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Japanese preschool children's understanding of false-belief and grammatical competence: Is there any relationship?

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Abstract: The relationship between a preschooler's false belief understanding and language competence is inconclusive and is still being debated. The present study investigated the relationship between Japanese children's grammatical competence and their false belief understanding. Grammatical competence measured by the Japanese version of TROG (Bishop, 1989) did not correlate with false belief understanding when children's age was considered. However, when individual grammatical attributes were investigated, there were weak but significant correlations between syntactic aspects and false belief scores even when children's age variances were taken into account.

Key words: Theory of mind, Japanese grammar, Japanese language, false beliefs

1. Introduction

Understanding one's own and another person's mind is one of the important milestones in human development. This mental capacity, which is regarded as the Theory of Mind, has received a great amount of attention in developmental psychology since the study by Premack and Wodruff (1978). For the last 30 years of theory of mind research, it has become clearer that the development of such mental capacity is a protracted process, beginning at very early infancy (Onishi & Baillargeon, 2005; Southgate, Senju, & Csibra, 2007; Surian, Caldi, & Sperber, 2007) through into adulthood (Happe, 1994).

Understanding that other people have desires and beliefs that could be different from one's own is also crucial when one needs to infer other people's behaviours in the social world. In particular, young children appear to find it difficult to predict other's behaviours that are derived from their own false beliefs. Theoretical explanations involving mechanisms by which young children develop false belief understanding is still a on-going debate (Doherty, 2008; Flavell, Miller, & Miller, 2002). Moreover, there is growing evidence that this mental capacity is interrelated with the development of executive functions, language and other cognitive capacities such as working memory (Astington & Jenkins, 1999; Carlson & Moses, 2001; Perner, Lang, & Kloo, 2002).

How children's false belief understanding

develops in relation to language ability is one of the areas that require a further clarification. Existing literature suggests that the relationship between the theory of mind development and language is far from straightforward. de Villiers and colleagues (de Villiers & de Villiers, 2000; de Villiers & Pyers, 2002) made a strong claim that the development of syntax determines the false-belief-understanding. In their longitudinal investigation of language development, especially of children's mastery of specific aspects of syntax, appeared to be a good predictor for the development of false-belief-understanding. A similar line of argument is also supported by the longitudinal study that examined the contribution of semantics along with syntax. Astington & Jenkins' findings suggest that early syntax measures made an independent contribution, that was more relevant than semantics, to predict later theory of mind ability, but early theory of mind ability did not predict later language measures.

In contrast, Ruffman, Slade, Rawlandson, Ramsey and Garnham (2003) found that syntax ability did not act as a predictor, but that semantic and general language ability did. Ruffman et al. focused on the word order of syntactic ability and showed that the receptive word order measure did not predict the later measurement of belief understanding.

In order to evaluate the role of language in the development of theory of mind, Milligan, Astington, and Dack (Milligan, Astington, & Dack, 2007) carried out a meta-analysis of the relation between language and false-belief understanding. They concluded that the effect of early language ability on later false-belief understanding is strong and that the variances accounting for false-belief understanding differed depending on the different aspects of language measured. Receptive measures of vocabulary, albeit the effect size is small, appeared to be a unique contributor to the false-belief understanding. According to Milligan et al., other measures such as syntax, semantics and memory for complements, is dependant on the other abilities in language and thus it is hard to differentiate one from another.

However, given that Ruffman et al. examined the pure ability of word order understanding and found no predictive relationship with theory of mind development, it is important to separate language abilities, where possible. In the Millgan et al.'s meta-analysis, Ruffman et al's findings were not included and the number of studies that examined grammatical aspects of language were very small. Many studies used a battery of language development that includes several aspects of language measures. These were design to assess a total development of language but not necessarily to measure each aspect of language ability exhaustively. This might have been one of the reasons why general language measurements related to later false-belief understanding. In order to assess which aspect of language ability is important for theory of mind development, it is necessary to include more exhaustive measures that tap specific aspects of language.

In the present study, in order to assess the relation between grammar ability and false-belief understanding, the receptive grammar test TROG (Bishop, 1989) was used. This is the most widely used measure for assessing

specifically children's grammatical abilities. In the previous meta-analysis, there was only one study that used this measure to assess children's grammatical ability in relation to theory of mind understanding.

