Pro-Social Motive Promotes Early Understanding of False Belief

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Ever since Premack & Woodruff's classic article[1], which introduced the term "theory of mind", researchers have claimed that strategic deception is the most natural behavioural consequence of understanding false belief. Here we challenge that claim, and provide evidence for the first time that the earliest manifestation of false belief understanding in human development is found in young children's emerging pro-social behaviours. In a modified false belief task, children were asked either to choose one protagonist they should help to find the object (the pro-social context), or to choose one they need to deceive so that none of the protagonists can find the object (the competitive context). The results show that the pro-social motive, but not the competitive motive, boosts early false belief understanding. This is most clearly contrasted with findings that apes, our closest living relatives, are capable of intentionally manipulating others by concealing information only under competitive motives, not under cooperative alternatives. Thus, the current findings are the strongest to date that sophisticated understanding of other's belief in humans has its unique origin, separate from the primate origin at some point in recent evolution, when cooperative and communicative motives played an essential role for their survival.

There is a general consensus that only humans are capable of *intentionally* manipulating the psychological states of others, both for cooperative and competitive purposes. Other species may have contextually fixed behavioural associations which appear quite similar to deception or cooperation in human society[2, 3], but most experimental evidence currently available suggests that such behaviours require little understanding of mental states, and occur only in a narrow range of contexts, such as competing for food[4]. The only known exception is apes, our closest evolutionary relative, reported to be capable of intentionally manipulating others' perceptual states by concealing information, but even their capability is limited to function only competitive contexts, and not in cooperative contexts[5,6,7,8]. Intentional deception and cooperation in humans, by contrast, can occur in highly flexible contexts, and often require a sophisticated reading of others' psychological states to be successful. Such sophisticated social intelligence, however, takes years to develop. Over 2 decades of research in theory of mind development suggests that sometime between 4 and 5 years of age, normally developing children of any country, culture and gender become capable of understanding false beliefs. Standard false belief tasks, which typical 3-year-olds would fail, have been widely recognized as a litmus test for developing theory of mind[9, 10].

From the beginning, the concept of false belief has been predominantly associated with the act of deception, i.e. the act of *creating* false belief in someone's mind[11]. Some researchers have suggested that development of children's conceptual understanding of deception coincides with their understanding of false belief[12, 13]. Furthermore, according to one evolutionary hypothesis, it is the capability for complex social manipulation such as deception that caused the enlargement of the brain in primates[14]. More generally, the so-called "Machiavellian Intelligence" hypothesis

claims that sophisticated mind-reading ability in humans has its evolutionary origin in deliberate exploitation for personal gain[15, 16].

The question of whether or how our motive to help others relates to our understanding of others' mind, by contrast, has received surprisingly little attention until recently. Only during the last five years, was the possibility that our ability to read others' mind might have evolved and developed to support cooperation and communication seriously considered[17, 18, 19]. For the evolutionary side of story, evidence has become available which indicates that social cognition in humans is geared to pro-social activities such as cooperation and communication while the social intelligence of non-human primates functions better in a competitive situation [5, 6, 7, 8]. For the developmental side of the story, several new findings suggest that spontaneous and robust pro-social and communicative actions are consistently produced by toddlers between 1 and 2 years old[20, 21]. For a preference for pro-social trait in others, even an earlier developmental root has been suggested more recently: a study revealed that at six month, infants prefer those who help others than someone who hinders others[22].

What has been missing so far, however, is an experimental test which directly examines the link between children's understanding of false belief and pro-social behaviors. In the present study, our hypothesis is that early theory of mind ability in human children is geared to cooperative and communicative purposes more strongly than it is to competitive or deceptive counterparts. If this is correct, children younger than four, who typically fail standard false belief tasks, should perform better in tasks where their understanding of false belief is mandatory to help others.

We introduce a novel paradigm based on the standard location change false belief task[9], which we call the "Helping False Belief (FB) Task" and the "Deceiving

False Belief (FB) Task". In order to create an appropriate setting for the child's helping or deceiving act, some modifications to the standard location change task were necessary (Fig. 1). The key feature of the modified FB tasks is that the child's understanding of false belief is assessed by his elicited non-verbal demonstration of choosing one protagonist over the other either (a) as the beneficiary of his help through indicating the true location of the object (in this case, the protagonist with a false belief should be chosen), or (b) as the victim of deception through deliberate misinforming of the object location (in this case, the protagonist with the true belief should be chosen). Two differently coloured boxes were used as the possible locations of the object, and the child was instructed to inform or misinform the true location of the object, by indicating the colour of the relevant box by means of showing a matching coloured ping-pong ball to the chosen protagonist.

