Children's Understanding of First- and Second-Order False Beliefs in One Narrative

Kumiko Matsumoto

Ochanomizu University, Japan

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Abstract

The results of false belief tasks show that children acquire second-order false beliefs (B thinks that A thinks X is Y) a few years later than first-order false beliefs (A thinks X is Y) (ex. Hayashi, 2002). Although different tasks are used to investigate these two false beliefs, it was unclear whether the story of the second-order false belief task is difficult or the second-order false belief itself is difficult. Therefore, previous studies have focused on creating simple stories for second-order false belief tasks to equalize their complexity level with that of first-order false belief tasks (ex. Sullivan, Zaitchik, & Tager-Flusberg, 1994). But when making the story simple, they also made the structure of the false belief easier. Accordingly, we created two compound tasks, the "fallen ball task" and the "transferred contents task", which examine both first- and second-order false beliefs of one protagonist in a simple narrative. The study included 67 children aged four-and-a-half to eight-and-a-half years. In both tasks, no child could answer second-order false belief questions, although six-year-olds were shown to answer them in the simple story of Hayashi's (2002) task. Thus, we concluded that complexity of the story does not affect children's theory of mind but the structure of the belief does. Moreover, we found that most children who acquired first-order false belief use it when answering the second-order false belief question. We believe that the compound tasks will lead to a new discussion in future studies on theory of mind.

INTRODUCTION

In our daily lives, we often guess or read others' mental states (beliefs, desires, etc.) in various situations, especially when communicating with others. In order to do so, we need to understand first-order beliefs, for example, "A thinks that X is Y." However, this is insufficient for the complex situations we face in everyday life. We also need to understand phrases such as "B thinks that 'A thinks that X is Y'," which are called second-order beliefs. Studies that seek to identify the age at which children begin to understand first- and second-order beliefs fall into a category called "theory of mind." Studies on theory of mind have been developed in various fields, such as developmental psychology, philosophy. Recently, such studies have focused on more practical aspects, especially within autism and medical science research.

In theory of mind research, "false belief tasks" are often implemented to investigate children's ability to understand first- and second-order beliefs. There are three well-known false belief tasks: the chocolate task (Wimmer & Perner, 1983), the Smarties task (Perner, Leekman & Wimmer, 1987), and the ice cream task (Perner & Wimmer, 1985). All these three tasks have a structure in which "the belief of a protagonist changes from true belief to false belief when the location (content, information) changes in his/her absence; in the first two tasks, the belief of only protagonist A changes, while in the last task, the belief of both protagonists A and B changes unknown to each other (Matsumoto, 2008)". The results of these tasks show that children acquire second-order false beliefs a few years later than first-order false beliefs (Sullivan, Zaitchik, & Tager-Flusberg, 1994; Hayashi, 2002). Although different tasks are used to investigate these two types of false beliefs, it has been posited that this delay is caused by the complex stories used in second-order false belief tasks. Prior to a discussion on this matter, we survey the details of these tasks below.

The most frequently used first-order false belief task is the chocolate task (Wimmer & Perner, 1983). In this task, a character named Maxi puts a piece of chocolate into a blue cupboard and then leaves. While he is away, his mother removes the chocolate from the blue cupboard and places it in a green cupboard. The subject is then asked where the character will look for the chocolate when he returns home. The results of this survey showed that most of the six- to nine-year-old children could answer first-order false belief questions, but most of the four- to five-year-olds could not. As the same results were obtained in the Japanese context (Beppu & Nomura, 2005; Koyasu, Nishigaki, & Hattori, 1998; Hayashi, 2002), we can say with some certainty that children develop the ability to pass the chocolate task at age six.

Another famous first-order false belief task is the Smarties task (Perner, et al., 1987). In the Smarties task, the experimenter shows the child a Smarties box and asks what the participant thinks is inside it (expectation question). Then the experimenter shows that the child's answer, "Smarties," is wrong, and that the box actually contains a pencil. The experimenter puts the pencil back in the box and closes it again. Next, the child is asked what his/her friend will think is in the box when seeing it for the first time (first-order false belief question). The child is also asked what he/she thought was in the box when he/she initially saw it (self-past question).