Another reason for investigating language and false-belief understanding in the present study is that the meta-analysis by Millgan et al. only included studies involved English-speaking children. Some studies that investigated Cantonese-speaking children suggest that general language competence rather than complementation was related to false-belief understanding (Cheung, 2006; Cheung et al., 2004). Moreover, the effect of complements on false-belief understanding was explained by general ability and short-term memory (Tardif, So, & Kaciroti, 2007). Findings from Cantonese-speaking children's development in false-belief understanding in relation to language are in line with those from English-speaking children.

From a cross-linguistic perspective, that general language ability relates closely to false belief understanding is plausible as both involve some forms of representational abilities. However, when it comes to examining a specific aspect of language, unique contributions of such language abilities appeared to be weak or not evident as reviewed above. This was also the case for Japanese-speaking subjects; children's syntax and semantic competence measured by the sentence comprehension task did not have any association with false-belief understanding after controlling for age and receptive vocabulary in both the clinical groups and the normally developing children (Naito & Nagayama, 2004).

Currently, little is known about role of language in relation to theory of mind in Japanese. There are also interesting findings regarding cultural differences in the rate of development of theory of mind understanding; Japanese children appeared to lag about one year behind their counterparts who are mainly in western societies (Naito & Koyama, 2006; Wellman, Cross, & Watson, 2001). One could speculate that language may have a role in facilitating the development of theory of mind understanding. In a search for explanations for such a delay in the area of language requires a much deeper understanding of language differences from forms of morphology and syntax to language use i.e. pragmatics.

In order to clarify the relationship between grammatical ability and children's theory of mind understanding in Japanese, the present study investigated the performance of receptive grammar in relation to false-belief understating, using the exhaustive scale, namely a Japanese version of TROG., known as the J. COSS. It was expected that using such a measure would enable us to develop a clearer view of the relationship between grammatical aspects and theory of mind development.

2. Method

2.1 Participants

Seventy-five Japanese children participated in this study. These children were divided into three age groups: 30 four-year-olds (M=53 months, SD=4.6), 26 five-year-olds (M=67 months, SD=3.3) and 19 six-year-olds (M=76, months, SD=3.3). The children were drawn from the two preschools in neighbouring

regions in Nara, Japan.

2.2 Materials and procedure

All children received two false-belief tasks, which were designed to measure the development of theory of mind (Gopnik & Astington, 1988; Perner, Leekam, & Wimmer, 1987; Wimmer & Perner, 1983). One of the tasks was an unexpected transfer task in which a protagonist's initial belief becomes false. An item that the protagonist put in a container is unexpectedly transferred to another container while the protagonist was absent. The participant is not aware that the item has been moved. In this task, the participants are asked to indicate which container the protagonist might look for the item when they return to the scene. This question is to test the participants understanding of the protagonist's beliefs. In order to confirm that participants' answers reflect their understanding of protagonist beliefs, the whereabouts of the item in the current and initial settings were also asked.

The children passed this task only when they answered all three questions correctly and they then received a score of 1.

The other task was an unexpected contents task in which the contents of a familiar box, such as a container of the children's favourite sweets, contained a different and unexpected item. In such a setting, participants are assumed to have a false belief when they are asked about the contents of the familiar box. In this task, participants are generally asked two questions to test their understanding of their own and other's beliefs. In order to confirm that the participants' answers reflect an understanding of his/her own or other people's beliefs, a reality question regarding the current contents of the box was also asked. The children passed the tasks for their own belief and for other's belief respectively when they answered both the reality question and the belief questions correctly. They received a score of 1 for passing each of the tasks, resulting a range of scores between 0 and 2. Questions within each task as well as the order of administering the two tasks were counterbalanced.

