bare plurals have been argued to be associated with two interpretations¹ (Sauerland et al., 2005; Spector, 2007; Zweig, 2009; Tieu et al., 2014; Renans, et al., 2018; Renans, et al., 2020). One interpretation is what we are intuitively familiar with, *more than one* (or *two or more*), and this is known as an exclusive reading. The other interpretation is the reading that includes *one*, such as *one or more*, and this is known as an inclusive reading.

Between the two possible interpretations, there have been observations that show a different preference by adults and children. For instance, Tieu et al. (2004) report that English adults tend to prefer the exclusive interpretation (1a) while children tend to prefer the inclusive interpretation (1b).

- (1) Emily fed giraffes.
- a. Emily fed more than one giraffe. (exclusive)
 - b. Emily fed one or more than one giraffe. (inclusive)
- (adapted from Tieu et al., 2014: p123-124)

In negative contexts, on the other hand, another different preference pattern emerges. For example, consider the negative sentence (2) and its possible interpretations as shown (2a and 2b).

- (2) Emily didn't feed giraffes.
- a. Emily didn't feed one or more than one giraffe. (inclusive)
= Emily didn't feed any giraffes.
 - b. Emily didn't feed GIRAFFES², she only fed one. (exclusive)
= Emily didn't feed more than one giraffe, she only fed one.
- (adapted from Tieu et al., 2014: p123-124)

The negative sentence (2) can be interpreted in two possible ways: (2a) with an inclusive reading (*not one or more giraffes* (i.e., *none*) and (2b) with an exclusive reading (*not more than one giraffe*). Unlike the pattern shown in the positive context, under negation, both English adults and children tend to prefer the inclusive interpretation (2a) to the exclusive one in (2b) in general. Within the

¹ In this paper, we only focus on existential readings, which refer to one or multiple, definite or indefinite individuals. This is different to other possible readings, such as the generic reading, which is a generalisation over individuals or refers to a kind or kinds of objects.

² According to Renans et al. (2020), sentences like this in conversations normally involve focal stress on the plural noun *giraffes*, and the exclusive readings “emerge as a marked option” (p311). However, this does not mean that without focal stress, the exclusive interpretation is not available anymore; speakers are able to compute the marked exclusive reading under negation without focal stress. This received support from the results of previous studies (Tieu et al., 2014; Renans et al., 2018; Renans et al., 2020) and our current study.

exclusive interpretation in (2b), adults showed a slightly higher preference for it than children (Tieu et al., 2014).

Tieu et al. (2014) employ the scalar implicature approach to explain this L1 pattern. They propose that the exclusive readings associated with bare plurals (i.e., plurality inferences) are a type of scalar implicature. The plural inference arises from “a comparison of the plural and the singular, where the singular has already been enriched with its own scalar implicatures” (i.e., *exactly one*) (Tieu et al., 2014: p123; see also Spector, 2007). Plurality inferences tend to work in the same way as other scalar expressions, such as the quantifier *some* and the disjunction *or* (e.g., Papafragou and Musolino, 2003; Barner et al., 2011). Scalar implicatures appear in upward-entailing environments (e.g., positive contexts) but tend to disappear in downward-entailing environments (e.g., negative contexts). Accordingly, exclusive readings would be computed more often in the positive than in the negative context by both English adults and children. However, children in general are less sensitive to scalar implicatures than adults, leading to exclusive readings being computed less often by children than by adults in both positive and negative contexts (Tieu et al., 2014).

Previous studies regarding the interpretations of bare plurals have also been carried out in other languages with obligatory plural marking, such as Greek and Turkish (Renans, et al., 2018; Renans, et al., 2020). Both Greek and Turkish children and adults showed similar patterns to English speakers in the interpretation of bare plurals, supporting that plurality inferences are scalar implicatures and that they tend to appear in positive contexts but disappear in negative contexts.

The current study extends the given findings to languages where plural marking is optional, with a view to exploring to what extent the presence/absence of plural marking contributes to plurality inferences. Using a similar TVJT, we investigate how Chinese speakers interpret plurality in the absence of obligatory plural marking and explore what interpretations the use of optional plural marking can trigger.

3. Plurality in Chinese

Chinese bare nouns are argued to be number neutral (Krifka, 1995; Rullmann and You, 2006). A bare noun can ‘refer to one entity or several entities’ (Li, 2020: p799). A plural marker, *-men*, though available, is not necessary to denote plural entities. Consider the example below with the bare noun *shu* (lit. book) in the positive sentence.