Sixty preschool children aged between 2;6 and 5;5, divided into three age groups, participated in the Helping FB Task, which was preceded by the Standard FB Task. Each condition consisted of three trials. A child scored one point (a) if the child made a correct prediction about where the protagonist with false belief will look for the object (Standard FB Task) or (b) if the child chose the protagonist with false belief to inform the true location of the object (Helping FB Task). In order to avoid the possibility that children's choice of the protagonist is based on (a) attribution of ignorance, rather than false belief, or (b) some low-level cues such as the order of appearance (or their preference for the first appearing "victim" over the second appearing "bad guy"), a control session was also added, where (a) both protagonists end up being ignorant about the object transfer, and (b) the second appearing protagonist would always have the false belief about the location (Fig. 2).

The same number of children, aged between 2;7 and 5;5, participated in the Deceiving FB Task. The experimental procedure used in the Deceiving FB Task was exactly the same as the Helping FB Task, except for the following point: the experimenter and the child participant decided to keep the target objects to themselves, and the child was asked to deceive only one of the two protagonists so that eventually both protagonists end up failing to find the objects. The child received one point when he correctly chose the protagonist with true belief to misinform about the object location.

Our rationale behind the experimental design was that children's choice of the protagonist to help or deceive is based on their understanding of his belief state. More specifically, the task required the child (a) to attribute either false or true belief to each protagonist, and (b) to predict which one of the two protagonists is more likely to succeed or fail to search the correct location.

Mean scores for the Helping FB Task (Fig. 3) were compared by means of 3 (age groups, n=20 for each group) x 2 (standard task vs. helping task) mixed factors ANOVA. It revealed the main effect of task [$F(1,57)=99.97$, $p<.001$] and age group [$F(2,57)=4.80$, $p<.05$], together with the interaction of the two variables [$F(2,57)=3.34$, $p<.05$]. Post-hoc tests revealed significantly better performance for the Helping Task than for the Standard Task. A comparison between the experimental and control group revealed that children's choice of protagonist to help was not based on the attribution of ignorance, nor affected by the order of their appearance ($p<.001$) (Figure 4). Mean scores for the Deceiving Task (Fig. 3) were also analyzed by means of 3 (age groups, n=20 for each group) x 2 (standard task vs. deceiving task) mixed factors ANOVA. The main effect of task [$F(1,57)=10.46$, $p<.01$] and age group [$F(2,57)=5.17$, $p<.05$],

together with the interaction of the two variables [$F(2,57)=4.00$, $p<.05$] were obtained. Post-hoc tests revealed significantly better performance of 3- and 4-year-olds for the Deceiving Task than the Standard Task.

Overall, the results indicate that younger children in particular performed better in the newly introduced FB tasks, i.e. the Helping and the Deceiving Task, than the Standard Task. We speculate three possible reasons for this. First, to choose the right "protagonist" in response to the new target question may have been easier for them than to choose the right "location" in response to the standard target question, as they were less likely to be affected by the reality bias (i.e. their knowledge about the current object location) in the former. More generally, false belief tasks which do not elicit any explicit response concerning the location are considered to be more appropriate to tap younger children's false belief reasoning, for similar reasons[23, 24, 25]. Second, in the new FB tasks, false belief understanding was situated in a social context, where it may be easier for children to relate to protagonists' mental states more naturally[18, 26]. Third, the very need for comparing and contrasting the mental states of the two protagonists to pick the one to help or the one to deceive, may have been another contributing factor for their successful performance[27].

Ultimately, the most important finding in the current study lies in the comparison between children's performance in the Helping FB Task and in the Deceiving FB Task, the two tasks that involved identical methodological manipulation except for the contrast in the child's target action. Children's performance in all three age groups in the Helping FB Task was significantly higher than a chance level of 50 % (all t's > 3.58, all p's ≤ .002, two-tailed t-test). By contrast, children performed at or close to a chance level in the Deceiving FB Task (all t's < .72, all p's > .48, n.s.).

Furthermore, a 2 (helping task vs. deceiving task) x 3 (age groups, n=20 for each group) ANOVA yielded significant main effect of task [$F(1,114)=17.42$, $p<.01$], but no main effect of age group or the interaction of the two variables, indicating a significantly better performance for the Helping Task than the Deceiving Task.

The finding is important in several ways, particularly when compared with the findings of meta-analysis of 178 false-belief test results[10]. The meta-analysis has revealed that a deceptive motive enhanced the performance of children of all ages, though it has never brought 3-year-olds' performance to above chance level. The result of the Deceiving FB Task in the present study confirms the trend. No other social motives that might enhance younger children's performance are mentioned in the meta-analysis, and it was concluded that no task manipulations which have been included in the meta-analysis produced above-chance level performance in the youngest children. As the present study clearly shows, however, pro-social motives in the Helping FB Task boosted 3-year-olds' grasp of protagonist's false belief to above-chance level. The finding strongly suggests that false belief understanding may be sensitive to different social or communicative contexts, and that pro-social motives may be particularly suitable to elicit younger children's natural ability to understand others' mind.

Our findings thus support the evolutionary hypothesis that human social intelligence has evolved to emphasize and appreciate the benefit of cooperation more than that of competition, which has traditionally been regarded as a "poor cousin of Machiavellianism"[28]. Of course, we are not denying that human beings are not only cooperative, but also extremely competitive. What the current study reveals is that a strong pro-social trait in early childhood is not the sign of indiscriminate or naïve trust

of others, but is more likely to be a uniquely human ontological pathway into more sophisticated understanding of complex social interactions.