Since it is difficult to keep asking these questions when children do not answer "Smarties" to the expectation question, Koyasu (1997) devised a location change condition. In this condition, the experimenter shows the child a toy refrigerator and a toy chest, and asks children, "Where is the ice-cream, in the refrigerator or in the chest?" According to his survey, only one out of 118 children answered "the chest," while 27% of children did not answer "chocolate" or "Smarties" in the Smarties task. Koyasu (1997) then executed the Smarties task and the location change condition with three- to six-year-olds. The result of the first-order false belief question in this task shows that only 54% of six-year olds could answer correctly.

The best-known second-order false belief task is the ice cream task (Perner & Wimmer, 1985). Two children, John and Mary, are in the park with an ice cream man. The ice cream man tells Mary that he will be in the park all day long, so she goes home to get money to buy an ice cream. While she is gone, the man tells John that he will be moving toward the church. On his way to the church, the man happens to see Mary and tells her that he is going to the church. Later, John visits Mary's house, but her mother tells him that Mary has gone out to buy an ice cream. Now the subject is asked where John thinks Mary went to buy an ice cream. The results of this task show that the acquirement of second-order false beliefs starts after children reach the age of 10: only 50% of nine-year-olds and 67% of 10-year-olds could answer it correctly. Although there were significant differences between nine- and 10-year-olds, Koyasu et al. (1998) also insisted that children acquire second-order false beliefs at age 10.

Owing to the complexity of the story in the ice cream task, Hayashi (2002) and Astington, Pelletier, and Homer (2002) designed a new second-order false belief task based on the chocolate task (Wimmer & Perner, 1983). In the "simplified task" (Hayashi, 2002), for example, a girl puts a piece of chocolate in a cabinet and leaves the room. Her brother takes the chocolate out and puts it in a paper bag. Unbeknownst to her brother, the girl is watching what he is doing from the window. The child is asked, "Where does the boy think the girl will look for the chocolate when she returns home?" The results of this study showed that children between six-and-a-half and seven-and-a-half years old understand second-order false beliefs. Results of the "simplified task" (Hayashi, 2002; Astington et al., 2002) lead us to the conclusion that children actually begin to acquire second-order beliefs at age six.

Is making the story easier the only reason for this four-year advance? Perhaps not: Matsumoto (2008) insists that the second-order false belief used during the simplified task (Hayashi, 2002) has a simpler structure than the ice cream task (Perner & Wimmer, 1985). In the ice cream task (Perner & Wimmer, 1985), the beliefs of both John and Mary change from true to false, unbeknownst to each other, when the ice cream man moves from the park to the church. Yet, in the simplified task (Hayashi, 2002), the girl stays visible to the subjects while the boy in the story is transferring the chocolate. This may be the reason why children's performance was so good in the simplified task (Hayashi, 2002). To solve this problem, we should create a simple storied task with the same structure as the ice cream task.

Furthermore, in order to probe the idea that children acquire first-order false beliefs before second-order false beliefs, we have to ask both types of questions in an equal situation. Matsumoto (2008) thereby insists on the necessity of using new tasks that can ask both first- and second-order false belief questions at once. We call this task a

"compound task" to distinguish it from other false belief tasks.

Considering the aforementioned information, we created two compound tasks for this study: the fallen ball task based on the chocolate task (Wimmer & Perner, 1983) and the transferred contents task based on the location change condition (Koyasu, 1997). Requirements of the compound task for the current study include that the story must have minimum information, as well as a structure by which "the belief of a protagonist changes from true belief to false belief when the location (content, information) changes in his/her absence (Matsumoto, 2008)." Furthermore, we used three alternatives within each compound task. Although there were only two alternatives—the park (second-order) and church—during the ice cream task (Perner &Wimmer, 1985), we could not determine whether children changed their strategies in order to answer second-order false belief questions before and after understanding others' first-order false beliefs. We will make this point clear with our compound tasks.

This survey aimed to suggest the process of acquiring the false beliefs by verifying the two hypotheses that even if the story is simple, six-year-olds cannot answer second-order false belief questions correctly and that children's strategies to answer second-order false belief question changes before and after acquiring first-order false belief.