- (3) Zuotian wo mai le shu.
 yesterday I buy ASP book
 ‘Yesterday, I bought one or more than one book’ (inclusive)
 (adapted from Rullmann and You, 2006: p12)

For the use of the bare noun in the positive sentence (3), it has been reported that the situation where *I bought one book* and *I bought multiple books* are both

true, thus the interpretation of bare noun is akin to an inclusive meaning *one or more books* (Rullmann and You, 2006). This inclusive reading also tends to appear in the negative context, as shown in (4).

- (4) Zuotian wo mei mai shu.
 yesterday I not buy book
 ‘Yesterday, I didn’t buy one or more than one book’
 = ‘Yesterday, I didn’t buy any book’ (inclusive)

In (4), under negation, *shu* is also normally interpreted with an inclusive reading, meaning *none*.

Now consider the plural particle *-men*. It has been argued that the plural marker *-men* is only associated with exclusive readings (Li, 1999; Kim and Melchin, 2018; Li, 2020). Its distribution is rather limited since it can only be used with humans and other personified individuals, such as *hudie-men* (lit. butterflies) in (5a) and *xuesheng-men* (students) in (5b).

- (5) a. Hudie(-men) zai changge.
 butterfly-pl ADV sing
 ‘(the) butterflies are singing’ (exclusive)
 b. Xuesheng(-men) zai kan shu.
 student-pl ADV read book
 ‘(the) students are reading’ (exclusive)

It should be noted that *-men* can be optional in both (5a) and (5b), meaning overt plural marking is not necessarily needed to convey a plural meaning in Mandarin Chinese. Bare nouns are more widely used to incur plural meanings. This suggests that the plural marker *-men* is not as productive as plural markers in obligatory plural marking languages, such as the English *-s*.

In sum, a widely accepted view to date is that in Chinese, bare nouns tend to have inclusive readings in both positive and negative contexts, while *men* plurals have exclusive readings *only*. Given this interpretive pattern, we aim to observe how Chinese children and adults interpret nominals with/without overt plural marking in positive and negative contexts. If the generalisation above is on the right track, we predict that the results for bare nouns and *men* plurals will differ: the former is interpreted inclusively while the latter will receive, almost exclusively, exclusive readings in both positive and negative contexts.

We also make hypotheses under the implicature approach as follows. First, if the exclusive readings associated with the plural marker *-men* arise as scalar implicatures, we expect *men* plurals to be interpreted exclusively in positive contexts but inclusively in negative contexts. Following this, we also expect that children compute the exclusive readings associated with *-men* less often than adults, due to their insensitivity to scalar implicatures. Third, if the plurality inferences (i.e., exclusive readings) are associated with the particle *-men*, we expect that there should be no difference between children’s and adults’ interpretations of bare nouns, as no plurality inferences will be computed with

bare nouns without *-men*. By testing children of ages 4 to 6 - the age groups where the full computation of implicatures has not yet fully emerged (e.g., Zhao et al., 2021) - we seek to observe their interpretation of the base meaning of nominals.

4. Experiment

4.1. Methodology

The task design of the current study was adapted from Tieu et al. (2014). During the test, the participants were first introduced to a rabbit puppet named Xiaobai. The puppet's videos are pre-recorded and were played at different time points during the test. Each participant listened to a series of pre-recorded short stories and watched accompanying animations. After each story, the puppet appeared on the screen and was asked 'what happened in the story' by the experimenter, whose lines were also pre-recorded. The puppet would reply to the question with a test token. For the participants who attended the experiment through online one-to-one interviews, they were then asked by the researcher if Xiaobai's reply (text token) was true or false based on the story. For the participants who participated in the experiment through an online experiment platform, two buttons named 'True' and 'False' respectively would then appear on their screen for them to click on.

4.2. Participants

The participants include 30 Chinese-speaking children and 66 Chinese-speaking adults. The child participants were 4 to 6 years old (mean = 5;01).

4.3. Procedure

Though the experiment had originally been planned in a face-to-face setting, the Covid-19 pandemic meant that we had to test the child participants and 21 adult participants through online one-to-one interviews. For the other 45 adult participants, we tested them remotely using the Gorilla Experiment Builder (Anwyl-Irvine et al., 2018). No statistically significant effect of the test methods on the participants' responses was identified, therefore, we report the data collected from both ways together in this paper.