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Supplementary Methods is linked to the online version of the paper at **www.nature.com/nature**.

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Figure Captions

Figure 1. Actions shown in (A) Standard FB Task, (B) Helping FB Task, and (C) Deceiving FB Task.

Figure 2. Actions shown in the control condition of the Helping FB Task.

Figure 3. Mean scores across the Helping FB Task and the Deceiving FB Task for three age groups.

Figure 4. Mean scores of the Helping FB Task in the experimental (where the first appearing puppet has false belief) and control conditions (where the second appearing puppet has false belief).

Figure 1.

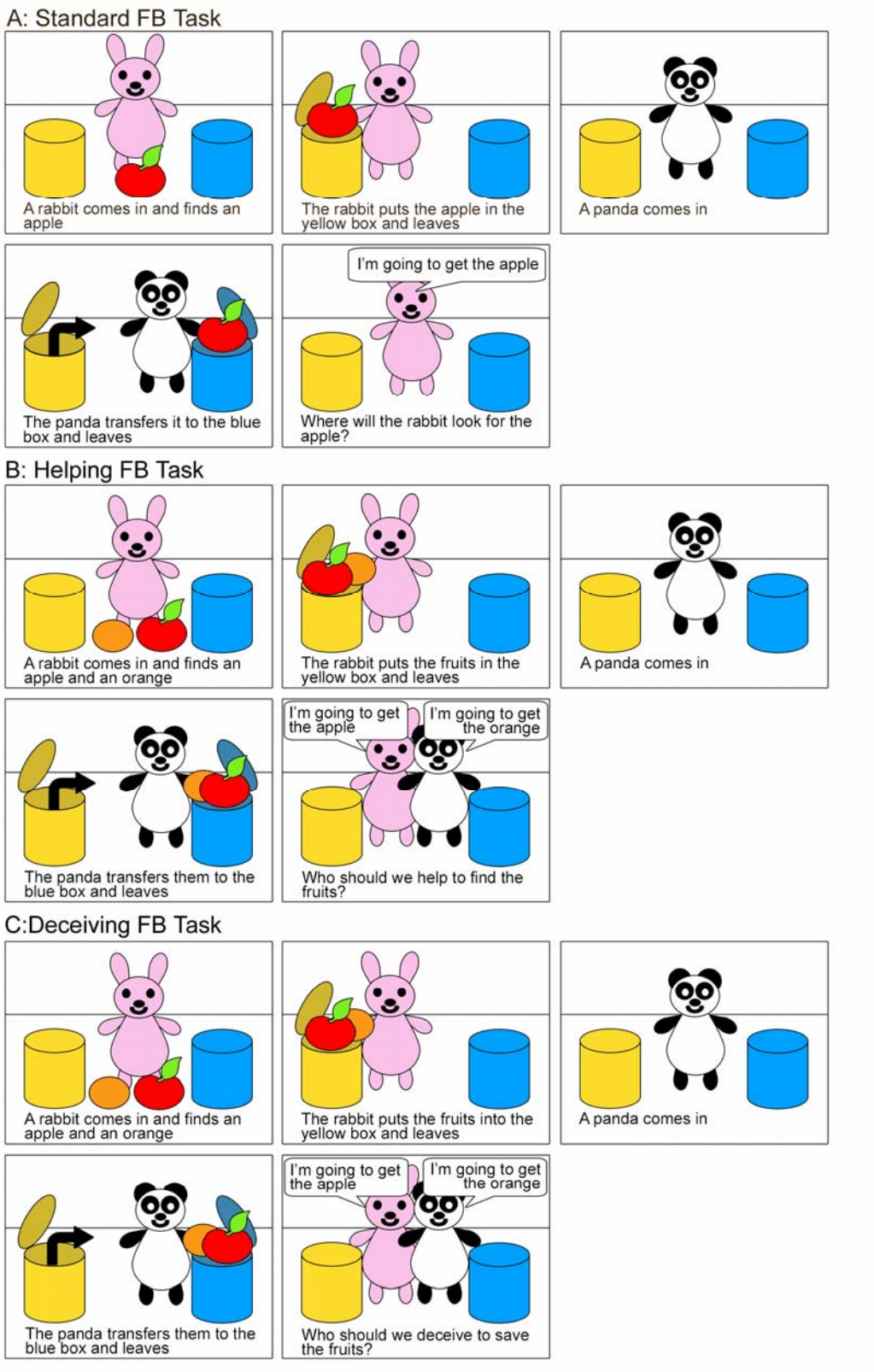


Figure 2.