METHOD

Participants. The study participants were Sixty-seven children and included 20 five-year-olds (M = 57 months, SD = 0.29), 22 six-year-olds (M = 72 months, SD = 0.32), and 25 seven- to eight-year-olds (M = 92 months, SD = 0.63).

Materials. The materials used in the fallen ball task were paper puppets named Taro (a boy) and Hanako (a girl), a room with a window, a toy box, a table, a basket, and a ball. The materials used in the transferred contents task were a box of colored pencils, a box of chocolates, a carton of milk, and one colored pencil, which are very common things; it is easy to imagine that a box of colored pencils typically contains a colored pencil. A stuffed elephant and a teddy bear were used as characters.

Figure 1. A photograph of the puppet play in the "fallen ball task."

Procedure. An experimenter tested the children individually in a quiet room away from the classroom. Two tasks were executed simultaneously, but alternately, to avoid the influence of the first task on the second. The whole procedure took approximately 10 to 15 minutes. The story and the questions in the task are shown in Appendix A and B. All of the children were asked the same questions in the same order to which

they gave oral answers.

RESULTS

Two of the five-year-olds who could not answer the memory question in the fallen ball task were excluded from the analysis because an understanding of the story is an essential condition when answering belief questions. Additionally, in the transferred contents task, two of the five-year-olds and one of the six-year-olds who were unable to answer the control questions and two of the seven-to eight-year-olds who were unable to answer the expectation question were excluded. Table 1and 2 show the percentage of answers to each belief question in the fallen ball and transferred contents tasks by age group. Although we asked Hanako's belief (the fallen ball task) and a self-past question (the transferred contents task), those results are excluded from this paper.

Table 1: *Percentage of Answers to Each Belief Question by Age Group (the fallen ball task)*

Answers	Ages 5 (N=16)		6 (N=21)		7–8 (N=23)	
	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
First-order false belief						
Toy box (dummy)	-	44	-	43	-	26
Table (first order)	31	-	43	-	70	-
Wastebasket (current place)	-	19	-	14	-	4
"I don't know"	-	6	-	0	-	0
Second-order false belief						
Toy box (second order)	13	-	24	-	26	-
Table (first order)	-	13	-	29	-	52
Wastebasket (current place)	-	50	-	24	-	13
"He thinks"/"He doesn't think"	-	24	-	18	-	0
"I don't know"	-	0	-	5	-	9

Table 2: *Percentage of Answers to Each Belief Question by Age Group (the transferred contents task)*

Answers	5 (N=16)		Ages 6 (N=21)		7–8 (N=23)	
	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
First-order false belief						
Colored pencil box (first order)	25	-	52	-	70	-
Carton of milk (current place)	-	63	-	38	-	17
Chocolate box (dummy)	-	6	-	10	-	13
"I don't know"	-	6	-	0	-	0
Second-order false belief						
Colored pencil box (second order)	6	-	10	-	17	-
Carton of milk (first order)	-	25	-	42	-	57
Chocolate box (current place)	-	56	-	38	-	22
"He knows"/"He doesn't know"	-	13	-	10	-	4

First-order belief. In both tasks, seventy percent of the seven- to eight-year-old children could answer the first-order false belief question correctly (the fallen ball task: $x^2(2) = 6.20$, $p < .05$, the transferred contents task: $x^2(2) = 7.51$, $p < .05$). There were significant differences between the five-year-olds and the seven- to eight-year-olds (the fallen ball task: $p < .05$, the transferred contents task: $p < .10$).

Second-order false belief. None of the age groups in this survey could correctly answer the second-order false belief question in both tasks (maximum twenty-six and seventeen percent in the fallen ball and transferred contents tasks, respectively).

Wrong answers of second-order false belief. In the fallen ball task, fifty percent of the five-year-olds answered the current place but fifty-two percent of the seven-to eight-year-olds answered the first-order. In the transferred contents task, fifty-six percent of five-year-olds answered the current place and fifty-seven percent of age seven- to eight-years-old answered the first-order.

DISCUSSION

The results show that seven- to eight-year-old children understand first-order false beliefs but do not understand second-order false beliefs. Thus, although the story was simple, even seven- to eight-year-olds could not answer the second-order false belief question, probably because the delay in acquiring second-order false beliefs was caused by the structure of the belief itself.