4.4. Materials

There were two categories of test items: bare noun and *men* plural. Each was constructed into three positive and three negative test tokens. There were six test stories, three for each category. Each test story was combined with one positive and one negative test token. This is summarised in Table 1 below.

Table 1. Number of test stories and test tokens

	bare nouns	<i>men</i> plurals
	3 test stories	3 test stories
positive	3 tokens	3 tokens
negative	3 tokens	3 tokens

As shown in Table 1, in total, there were 12 test tokens (six for each category). Each participant responded to 8 out of the 12 test tokens (four for each category, either positive or negative) and each type of test token was used equally across the participants. In total, each participant responded to 12 trials (8 test tokens, plus 4 control items which will be presented later).

For bare nouns, the test items include *xionghao* (lit. panda), *ningmeng* (lit. lemon), and *xigua* (lit. watermelon); for *men* plurals, the test items include *xiaotuzi-men* (lit. rabbits), *xiaoniao-men* (lit. birds), and *xiaoxiang-men* (lit. elephants). The examples for test stories and test tokens are presented as follows.

For bare nouns, the test story (6)³ and its animation (Figure 1) show that the main character Qianqian only fed one panda.

- (6) Story: Qianqian went to the zoo. She didn't have enough bamboo, so she only fed this panda.

Experimenter: Xiaobai, what happened in the story?

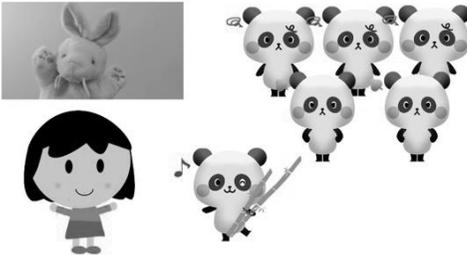


Figure 1. The last image of the animation for the story in (6)

The puppet's response was either (7a) or (7b). For the positive test sentence (7a), if the participants interpreted the bare noun *xionghao* (lit. panda) with the exclusive reading *more than one panda*, they were expected to assign the FALSE value to it, as this test sentence conflicts with the fact that Qianqian only fed one panda. However, if the participants interpreted the bare noun with the inclusive

³ Here we only present the English translation of the test stories (6) and (8), which are in Chinese in the real test.

reading *one or more than one panda*, they would assign the TRUE value to this test sentence.

- (7) a. (positive test sentence:
 Qianqian wei le xiongmao.
 Qianqian feed AX panda
 *‘Qianqian fed panda’
 b. (negative test sentence:
 Qianqian meiyou wei xiongmao.
 Qianqian not feed panda
 *‘Qianqian didn’t feed panda’

For the negative test sentence (7b), the participants were expected to assign the FALSE value to it, if they interpreted *xiongmao* (lit. panda) with an inclusive reading under negation, meaning Qianqian did not feed any panda. Otherwise, they were expected to assign the TRUE value to the test sentence.

For *men* plurals, the test story (8) and the animation (Figure 2) show that Qianqian is only teaching one rabbit English.

- (8) Story: There is a rabbit in the classroom. Qianqian is teaching this rabbit English.
 Experimenter: Xiaobai, what happened in the story?

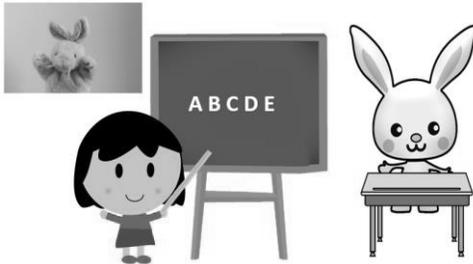


Figure 2. The last image of the animation for the story in (8)⁴

The test story is followed by the test tokens such as (9a) and (9b). First, for the positive test sentence (9a), if the participants interpreted *xiaotuzi-men* (lit. rabbits) with an exclusive reading, we would expect them to assign the FALSE value to this sentence. However, if they interpreted it inclusively, they would assign the TRUE value to this test sentence.

⁴ Compared with the test stories for bare nouns where the main character executed an action on one out of some objects (e.g., feeding one panda out of a group of pandas), the main character here in *men* plural test stories only executed her action on the only one object, this is to avoid the situation where participants may think there are *xiaotuzi-men* (lit. rabbits) that Qianqian is not teaching, pointed out by a native Chinese speaker in the pilot study.

