A Note on Children's Interpretation of Noun Phrases Containing a Numeral*

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1. Introduction

This paper is concerned with children's interpretation of numerally quantified noun phrases (numeral QNPs). Previous experimental studies on English and Japanese have found that children differ from adults in the interpretation of negative sentences containing a numeral QNP in the object position (Musolino (1998), Lidz and Musolino (2002), Terunuma (2008, 2009, 2010)). In an attempt to explain the difference between children and adults observed in English and Japanese, Terunuma (2008, 2009, 2010) claims that children interpret numeral QNPs as being referential even when adults do not. This paper examines whether Terunuma's (2008, 2009, 2010) referentiality analysis is tenable with respect to findings from child Chinese.

The organization of this paper is as follows: Section 2 summarizes the results of the previous experiments on English-speaking and Japanese-speaking children, and reviews Terunuma's (2008, 2009, 2010) referentiality analysis. Section 3 turns to Chinese-speaking children's

* In order to discuss the acquisition of negative sentences containing a numerally quantified noun phrase in Chinese, this paper investigates how Chinese-speaking adults interpret a relevant sentence. I am grateful to the informants I consulted for their acceptability judgments. They include Jia-hui Wang, Yan-shan Xue, Yi Wen, Min Fei, and Bing Wang. I am also thankful to Takeshi Koike, who helped me recruit the informants.

interpretation of negative sentences containing a numeral QNP in the object position, and shows that findings from child Chinese are compatible with the referentiality analysis. Section 4 concludes the paper.

2. Terunuma's (2008, 2009, 2010) Referentiality Analysis

In adult English, the sentence in (1), which contains a numeral QNP in the object position, is ambiguous with respect to the relative scope of negation and the numeral QNP *two slices of pizza*.

(1) Cookie Monster didn't eat two slices of pizza.

(1) can have either the interpretation in (2), where the numeral QNP takes narrow scope with respect to negation, or the interpretation in (3), where the numeral QNP takes wide scope with respect to negation.

(2) The number of slices of pizza that Cookie Monster ate is not two.

(3) There are two slices of pizza that Cookie Monster did not eat.

In adult Japanese, similarly, the sentence in (4) is ambiguous between the narrow scope reading and the wide scope reading of the numeral QNP *suika-o ni-ko* 'two slices of watermelon.'[1,2]

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[1] In (4) in the text, the numeral *ni* 'two' is in the position just after the Accusative Case particle. Following Watanabe (2006, 2008), we assume that numerals in such a position are within nominal projection.

[2] I will use the following abbreviations: Acc = Accusative, Gen = Genitive, TTop = Thematic topic particle, Past = Past tense morpheme, Neg = Negative morpheme, CL = Classifier, SFP = Sentence-final particle.

(4) Mickey-wa suika-o ni-ko tabe-nakat-ta yo.
Mickey-TTop watermelon-Acc two-CL eat-Neg-Past SFP
'Mickey didn't eat two slices of watermelon.'

Whether children's interpretation of sentences such as (1) and (4) is the same as adults' was investigated in Lidz and Musolino's (2002) and Terunuma's (2008, 2010) experiments that used the truth value judgment task (TVJT) methodology (Crain and Thornton (1998)). In both experiments, sentences such as (1) and (4) were judged against two types of context stories. One type of story depicted the context where the narrow scope reading of QNPs is true (¬Q context), while the other depicted the context where the wide scope reading of QNPs is true (Q¬ context). In the ¬Q context for (1), for example, there are two slices of pizza, and Cookie Monster eats one but not the other. In the Q¬ context for (1), there are four slices of pizza, and Cookie Monster eats two but not the other two. The task of the participants was to judge whether sentences such as (1) and (4) were acceptable as descriptions of the given contexts.

In Lidz and Musolino's (2002) experiment, twenty-four English-speaking children (3;11-4;11) and twenty-four English-speaking adults were tested on sentences like (1).[3] The results of their experiment are as follows: The rates at which the children and the adults accepted the sentences in the ¬Q context were 81% and 97% respectively, while the rates at which they accepted the sentences in the Q¬ context were 33% and 93% respectively. These results show that while English-speaking adults accept sentences like (1) in both contexts, English-speaking children accept the

[3] The children were randomly divided into two groups of twelve. One group was given test sentences in the ¬Q context on four trials. The other group was given test sentences in the Q¬ context on four trials. The adults were tested with the same method.

sentences in the ¬Q context and reject the sentences in the Q¬ context.[4]