A receptive grammar test, J. COSS-3rd (Japanese test for Comprehension of Syntax and Semantics) (Nakagawa, Ogawa, & Suga, 2005) was administered to the children. This test was used to measure children's language ability in the light of grammatical competence. A half of the children received the grammar test before the false-belief tasks and the rest of the children received the same test after the false-belief tasks. The J. COSS comprises two parts: part 1 is a vocabulary check, and part 2 assesses receptive grammar. This part of assessment was consisted of 20 grammar sections, each section comprises 4 questions, each with 4-alternative-forced-choices. The children received a credit when all of the four questions in a section were answered correctly. In this way, children's grammatical ability was scored in a range between 0 and 20.

3. Results

3.1 False-belief task performance across age groups

The proportions of the children who passed the unexpected transfer task and the unex-

Table 1. Proportions of children who passed the false-belief tasks for each age group.

Age group	n	Mean age	False belief tasks		
			Transfer	contents (own)	contents (other)
4-year-olds	30	4;05	0.20	0.23	0.07
5-year-olds	26	5;07	0.54	0.35	0.23
6-year-olds	19	6;04	0.63	0.47	0.47

pected contents task were summarised in Table 1.

The proportion of the children who passed the unexpected transfer task differed with ages: χ^2 (2, N=75)=10.89, p<0.01. On the other hand, clear age effects were not evident in their performance of the unexpected contents tasks. The children's performance for their own belief question did not show significant age effects: χ^2 (1, N=75)=3.05, n.s. As for the own false belief question, although a significantly larger number of the 4-year-old children than expected, performed poorly in the own belief question: χ^2 (1, N=30)=8.53, p<0.01, the 5-and 6-year-old children's performances did not differ from the expected values: χ^2 (1, N=26)=2.46, n.s for the 5-year-olds, and χ^2 (1, N=19)=0.53, n.s for the 6-year-olds. For the other's false belief question, the number of children who succeeded in identifying other people's false belief significantly differed across ages: χ^2 (1, N=75)=11.0, p<0.01.

Children's performances in the two types of false belief tasks were compared. The number of children who passed the unexpected contents task for their own false belief question (33.3%) did not differ significantly with that of children who passed the other's false belief question (22.7%) in the same task: McNemar's χ^2(1, N=75)=1.96, p=0.096. On the other hand, the total number of children who passed the unexpected transfer task (42.7%) differed significantly from those children who passed the unexpected contents task for the other's false belief: McNemar's χ^2 (1, N=75)=7.84, p=0.004 but not for the own belief question: McNemar's χ^2 (1, N=75)=1.44, p=0.23.

3.2 Grammatical competence across the age groups

Children's language performances in the J. COSS were computed in terms of the proportion of the children who passed each section. These were summarised in Table 2.

More than 50% of the 4-year-old children completed sections A to G, whereas a similar proportion of the 5- and 6 year-old children reached the section "not only A but also B". As indicated in the Table 2, as the sections progressed, the proportion of children who passed the section decreased for all the 4-and 5-year-olds. Although the achievements of 5-and 6-year-olds were similar on the 50% criterion, some differences were evident in the 6-year-olds. Given the fact that the sections were sequential and were in a linear order, it was surprising to find that both age groups did not performed well on the numeral section relative to the adjacent sections; this was particularly evident in the performance of 6-year-olds.

Table 2. Proportion of children who passed each section of the J. COSS

JCOSS Section	grammatical aspects	Age group 4-year-olds	5-year-olds	6-year-olds	TOTAL
A	noun	1.00	1.00	1.00	1.00
B	adjective	0.97	1.00	1.00	0.99
C	verb	0.93	1.00	1.00	0.97
D	subject+predicate	0.90	0.96	1.00	0.95
E	negation	0.80	0.92	1.00	0.89
F	subject+object+predicate	0.70	0.85	1.00	0.82
G	reversal	0.63	0.84	0.84	0.76
H	not only A but also B	0.33	0.57	0.53	0.47
I	A but not B	0.27	0.46	0.47	0.39
J	locative	0.17	0.27	0.28	0.28
K	numeral	0.00	0.12	0.16	0.08
L	passive sentence	0.33	0.12	0.37	0.15
M	neither A nor B	0.00	0.15	0.37	0.15
N	comparative	0.10	0.19	0.42	0.21
O	subject pre-modifier	0.00	0.15	0.32	0.13
P	plural	0.03	0.12	0.21	0.11
Q	predicate modifier	0.00	0.04	0.26	0.08
R	ga-, wa-partile	0.00	0.19	0.11	0.09
S	multicomponent sentence	0.07	0.08	0.16	0.09
T	subject post-modifier	0.03	0.04	0.05	0.04