- (9) a. (positive test sentence:)
 Qianqian zai jiao xiaotuzi-men xue yingyu.
 Qianqian AD teach rabbit-s learn English
 ‘Qianqian is teaching (the) rabbits English’
- b. (negative test sentence:)
 Qianqian mei zai jiao xiaotuzi-men xue yingyu.
 Qianqian not AD teach rabbit-s learn English
 ‘Qianqian is not teaching (the) rabbits English’

For the negative test sentence (9b), if the participants interpreted the plural *xiaotuzi-men* inclusively, they would assign the FALSE value to it, but if they interpreted the plural exclusively, they would respond with the TRUE value.

The control items are singular numeral classifier DPs in the form of *one CL x*, such as *yi zhi xiongmao* (lit. one CL panda). They are either combined with the aforementioned stories with singular meanings ((6) and (8)), or with an additional type of story which have plural meanings. They will help us better understand whether the participants can distinguish between the singular and plural meanings presented by the stories and control sentences. For example, for the singular story in (6) where Qianqian only fed one panda, the control items are such as (10a) and (10b).

- (10) a. (positive control item)
 Qianqian wei le yi zhi xiongmao. (target answer: True)
 Qianqian feed AX one CL panda
 ‘‘Qianqian fed a panda.’’
- b. (negative control item)
 Qianqian meiyou wei yi zhi xiongmao. (target answer: False)
 Qianqian not feed one CL panda
 ‘‘Qianqian didn’t feed a panda.’’

(10a) and (10b) contain the singular numeral classifier DP *yi zhi xiongmao* (lit. one CL panda), meaning ‘‘a panda’’. If the participants can understand the singular meaning signified by the story, they will respond the TRUE value to (10a) but the FALSE value to (10b).

In plural stories, Qianqian executed her action on more than one object. For example in (11), Qianqian fed three pigs. The control items under these stories are such as (11a) and (11b).

- (11) Story: Qianqian had some apples and she fed three pigs.
- a. (positive control item)
 Qianqian wei le yi zhi zhu. (target answer: False)
 Qianqian feed AX one CL pig
 ‘‘Qianqian fed a pig.’’

- b. (negative control item)
 Qianqian meiyou wei yi zhi zhu. (target answer: False)
 Qianqian not feed one CL pig
 “Qianqian didn’t feed a pig.”

If the participants can understand the plural meaning signified by the plural story, they will respond the FALSE value to (11a). The target answer for (11b) is also FALSE, with *yi zhi zhu* (lit. one CL pig) under negation being interpreted as *none*. However, there might be an additional interpretation, that is, *not exactly one pig*. This will lead to a TRUE value response to (11b).

5. Results

We investigate three factors in this experiment: category (bare noun vs. *men* plural), context (positive vs. negative), and age group (child vs. adult). We used R (R Core Team, 2012) and lme4 (Bates et al., 2012) to perform a generalised linear mixed-effects analysis of the data, with age group, category, and context as the fixed effects, and by-subject intercept as the random effect. The result revealed significant effects of category ($p < .001$), context ($p < .001$), and age group ($p < .001$).

We first report the results for the bare noun category by showing the percentage of exclusive readings comparing children and adults in each of positive and negative contexts. This is shown in Figure 3 below.