In Terunuma's (2008, 2010) experiment, thirty Japanese-speaking children (3;10-5;3) and fifteen Japanese-speaking adults were tested on sentences like (4).[5] The participants were classified into four age groups: C1 (children under 4;6), C2 (children of and over 4;6 but under 5;0), C3 (children of and over 5;0) and A (adults).[6] In the ¬Q context, the test sentences were accepted at the following rates: 38.9% by C1, 60% by C2, 66.7% by C3, and 83.3% by A. In the Q¬ context, the acceptance rates were 55.6% for C1, 63.3% for C2, 25% for C3, and 96.7% for A. These findings show the following: Japanese-speaking adults accept sentences like (4) both in the ¬Q context and in the Q¬ context. However, Japanese-speaking children, particularly younger children, reject the sentences in the ¬Q context, and they also frequently reject the sentences in the Q¬ contexts.

In order to uniformly explain the above findings from child English and Japanese, Terunuma (2008, 2009, 2010) proposes that children's responses to negative sentences containing a numeral QNP be analyzed not in terms of the relative scope of negation and numeral QNPs but in terms of the referential interpretation of numeral QNPs. More specifically, she claims that children interpret numeral QNPs as being referential even when adults do not.

Let us first take a look at how the referentiality analysis accounts for English- and Japanese-speaking children's responses to sentences such as (1) and (4), repeated here, in the ¬Q context.

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[4] Musolino (1998) also reports that English-speaking children (3;11-6;1) tended to reject sentences like (1) in the text in the Q¬ context.

[5] Each participant was given test sentences in the ¬Q context on two trials and in the Q¬ context on two trials.

[6] Among the thirty children tested on sentences like (4) in the text, nine were in C1, fifteen were in C2, and six were in C3.

(1) Cookie Monster didn't eat two slices of pizza.

(4) Mickey-wa suika-o ni-ko tabe-nakat-ta yo.
Mickey-TTop watermelon-Acc two-CL eat-Neg-Past SFP
'Mickey didn't eat two slices of watermelon.'

In the ¬Q context, English-speaking children accept sentences like (1) but Japanese-speaking children reject sentences like (4). This is because English-speaking children interpret sentences like (1) in a similar way as English-speaking adults interpret sentences like (5) and Japanese-speaking children interpret sentences like (4) in a similar way as Japanese-speaking adults interpret sentences like (6).

(5) John didn't eat the two apples.

(6) John-wa sorera-no ni-ko-no ringo-o
John-TTop those-Gen two-CL-Gen apple-Acc
tabe-nakat-ta.
eat-Neg-Past
'John didn't eat those two apples.'

In adult English and Japanese, numeral QNPs in sentences like (5) and (6) are interpreted as being referential. English-speaking adults consider (5) to be true in the context illustrated in (7), while Japanese-speaking adults consider (6) to be false in the same context.

(7) Of the two apples referred to, John ate one but didn't eat the other.

It is important to note here that the context in (7) is similar to the ¬Q context that was used for sentences such as (1) and (4) in Lidz and Musolino's (2002) and Terunuma's (2008, 2010) experiments. In both

contexts, there are two tokens of the entity denoted by the object noun in the given sentences, and the action denoted by the verb in the sentences is performed on only one of the two tokens. It is thus plausible to suppose that English-speaking adults accept sentences like (5) and Japanese-speaking adults reject sentences like (6) in the ¬Q context. Although adults do not interpret numeral QNPs in sentences such as (1) and (4) as being referential, it is assumed under the referentiality analysis that children do so. Then, it follows that English-speaking children accept sentences like (1) and Japanese-speaking children reject sentences like (4) in the ¬Q context.

Next, we take a look at how children's responses in the Q¬ context are accounted for under the referentiality analysis. English-speaking children and Japanese-speaking children frequently reject sentences such as (1) and (4) respectively in the Q¬ context. On the referentiality analysis, this is attributed to the plot of the stories used as the Q¬ context for the sentences. In the stories in question, there are four tokens of the entity denoted by the object noun in the sentences. The action denoted by the verb in the sentences is performed on two of the four tokens but not on the other two. This plot can lead children to consider sentences such as (1) and (4) to be false. For example, in the Q¬ context for (1), Cookie Monster eats two of the four slices of pizza and leaves the other two uneaten. In this situation, two pairs of pizza slices are salient: the eaten pair and the uneaten pair. For children who interpret the numeral QNP in (1) as being referential, both the eaten pair and the uneaten pair are possible referents. When the eaten pair is chosen as the referent of the numeral QNP, (1) is false in the given context. When the uneaten pair is chosen as the referent, (1) is true. Some children choose the eaten pair as the referent and reject the sentence. This explains English-speaking and Japanese-speaking children's rejection of sentences

such as (1) and (4) in the Q¬ context.[7]

3. Discussion: the Referentiality Analysis and Findings from Child Chinese

Let us now consider the interpretation of negative sentences containing a numeral QNP in child Chinese. Chinese-speaking children's (and adults') interpretation of negative sentences like (8), which contain a numeral QNP in the object position, was investigated in two experiments conducted by Su (2003) using the TVJT methodology.