Furthermore, in this survey, the acquirement of the first-order false beliefs was delayed one year compared to the chocolate task (Wimmer & Perner, 1983). What has caused this delay? In these tasks, the information children have to remember includes the location of the object and the characters that moved the object. In the chocolate task, there are three pieces of information (blue cupboard, green cupboard, and mother). In the fallen ball task, children have to choose appropriate locations and characters from six pieces of information (toy box, table, basket, Taro, Hanako, the wind). According to Piaget's developmental stages, seven- to eight-year-olds, who could answer first-order false belief questions in the fallen ball task, are at the beginning of the concrete period. In this period, children start to arrange, classify, and commit information logically (Kojima & Morishita, 2004). This theory explains why six-year-olds can pass the chocolate task but fail the fallen ball task. Thus, the fallen ball task seems to have too much information as a first-order false belief question when compared to the chocolate task.

In case of the transferred contents task, we can ask first-order false belief questions in the first half of the task, before the quantity of information increases. In the transferred contents task, there are only four pieces of information (pencil box, carton of milk, chocolate box, bear) in the first-order false belief section. Therefore, as a first-order false belief task, the difficulty is expected to be reduced than the fallen ball task. The percentage of six-year-olds who correctly answered the first-order false belief question (52%) was the same as in Koyasu's (1997) location change condition (54%), while the results of the chocolate task indicate that six-year-olds can, in fact, understand first-order false beliefs (Beppu & Nomura, 2005; Koyasu et al., 1998; Hayashi, 2002). From this point of view, the difficulty of the transferred task is the same as that of location change condition, but they must both be more difficult than the chocolate task. This is because in the former two tasks, the correct answer is "pencil box (ice-cream)," but the children never see the pencil in the pencil box (ice cream in the refrigerator) during the task, while they do watch the characters put the chocolate into the cupboard in the latter task. The invisible information possibly makes the task difficult for children younger than seven to eight years of age, the age when the concrete period begins.

Furthermore, incorrect answers on second-order false belief questions clarified that after children acquired the first-order false belief, they adopted it when guessing the second-order false belief. This result indicates that children take three steps before understanding the second-order false belief: 1) answer the current place, 2) answer the first-order false belief, and 3) answer the second-order false belief.

CONCLUSION

In the previous studies, as the story of the "ice cream task" is too complex, the tasks

with simple stories were created (Sullivan et al., 1994; Hayashi, 2002; Astington et al., 2002). The result of our survey shows that the structure of the belief, not the complexity of the story, affects the children's theory of mind. We need to reconsider the result of the "ice cream task," whose credibility has been doubted because of the complex story. However, the story of false belief tasks ought to be simple rather than complex, because the complexity of the story will be obstructive for children before the concrete period.
In addition, the three alternatives led us to the new finding that most children who acquire comprehension of first-order false beliefs use them to answer questions that engage second-order false beliefs. Future studies on how children start to understand the first- and second-order false beliefs will greatly help in assessing or training communication skills of children with developmental disorders.

Future research needs to demonstrate these tasks among samples of children with developmental disorders to see how these children develop the ability to understand second-order false beliefs. We believe that the compound tasks will lead to new discussion in future studies of theory of mind.

REFERENCES

Astington, J. W., Pelletier, J., & Homer, B. (2002). Theory of mind and epistemological development: The relation between children's second-order false-belief understanding and their ability to reason about evidence. *New Ideas in Psychology, 20*, 131-144.

Beppu, S., & Nomura, K. (2005). Koukinou Jiheisyouji ha kenjyouji to kotonaru "kokoro no riron" wo motsunoka [Do Children with High Functional Autism Have a Different Theory of Mind than Normal Children?]. *The Japanese Journal of Developmental* Psy*chology, 16*(3), 257-264.

Hayashi, H. (2002). Jidouki niokeru saikitekina shinteki jyoutaino rikai [Children's understanding of recursive mental states]. *Japanese Journal of Educational Psychology*, *50*, 43–53.

Kojima, H., & Morishita, M. (2004). *Jidou Shinrigaku he no Shoutai "Kaiteiban" – Shin shinrigaku library=3 [Invitation to child psychology "revised edition" – New Psychology Library, 3]*. Tokyo; Saiensu-sha Co., Ltd. Publishers.