3.3 Relations between false-belief task performance and grammatical competence

The relationship between the children's performance in the false-belief-tasks and the J. COSS were examined. Each score for the three questions in the two false-belief tasks was aggregated to represent the children's false-belief understanding. As for the children's grammatical competence, the J. COSS score, which was derived from a total number of passes in the J. COSS were used in the correlational analysis. The means and standard deviations for the false-belief score and the J. COSS score were presented in Table 3, and the correlations between the children's age, false-belief scores and JCOSS scores were summarised in Table 4.

As indicated in Table 4, both the false-belief scores and the J.COSS scores correlated significantly with the children's age: $r(73)=0.18$, $p=0.06$. However, when the children's age was controlled, there was no significant correlation between the J. COSS and false belief scores: $r(72)=-0.026$. n.s.

3.4 A closer look at grammatical sections in relation to false-belief scores

Although the J. COSS gives us a total number of scores, which represent grammatical competency, the present study intended to examine details of children's grammatical ability in relation their false belief understanding. For this reason, raw scores for each section

Table 3. Means and standard deviations of the children's false-belief task score and J. COSS score.

	JCOSS score (0-20)	False-belief task score (0-3)
4-year-olds		
M	6.97	0.5
SD	2.34	0.82
5-year-olds		
M	9.08	1.12
SD	3.26	0.99
6-year-olds		
M	10.74	1.57
SD	4.15	1.12
Total		
M	7.95	0.79
SD	2.98	0.95

Table 4. Correlations between children's age, false-belief score, and J.COSS score.

	Age months	False-belief
False-belief	0.40**	
JCOSS	0.49**	0.18§

one-tailed, **:p<0.01, §:p<0.1

were used for correlation with the children's false belief scores. Some of the grammar sections correlated significantly with the false belief scores. These were "subject+predicate" sentence: r (73)=0.225, "subject+object+predicate" sentence: r (73)=0.231, "reversal": r (73)=0.263 "neither A nor B": r (73)=0.198 (*ps*<0.05, one-tailed). Once age was partial out, the "subject +predicate" and "reversal" sentence comprehension continued to have significant correlations: r (73)=0.196, p<0.05, r (73)=0.176, p<0.1, respectively but the "subject+object+predicate" and "not only B but also A" sentence comprehension did not: r (73)=0.129, r (73)=-0.038, Ps<1, respectively.

4. Discussion

The present study investigated the relationship between preschool children's false belief understanding and grammatical ability. Firstly, the development of children's understanding false belief across the age groups is considered with reference to existing studies. Secondly, children's grammatical ability examined using the J. COSS is discussed in relation to original data published by Nakagawa et al. (2005). Finally, whether or not children's false belief understanding relates to their grammatical ability is considered.

4.1 Development of theory of mind: false-belief understanding

The present study assessed the understanding of false belief in two types of tasks. As children aged, the pass rates for both the unexpected transfer and the unexpected contents tasks, with the exception of the other's false belief question in the latter task, increased significantly. Although the other's false belief

question in the unexpected contents task did not show significant age related changes, the trend for pass rates indicates that a fewer older children than the youngest children answered this question correctly.

Next these data were compared with existing Japanese studies (Naito, 2003; Naito & Koyama, 2006; Naito & Nagayama, 2004). As for the unexpected transfer task, the passing rates in Naito (2003) were 17% for 4-year-olds, 46% for 5-year-olds, and 77% for 6-year-olds. Although our 6-year-old children performed slightly poorer than Naito's, those of the younger groups were almost identical. For the unexpected contents task, comparisons were made with the available figures in Naito & Koyama (2006) for the 4-year-old and 5-year-olds. Their children's performance were better for both age groups (37%: own false belief and 29%: other's false belief for 4-year-olds; and 65%: own false belief, and 66%: other's false belief for 5-year-olds) than that of the children in the present study. This discrepancy was due to the fact that some of the studies by Naito did not show any task differences whereas the present study did. Differences in task difficulties appeared to be reported elsewhere (Holmes, Black, & Miller, 1996).