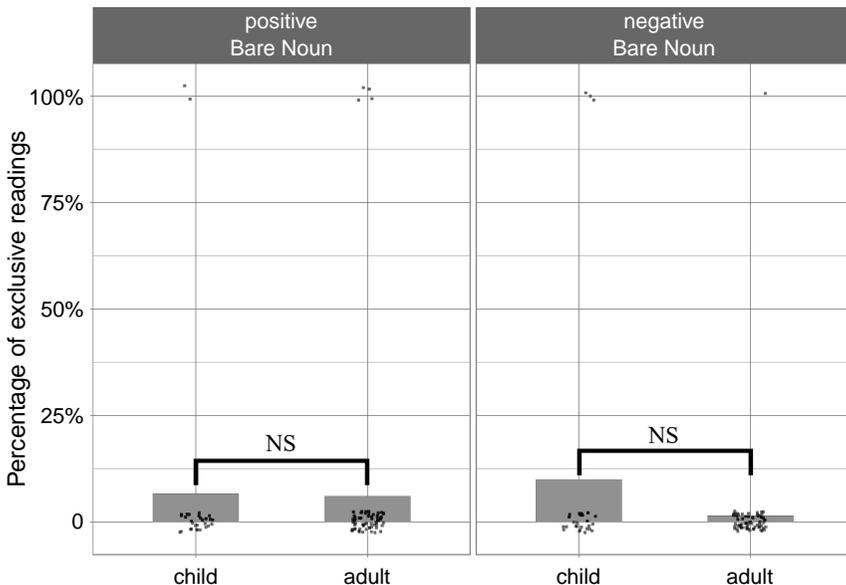


Figure 3. Exclusive readings of bare nouns by children and adults

As can be seen above, there is only a low percentage of exclusive interpretations in each context by each age group, and no statistically significant difference was identified between the adults' and children's responses in neither positive nor negative contexts. Both child and adult participants tended to interpret bare nouns inclusively in the positive context and under negation.

In comparison, Figure 4 shows the percentage of exclusive readings for *men* plurals in both positive and negative contexts by comparing the two age groups.

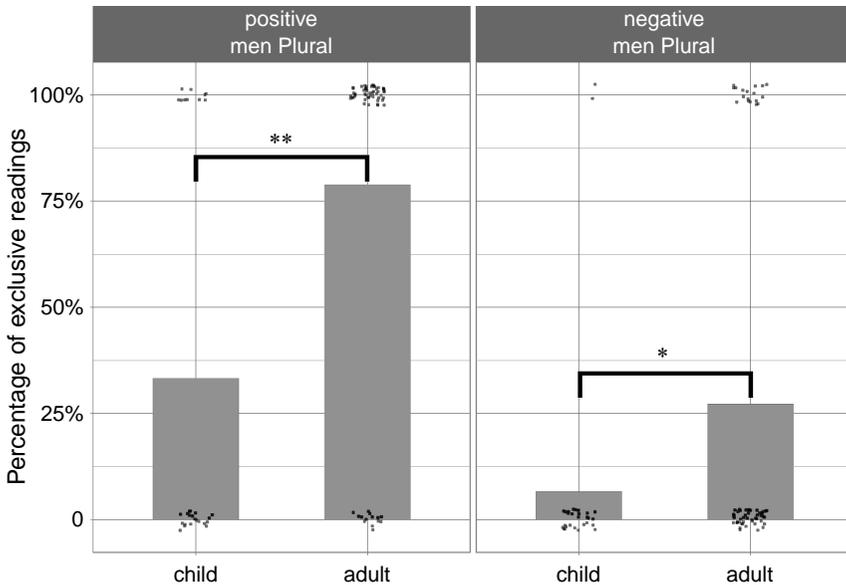


Figure 4. Exclusive readings of *men* plurals by children and adults

The results of *men* plurals are very different from those of bare nouns. For the positive context on the left, the difference between the exclusive interpretations by children and adults is significantly different ($p < .001$). Children interpreted exclusive readings one-third of the time and the inclusive reading was dominant at two-thirds, while the percentage of exclusive readings computed by adults is roughly 80%. For the negative context, the difference between the exclusive interpretations by children and adults is marginally different ($p < .05$). There is only a low percentage of exclusive readings for children and the inclusive reading was almost the only interpretation, whereas the rate for adults is roughly 30%.

To summarise, for *men* plurals, with adults, the exclusive reading was dominant in the positive context, while the inclusive reading was dominant in the negative context. On the other hand, the child participants tended to interpret *men* plurals inclusively in both positive and negative contexts. Overall, children interpreted exclusive readings less often than adults in both positive and negative contexts.

As for the control items, both age groups predominantly provided the correct responses. This means that they had no difficulty in understanding the singular and plural meanings signified by test stories and control sentences, indicating that the results from the test items are reliable. The results are shown in Table 2.

Table 2. Results of the control items (accuracy (%)):

	Singular stories		Plural stories	
	Positive	Negative	Positive	Negative
Child	100	86.67	86.67	80.00
Adult	87.5	98.34	88.33	73.61

To sum up the experimental results, children and adults tend to interpret bare nouns in Mandarin Chinese inclusively in both positive and negative contexts. For *men* plurals, children tend to interpret them inclusively in both positive and negative contexts, while adults tend to interpret them exclusively in the positive context but inclusively under negation, and they tend to compute more exclusive readings overall than children in both positive and negative contexts.