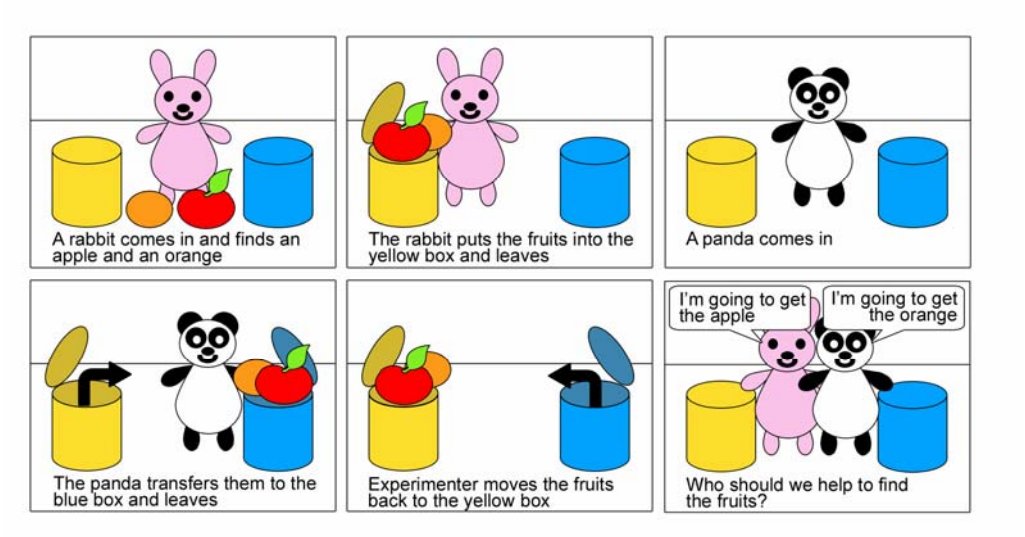


Figure 3.

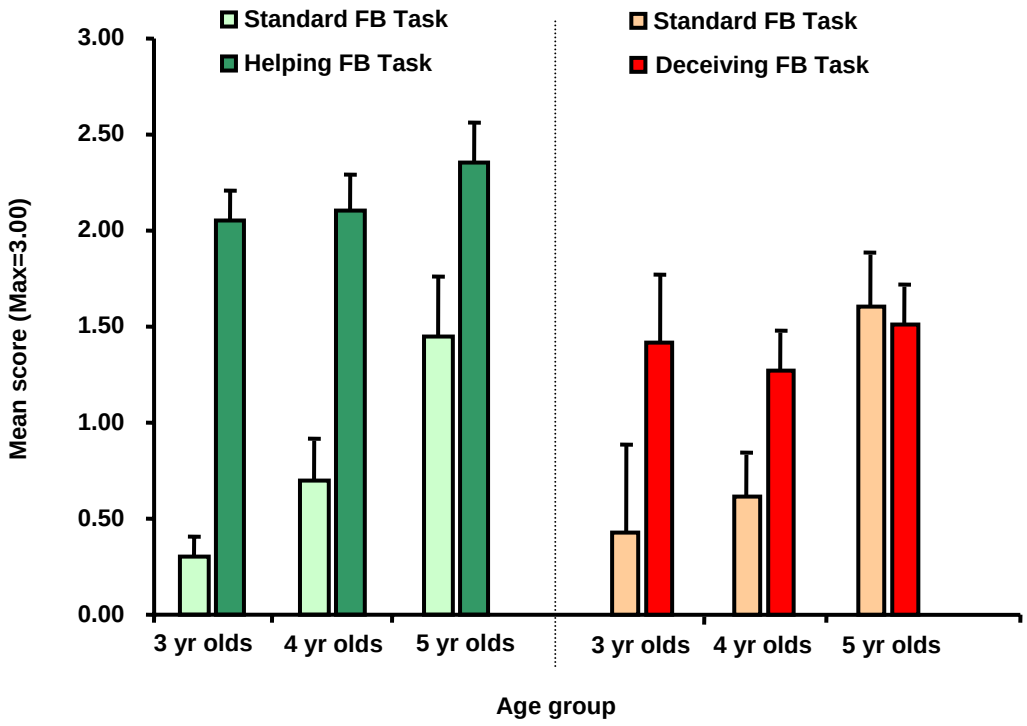
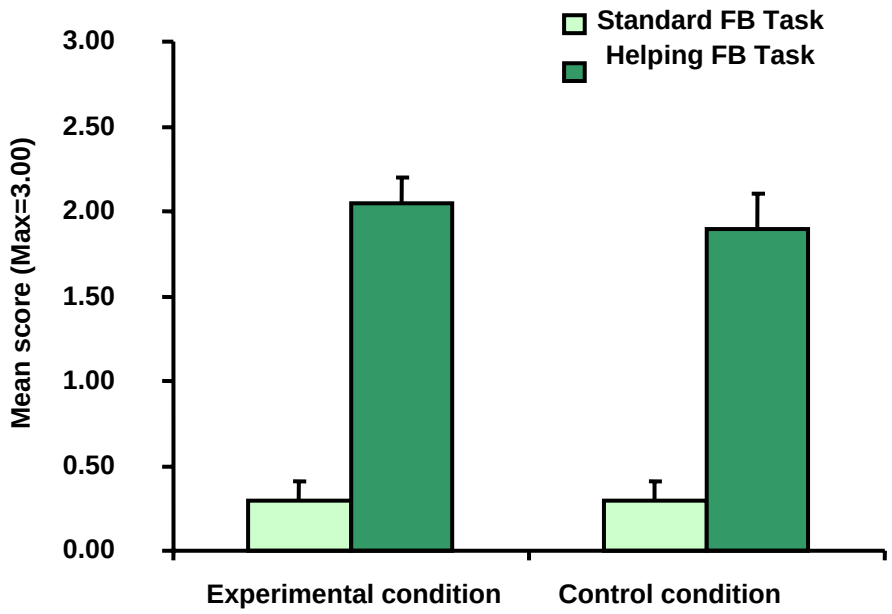