When Japanese children's performance, as a whole, was compared with that of the English-speaking population, group difference was evident. For example Naito and Koyama (2006) compared their data with Holmes et al, and Happe (1995), and concluded that Japanese children lagged by one-year, which confirmed the results of the meta-analysis by Wellman et al. (2001). The present results of children's performances were mostly similar to previous studies of Japanese samples or even poorer, which confirms that Japanese children's development of understanding false-belief is delayed. Such cultural differences seem robust. However, explanations of such differences have yet to be investigated. It may be that, as Naito & Koyama (2006) claims, the reason for the observed delay is not simple, but that Japanese children's reasoning about human behaviour may be derived from behavioural or situational cues other than from ascribing individual's mental states.

4.2 Grammatical competency as measured by Japanese version of TROG (J. COSS)

The recent development of a Japanese version of the test for reception of grammar (TROG) made a valid assessment of grammatical ability possible. The children's performance was compared with the original study by Nakagawa et al. (2005). Mean numbers of items that children passed in their study were 5.5 for 3-4 year-olds (3y6m-4y5m), 8.1 for 4-5 year-olds (4y8m-5y3m), and 10.3 for 5-6 year-olds (5y0m-6y7m). Although the children in the current study performed slightly better than the original sample, the average age of the children in the present study were older than that of the original study, especially for the two younger groups. Thus, the present data could be considered to fit with the norm provided in the original study. With respect to each grammatical section, several similar trends were found in both studies. The "numeral" section was performed poorly in both studies, with the proportion of passes being below 20%. Similarly, the "plural" section did not performed well for both samples. It may

be that preschool children were not yet sensitive to numerical precision expressed in language.

4.3 Does Japanese grammar relate to false belief understanding?

As discussed in the previous sections, the present study observed developmental trends for both the false-belief scores and the J.COSS scores, and these trends were in line with previous studies. The main objective of the present study was to clarify the relationship between grammatical competence and false belief understanding. Simple correlations confirm such an age-related development in both grammar and false belief understanding. However, grammar scores were marginally correlated with false belief scores. Furthermore, this association did not hold once age was partial-out. This result suggests that the global grammatical ability measured by J. COSS did not relate to false belief understanding in preschool children.

Nevertheless, some aspects of grammar, such as sentence comprehension of "subject+predicate", "subject+object+predicate", "reversal", and of "not only B but also A" were correlated significantly with false belief understanding. Controlling for age, the "subject+predicate" and "reversal" sentence comprehension continue to show weak associations with false beliefs. These findings suggest that a minimum level of understanding a sentence that involves syntactic aspects is required. It is reasonable to assume that when preschoolers were asked to infer the protagonist's behaviour while representing the other's or their own false belief, and gave a correct answer to it, it is essential to understand the basic story line used in the experiment. From the current results it is hard to make a strong claim about the relationship between such syntactic ability and false belief understanding. One could argue that sentence comprehension involves the skills of semantic as well as of syntax. Because the J. COSS uses words that are well known to young children it is very unlikely that they were challenged by semantic demands.

The present study did not examine the same individuals longitudinally; therefore, any causal relationships between grammatical ability and false belief understanding during the course of development cannot be inferred. However, it is likely that a minimal level of syntactic competence is required to pass the false belief tasks.

So does any specific role of language exist in the development of theory of mind? One of the areas in the theory of mind research that seems promising is a study on early conversation, specifically referring to one's own and another's mental terms (LaBounty, Wellman, Olson, Lagattuta, & Liu, in press; Symons, Fossum, & Collins, 2006; Taumoepeau & Ruffman, 2006, 2008). There is growing evidence suggesting that, in the English-speaking cultures, mental terms use during in everyday parent-child conversation influences how preschool children come to understand theory of mind. What is not clear is exactly how this happens during the conversation. There are also possible cultural differences in what and how it is transmitted or learned by young children during early communicative interactions. Further cross-cultural research

into this area is needed and some of the unsolved issues such as a group difference in theory of mind development could be addressed by such a study.

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