Koyasu, M. (1997). Youji no "Kokoro no Riron" no hattatsu – Kokoro no Hyousyou to Shashin no hyousyou no hikaku [The development of "theory of mind" in young children – A comparison between mental representation and photographic representation]. *Japanese Psychological Review, 40*, 97-109.

Koyasu, M., Nishigaki, J., & Hattori, K. (1998). Ehon keishiki niyoru jidouki no "kokoro no rikai" no chousa [A survey on children's understanding of mind by picture book form]. *Kyoto University Research Studies in Education, 44*, 1-23.

Matsumoto, K. (2008). Ichijiteki Shinnen kadai, Nijiteki Shinnnenn kadai nitsuiteno kousatsu: Goshinnnennkadai no kouzou bunseki wo chuushinn ni [The examination of 1st and 2nd order tasks: Focusing on the structure analysis of false belief tasks]. *The*

Bulletin of the Graduate School of Education of Waseda University, *16*(2), 13-23.

Perner, J., Leekman, S., & Wimmer, H. (1987). Three year-olds' difficulty with false belief: The case for a conceptual deficit. *British Journal of Developmental Psychology*, *5*, 125-137.

Perner, J., & Wimmer, H. (1985). "John thinks that Mary thinks that…": Attribution of second order beliefs by 5- to 10-year-old children. *Journal of Experimental Child Psychology*, *39*, 437-471.

Sullivan, K., Zaitchik, D., & Tager-Flusberg, H. (1994). Preschoolers can attribute second-order beliefs. *Developmental Psychology, 30*, 395-402.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, *13*, 103-128.

Appendix A. The Story of the Fallen Ball Task

This is Taro's (a boy) and Hanako's (a girl) room. There are three things in the room: a toy box, a table, and a wastebasket.

Taro and Hanako are playing with a ball together. But Hanako decides to go outside to play with her friends, so they put the ball away. Taro and Hanako put the ball in the toy box. Hanako leaves. "See you later!" she says.

Taro is playing alone in the room. He takes the ball out of the toy box and plays with it again. But Taro decides to play outside, too. Taro puts the ball on the table and leaves the room.

Now Hanako comes back in the room. "I'm back!" she says. Hanako finds the ball on the table, so she starts to play with it. But Hanako is hungry. She wants to eat snacks. Hanako puts the ball on the table and leaves the room.
With no one in the room, the wind blows in from the window and pushes the ball into the wastebasket.

Memory Question 1:
Where did Taro and Hanako put the ball at first?
Memory Question 2:
Where did Taro put the ball when he went out?
Memory Question 3:
Where did Hanako put the ball when she left the room to eat snacks?
Memory Question 4:
Finally, where did the ball fall?
First-Order False Belief Question 1:
Where does Taro think the ball is?
Control Question:
Where is the ball now?
First-Order False Belief Question 2:
Where does Hanako think the ball is?
Second-Order False Belief Question:
Where does Taro think Hanako thinks the ball is?

Appendix B: The Transferred Contents Task

There are three boxes in front of us: a box of colored pencils, a box of chocolates, and a box of milk.

Self-Belief Question:

In which box do you think a colored pencil is?

Here comes an elephant. Let's open the boxes with the elephant. (The experimenter opens the objects one after another.) Look! A colored pencil is in the box of milk! (The experimenter puts the colored pencil back into the box of milk and closes all boxes.) The elephant is now going home, good-bye! (The elephant leaves.) Now the bear comes. He is a friend of the elephant.

First-Order False Belief Question:

In which box does the bear, who hasn't seen inside the boxes, think the colored

pencil is?

Control Question:

Where is the colored pencil now?

Let's open the boxes and show the bear where the colored pencil is. (The experimenter opens the boxes one after another again.) Now the bear knows that the colored pencil is in the box of milk. The bear is now going home, good-bye! (The bear leaves.) Oh! The box of milk is a little wet. I think it's better to move the colored pencil. I will put it in the box of chocolate.

Second-Order False Belief Question:

When both the elephant and the bear come back, where does the bear think the

elephant thinks the colored pencil is?

Control Question:

Where is the colored pencil now?

Self-Past Question:

When you first saw the objects, in which box did you think the colored pencil was?

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