Figure 4.



Supplementary Information for

Pro-Social Motivation Promotes Early Understanding of False Belief

Supplementary Methods

Helping Location-Change FB Task

Participants

Sixty children participated in the Helping FB Task: 20 children between the age of 2;6-3;5 (*M*=3;0), 20 children between 3;6-4;5 (*M*=4;0), and 20 children between 4;6-5;5 (*M*=5;0). An additional 20 children between the age of 2;6-3;5 (*M*=3;0) were added as a control group. Children were recruited from kindergartens and nursery schools in Inuyama-city, Aichi prefecture. The numbers of male and female children in each group were approximately the same.

Materials

Boxes of different colours, ping-pong balls of the same colours, and small-sized objects that are familiar to children (e.g. flower, cup, candy) were used. Pairs of puppet characters were used to show the false belief stories in front of the child participant.

Design and Procedure

Children were tested individually in a quiet room at their kindergarten/nursery school, or in our laboratory room that was furnished to create a child-friendly environment. The participant and an experimenter were seated in front of a table, and a puppet player was seated across the table, facing the child and the experimenter.

Participants were given two experimental conditions, the Standard FB task and the Helping FB Task, each consisted of three trials. Children first were engaged in the Standard FB Task and then proceed to the Helping FB Task. The test session of the Helping FB Task was preceded by a short practice session, where the participant learned the basic protocol of helping a puppet with a given material (a coloured ping-pong ball).

The whole session, which lasted for 20-30 minutes for each child, was videotaped. The child's responses were kept in a log by the experimenter.

Standard Location-Change FB Task

The task basically followed the Standard Location Change False Belief Task. A child participant saw the following sequence of events. Puppet A puts an item into one of the two boxes on the table and disappears. Puppet B then comes in and transfers the item into the other box. After Puppet B's exit, the experimenter asked the child three confirmation questions: (a) Where is the item now?, (b) Who put it in the box?, and (c) Which box had the other character put it in? If the child's answer was wrong, the experimenter reviewed the story and corrected the mistake, so their possible subsequent failure in the experimental question would not be caused by a lack of false belief understanding. After the confirmation questions, Puppet A comes back and states that he is going to get "the item" (an apple, a ball, and etc). The experimenter then asked the test question: "Which box will Puppet A search to get the item?" The child's answer was counted as correct if the child chose the box which Puppet A initially put the item in.

Helping FB Task

(a) *Practice session*

Before the testing session, the child participated in a practice session to get familiarized with some basic protocols of helping action required in the main task. Four different scenes were acted out in front of the child.

Scene 1: The experimenter placed a toy food item inside one of the two boxes on the table. The two boxes were differently coloured, and the experimenter picked up the matching coloured ping-pong balls from a bowl to show to the child. The child was asked to pick the ping-pong ball whose colour matches the colour of the box containing the food. A puppet then appeared and stated that he was very hungry. The experimenter told the child that he can help the hungry puppet find the food, and then said "Let's help him by giving this ping-pong ball. He would know that there's something in the box which has the same colour as the ping-pong ball". Having received the ball from the child, the puppet reached the target box, and found the food.

Scene 2: After a toy food item was placed inside one of the boxes and the colour-matched ping-pong ball was picked up, a puppet came in and stated that he was hungry. However, this time, the puppet immediately proceeded to open the empty box and became clearly disappointed. The child was then given the ping-pong ball and encouraged to help the disappointed puppet. Having received the ball, the puppet reached the other box and found the food.

Scene 3: The experimenter placed *two* toy food items in the middle of the two boxes. A puppet appeared and put the two items in one of the boxes and disappeared. Then another puppet came up and transferred the two items to the other box. The experimenter asked the child three questions: (a) Where are the items now?, (b) Who put them in the box?, and (c) Which box had the other character put them in? Then the child was asked to pick up the ping-pong ball whose colour matched the colour of the box containing the items. The two puppets came back one after another and each stated that he was going to get one of the two items. The item chosen by each puppet was different, and if one puppet said "I'm gonna get an apple", the other said "I'm gonna get an orange", for example. The puppet who didn't know about the transfer of the items opened the empty box and cried, while the puppet which transferred them opened the right box and found the item. After the disappointed puppet went away in tears, the experimenter said, "Oh, I forgot about this ball. If we had given this ball to him, he could have found the item. I'm sorry that we couldn't, but next time maybe we should remember how to help someone like him."