(8) Xiaojie mei you mai liang-zhang ditan.
lady Neg have buy two-CL carpet
'The lady didn't buy two carpets.'

In one experiment, twenty-five Chinese-speaking children (4;1-5;8) and forty Chinese-speaking adults were given test sentences in the ¬Q context on three trials. In the other experiment, nineteen children (4;2-5;11) and twenty-nine adults were given test sentences in the Q¬ context on three

[7] It is natural to assume that when two possible referents are present, children make a random choice. The referentiality analysis thus predicts that children's performance with respect to sentences such as (1) and (4) in the text in the Q¬ context should be at chance level. This prediction is not at odds with the results of Terunuma's (2008, 2010) experiment on Japanese-speaking children. In her experiment, as noted in the text, children in C1 and C2 accepted sentences like (4) 55.6% and 63.3% of the time respectively in the Q¬ context. This seems to be almost chance performance. Although the rate at which children in C3 accepted the sentences in the Q¬ context was relatively low (25%), the statistical comparisons made by Terunuma (2008, 2010) show that in the Q¬ context, no significant difference is found between the performance of children in C1 and C2 on the one hand and that of children in C3 on the other.

However, it is not clear whether the prediction made by the referentiality analysis is compatible with Lidz and Musolino's (2002) observation that English-speaking children accepted sentences like (1) 33% of the time in the Q¬ context. This problem is left open.

trials.[8] Su (2003) found that while the adults accepted the sentences 72% of the time in the ¬Q context and 38% of the time in the Q¬ context, the children accepted the sentences 35% of the time in the ¬Q context and 63% of the time in the Q¬ context.

Chinese-speaking children's responses observed in Su's (2003) experiments are compatible with the prediction made by the referentiality analysis. In adult Chinese, the negative sentence in (9), where the numeral QNP in the object position is interpreted as being referential, is judged to be false in the context illustrated in (10).[9]

(9) Zhangsan mei you mai na liang-shang ditan.
Zhangsan Neg have buy that two-CL carpet
'Zhangsan didn't buy those two carpets.'

(10) Of the two carpets referred to, Zhangsan bought one but didn't buy the other.

This means that Chinese-speaking adults reject sentences like (9) in the ¬Q context. On the referentiality analysis, it is assumed that Chinese-speaking children, unlike adults, interpret numeral QNPs in sentences like (8) above as being referential. It is thus predicted that Chinese-speaking children will reject sentences like (8) in the ¬Q context. This prediction does not contradict the experimental result in which Chinese-speaking children accepted sentences like (8) in the ¬Q context only 35% of the time. With regard to the Q¬ context, on the other hand, it is predicted under the referentiality analysis that Chinese-speaking children will display a chance

[8] The basic plots of the ¬Q and Q¬ contexts used in Su's (2003) experiments are the same as those used in Lidz and Musolino's (2002) and Terunuma's (2008, 2010) experiments.

[9] All the five informants of mine, who are native speakers of Chinese, regarded (9) in the text as false in the given context.

performance for sentences like (8) in the Q¬ context. The rate at which Chinese-speaking children accepted the sentences in the Q¬ context (63%) seems near chance level.

4. Concluding Remarks

This paper has considered Terunuma's (2008, 2009, 2010) referentiality analysis, which is proposed on the basis of findings from English and Japanese, in light of findings from Chinese. I have argued that the referentiality analysis can explain Chinese-speaking children's interpretation of negative sentences containing a numeral QNP in the object position.

However, some problems remain with respect to the referentiality analysis. As mentioned above, a difference is found between English-speaking adults on the one hand and Chinese- and Japanese-speaking adults on the other in the interpretation of negative sentences containing a numeral QNP in the object position where the numeral QNP is referential. The problem arises as to what the source of the difference is. The referentiality analysis also leads to problems of why children, unlike adults, interpret indefinite numeral QNPs as being referential and how they acquire the adult-like interpretation of such QNPs. These problems are left for future research.

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