6. Discussion

It is clear that the participants displayed different patterns when interpreting bare nouns and *men* plurals in Mandarin Chinese. Bare nouns have an inclusive reading irrespective of context, supporting that Chinese bare nouns are number neutral. In contrast to bare nouns, the results for *men* plurals contradict the received wisdom on *-men* that it gives rise to exclusive readings only. Our results show that inclusive readings are available with *men* plurals in both positive and negative contexts. This is in line with what has been found with the interpretations of bare plurals in obligatory plural marking languages (English, Greek, Turkish), and we conclude that *men* plurals are similar to them.

We now turn to the hypotheses made following the implicature approach to plurality. First, our results show that both Chinese adults and children interpreted *men* plurals with exclusive readings more in positive contexts than in negative contexts. This is consistent with the nature of scalar implicatures, in that they appear in upward-entailing environments (e.g., positive contexts) but tend to disappear in downward-entailing environments (e.g., negative contexts).

Second, our results show that Chinese children interpreted *men* plurals predominantly inclusively in positive contexts and almost entirely inclusively in negative contexts. They computed exclusive readings associated with *men* plurals less often than adults in both positive and negative contexts. This is consistent with previous research investigating how children compute plurality inferences (e.g., Tieu et al., 2014; Renans, et al., 2018; Renans, et al., 2020) and other scalar

implicatures (e.g., Noveck, 2001; Papafragou and Musolino, 2003; Katsos and Bishop, 2011; Zhao et al., 2021).

The two findings discussed above support the implicature approach to plurality in previous studies (e.g., Tieu et al., 2014; Renans et al., 2018; Renans et al., 2020). This suggests that the plurality inferences associated with *men* plurals are also a type of scalar implicature.

Another important finding of this study concerns the comparison between the interpretations of bare nouns vs. *men* plurals. We hypothesised earlier that if plurality inferences are only associated with the plural particle *-men*, then no plurality inferences would be computed with bare nouns without *-men*. Plurality inferences, as a type of scalar implicature, will lead to different patterns of interpretation by children and adults. Thus, we should expect no difference in adults' and children's interpretations of bare nouns, but only with *men* plurals. This is indeed what was shown by our results. Therefore, we propose that the inclusive reading is the base meaning for both bare nouns and *men* plurals, evidenced by the results from children, and it is the plural marker *-men* that gives rise to plurality inferences. This further supports that plurality inferences can be derived from overt plural marking even in non-obligatory plural marking languages.

The current results also call into question the previous research stating that *-men* is optional, as the current results show that adults tend to interpret *men* plurals exclusively but bare nouns inclusively in the positive context. This suggests that *-men* may not be entirely optional. Previous studies (e.g., Li, 1999) argued that *-men* is used in definite contexts only, and this can be used as evidence against the optionality of *-men*. However, this remains speculative as the current study only tested the definite context and has no comparative data for the indefinite context. This calls for further study.

In addition, the current results lead to an interesting question on the derivation process of plurality inferences associated with *men* plurals. Based on Spector (2007) and van Tiel et al. (2014), we speculate that exclusive-inclusive alternation of *men* plurals may be realised via the scale of expressions, [*one..CL..N* > *bare nouns* > *-men plurals*], unlike English where the comparison is made directly between plurals and singulars to derive plural inferences. A further study would elucidate the precise mechanism behind the derivation of plural inferences using this kind of scale in Chinese and its implications for a cross-linguistic variation.

7. Conclusion

The current research provided a new set of data on how plurality is interpreted in optional plural marking languages. We conducted an experimental study on Chinese bare nouns and *men* plurals. Both Chinese adults and children interpreted bare nouns inclusively in both positive and negative contexts. On the other hand, adults tend to interpret *men* plurals exclusively in the positive context but inclusively under negation. In comparison, children tend to interpret them inclusively in both contexts and they computed exclusive readings in general less often than adults did. The findings suggest that *men* plurals are like bare plurals

in obligatory plural marking languages and their base meaning is the inclusive reading. Exclusive readings arise from the plural marker *-men*, and therefore it also explains the absence of exclusive readings for bare nouns. Exclusive readings associated with *men* plurals tend to appear in positive contexts but disappear under negation, in the same way as bare plurals in obligatory plural marking languages. This supports the scalar implicature approach to plurality explored in previous research. We therefore propose that the plurality inferences associated with the plural marker *-men* in Chinese, as an optional plural marking language, are also scalar implicatures.

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