Scene 4: The same story as the Scene 3 was acted out, but this time, before the disappointed puppet disappears, the child was encouraged to help him. The experimenter gave the ball to the child and said, "Oh, he has opened the empty box mistakenly. Maybe we should help him. Give this ball to him and then he will know where he can find the item." Having received the ball from the child, the disappointed puppet went to the right location and found the target item. The other puppet also found his item on his own.

(b) *Test session*

After the practice session, the child proceeded to the test session, which consisted of three trials. The experimenter placed two toy items in the middle of the two boxes. A puppet appeared and put the two items in one of the boxes and disappeared. Then

different puppet came up and transferred the two items to the other box. The experimenter asked the child three questions: (a) Where are the items now?, (b) Who put them in the box?, and (c) Which box had the other character put them in? Then the child was asked to pick up the ping-pong ball whose colour matched the colour of the box containing the items. The two puppets came back one after another and each stated that he was going to get one of the two items. The item chosen by each puppet was different. At this point, the experimenter said to the child, "One of them may go to the wrong box and get disappointed, and so maybe we should help him! Please give this ball to him so that he will know the right location!" The child was required to choose the puppet which is more likely to fail to find the item he wanted, in order to help him.

(c) *Control group*

20 children (*M*=3;0) participated in a control session, which was designed to test (a) if children's choice of puppet to help is based on attribution of ignorance, rather than false belief, or (b) if the order of the two puppets' appearance influenced children's choice of the puppet. In the test session, as in the standard location-change false belief tasks, it was always the first appearing puppet which ended up being both ignorant about the object transfer and having a false belief about the location of the toy items. Hence, the possibility remained that the children's correct choice of puppet to help is not due to their careful consideration of puppets' belief states, but to attribution of ignorance, or to a blind choice of the puppet which appears first (or their preference for the first appearing "victim" over the second appearing "bad guy"). To counterbalance the order of appearance and having false belief, as well as controlling knowledge/ignorance of object transfer, the control session was set up so that the second appearing puppet would always have a false belief about the location, while both puppets are ignorant about the object transfer. This was achieved by the addition of the following step to the story in the test session: after the second appearing puppet transferred the toy items and disappeared, the experimenter transferred them back to the original location. In this way, although neither puppet knew about the second transfer of the items, the first appearing puppet ended up with correct belief, and the second appearing puppet with false belief, about their location. Children who participated in the control session also performed the standard FB task first, which was immediately followed by a practice session customized for the control session.

Deceiving Location-Change FB Task

Participants

Sixty children participated in this study; 20 children between the age of 2;7-3;5 (*M*=3;1), 20 children between 3;6-4;5 (*M*=4;1), and 20 children between 4;6-5;5 (*M*=5;0). The numbers of male and female children in each group were approximately the same. They were recruited from kindergartens and nursery schools in Inuyama-city, Aichi prefecture.

Materials

Materials used in the Deceiving FB Task were same as in the Helping FB Task: coloured boxes, coloured ping pong balls and small-sized objects familiar to children..

Design and procedure

The basic design of the Deceiving FB Task was the same as the Helping FB Task: participants were given two types of false belief tasks; Standard Location-Change FB Task and Deceiving FB Task, each consisted of three trials. Children first participated in the Standard FB Task, which was followed by a short practice session and a testing session of the Deceiving FB Task. The whole session lasted about 20-30 minutes for each child. The child's response was kept in a log by the experimenter and whole session was videotaped. As we found no order effect to the choice of the puppet to help in the Helping FB Task, it was simply assumed that there would be no order effect in the Deceiving FB Task either, without any control task.

(a) *Practice session*

Children were familiarized with basic protocols of deceiving action required in the main task in the practice session. Four different scenes were acted out in front of the child. *Scene 1:* The experimenter placed a toy food item in one of the two boxes on the table. A puppet appeared and stated that he was hungry. The experimenter told the child that they want to keep the toy food to themselves, and that the puppet should not take it from them. After the child agreed, the experimenter suggested to the child that they should make the puppet search in the wrong box so that he cannot find the toy food. The child was asked to pick the ping-pong ball whose colour matches the colour of the empty box

on the table, and to give it to the hungry puppet. Having received the ping-pong ball, the puppet searched the empty box, and left the scene without finding the food.

Scene 2: As in Scene 1, the experimenter put the toy food item in one of the two boxes on the table and suggested that if someone comes in and looks for food, they should guide him to the wrong location so that they can keep the food to themselves. The child prepared the ping-pong ball whose colour matched the colour of the empty box on the table. A puppet appeared and claimed that he was hungry, and the child was encouraged to give the ball to him. Having received the ping-pong ball, the puppet searched the empty box, and failed to find any food.

Scene 3: The experimenter placed two toy food items in the middle of the two boxes. A puppet appeared and put the items in one of the boxes and disappeared. Another puppet came in and transferred the items to the other box. After the second puppet disappeared, the experimenter gave the three confirmation questions to the child. Then the child was asked to choose a ping-pong ball whose colour matched the colour of the box which is currently empty. The two puppets came back one after another, and each stated that he was going to get one of the two items. The puppet which transferred the items searched the right box and found the item he wanted, but the other one searched the wrong box and disappeared without finding the item he wanted. The experimenter then said, "Oh, I forgot about this ball. If we had given this ball to the puppet who took away our toy item, he couldn't have found it. I'm sorry that we didn't do it in time, but next time we should use the ball to keep the toy items to ourselves."

Scene 4: The same story as in the Scene 3 was acted out, but this time, the child was encouraged to give the ball to the puppet which approached the right box, to misinform him about the location. Having received the ball, the puppet went to the wrong box and failed to find the item he wanted. Meanwhile, the other puppet also searched the wrong box and failed to find the item he wanted. Thus, the child succeeded to keep the items to himself.

(b) *Test session*

After the practice session, the child proceeded to the test session. The experimenter placed two toy items in the middle of the two boxes on the table. A puppet appeared and put the two items in one of the boxes and disappeared. Then another puppet appeared and transferred the two items to the other box. The experimenter asked the child three

confirmation questions. The child was then asked to pick up a ping-pong ball whose colour matched the box that is currently empty. The two puppets came back one after the other and each stated that he was going to get one of the two items. At this point, the experimenter said to the child, “One of them may go to the right box and find the item he wants, but we don’t want it to happen. Please give this ball to him, so that he will search the wrong box!” The child was required to choose the puppet which is more likely to succeed to find the item he wanted, as the victim of his deception.

Figure 1.

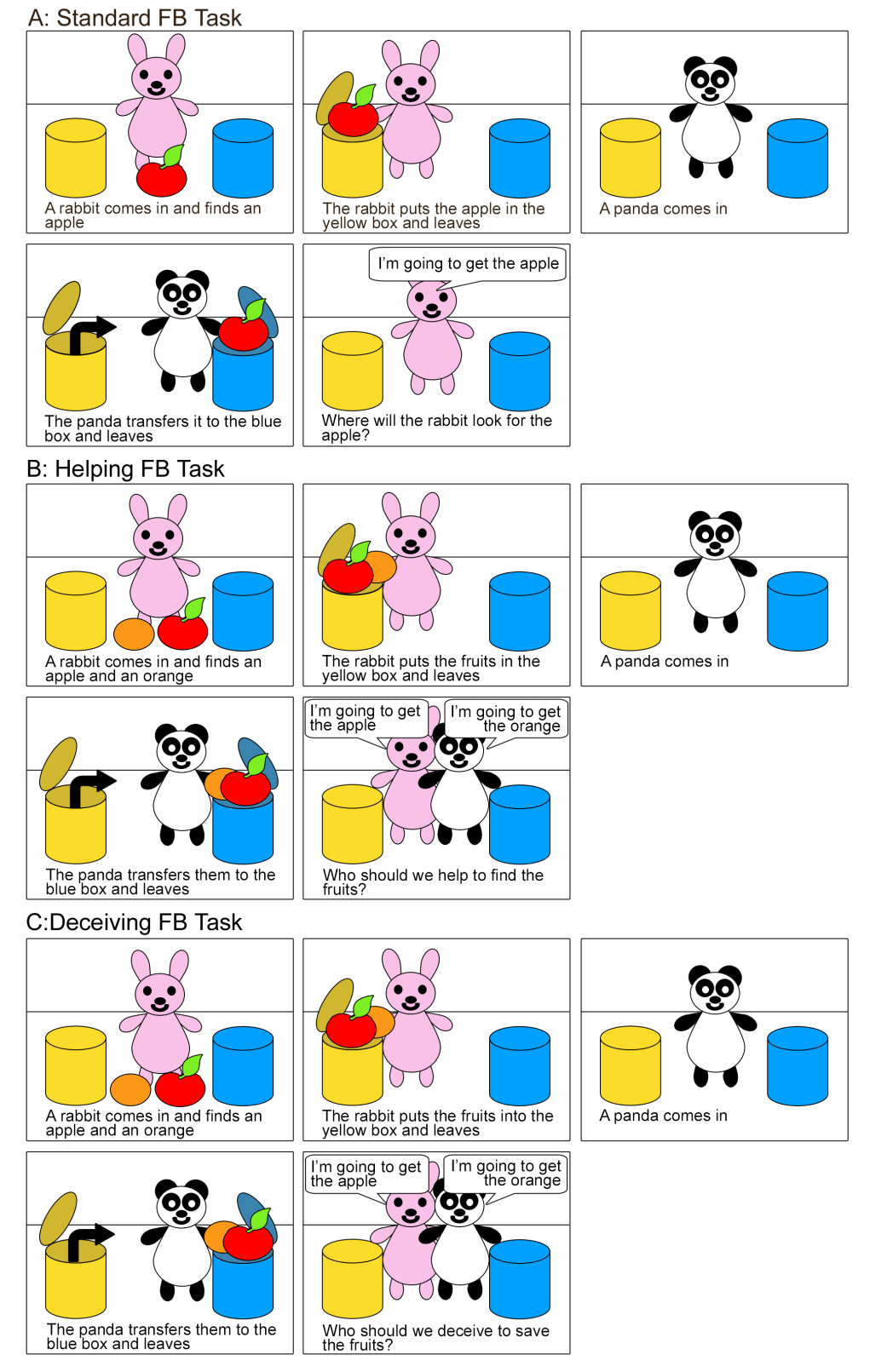


Figure 2.

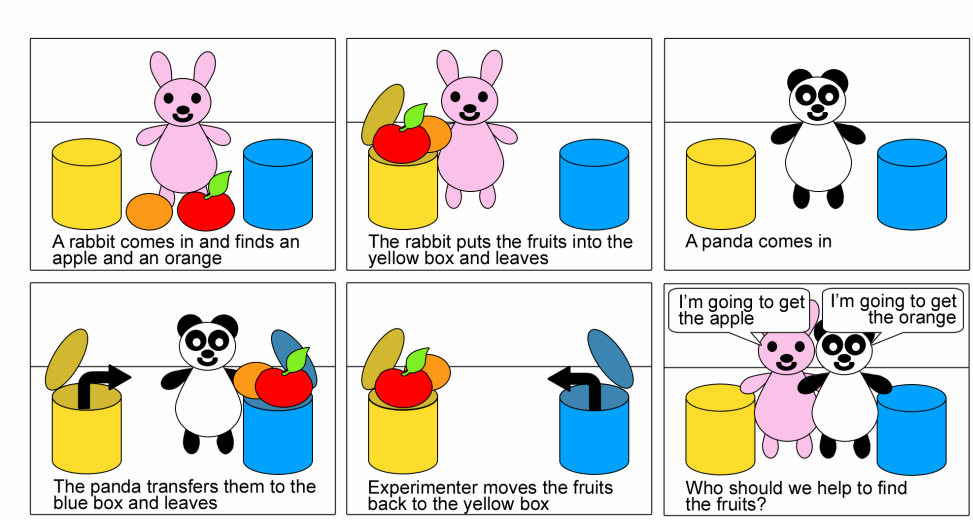


Figure 3.

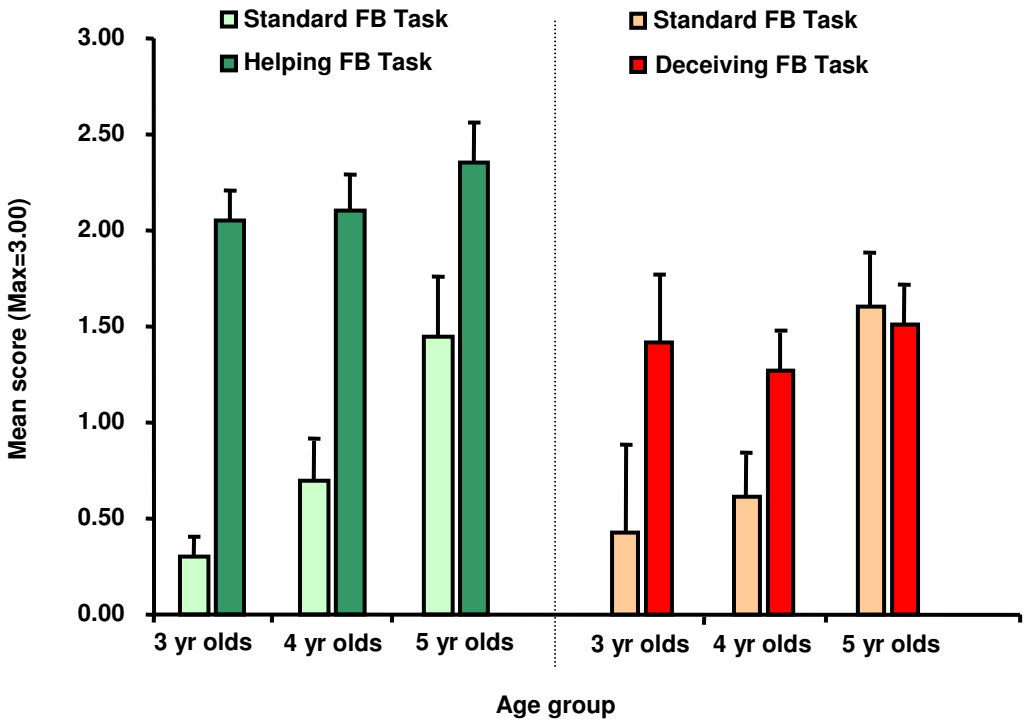


Figure 4.