



ELSEVIER

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp



Expectations about recipients' prosociality and mental time travel relate to resource allocation in preschoolers

Yuto Kumaki^{a,*}, Yusuke Moriguchi^b, Masako Myowa-Yamakoshi^b

^a Faculty of Education, University of Teacher Education Fukuoka, Munakata 811-4192, Japan

^b Graduate School of Education, Kyoto University, Kyoto 606-8501, Japan

ARTICLE INFO

Article history:

Received 6 January 2017

Revised 13 October 2017

Available online 5 December 2017

Keywords:

Resource allocation

Reciprocity

Future thinking

Mental time travel

Friendship

Preschooler

ABSTRACT

Previous studies have revealed that preschoolers selectively allocate their resources based on their social relationship with recipients such as friendship. In this investigation, we investigated how expectations about recipients' prosociality and the ability of future thinking relate to the selective allocation of resources. In Study 1, participants aged 3.5–6 years chose how to allocate resources from two ways (selfish allocation, where only the participants could receive stickers, and equal allocation, where the participants and recipients receive get the same number of stickers) in costly and non-costly situations with three recipients (friend, peer, and stranger). Participants were asked to state which alternatives the recipients would choose if they were given a choice. The results showed that children aged 5 and 6 years tended to choose equal allocation of resources when they expected the recipients to do the same both in costly and non-costly situations. This tendency was not observed in children aged 3.5 and 4 years. In Study 2, the relationships between selectivity in non-costly allocation and two facets of future thinking (delay of gratification and mental time travel) were investigated in children aged 5 and 6 years. The results suggested that children with a higher mental time travel ability tended to be more selective in allocating resources based on social relationships; they tended to allocate more resources to the friend and fewer to the peer. Our findings suggest that expectations about a

* Corresponding author.

E-mail address: yuto.kumaki@gmail.com (Y. Kumaki).

recipient's prosociality and the ability of mental time travel affect selectivity of resource allocation in children aged 5 and 6 years.

© 2017 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Children begin to share their resources with others during the second year of life (Brownell, Svetlova, & Nichols, 2009; Dunfield, Kuhlmeier, O'Connell, & Kelley, 2011; Rheingold et al., 1976). During this period, they allocate their resources in response to others' expression of their desires (Brownell et al., 2009; Dunfield et al., 2011) and allocation is not affected by the social relationship (e.g., friendship). In contrast, during the preschool period, allocations become selective depending on the social relationship with the recipient. For example, preschoolers may allocate more resources to individuals similar to them such as members of the same gender, race (Renno & Shutts, 2015), and in-group (Dunham, Baron, & Carey, 2011; Fehr, Bernhard, & Rockenbach, 2008).

Friendship is one of the social relationships that can affect preschoolers' resource allocation (Berndt, 1981; Birch & Billman, 1986; Garon, Johnson, & Steeves, 2011; Lu & Chang, 2016; Moore, 2009; Paulus, 2016). Moore (2009) studied resource allocation among children aged 4.5–6 years who were given two alternatives to choose concerning how to allocate stickers among a friend, a non-friend, and a stranger. *Friend* was defined as a classmate with whom the participant often played, and *non-friend* was defined as a classmate with whom the participant did not like playing. The first alternative was that of selfish allocation, where only the participant could get stickers and the partner could not. The other one was that of equal allocation, where both the participant and partner get the same number of stickers. Moreover, in Moore's study, there were two types of games: prosocial and sharing. In the prosocial game, the participant's gain remained constant in both alternatives (e.g., 1 for the participant and 1 for the partner, 1 for the participant and 0 for the partner). Therefore, there were no costs to choosing equal allocation. On the other hand, in the sharing game, the participant could obtain more rewards by choosing the selfish alternative (e.g., 1 for the participant and 1 for the partner, 2 for the participant and 0 for the partner). Moore reported that children were more likely to choose equal allocation when the partner was a friend or stranger than when the partner was a non-friend in the prosocial game. In the sharing game, the child was more likely to choose the equal allocation when the partner was a friend than when the partner was a non-friend or stranger. These results showed that the social relationship with the recipient affected resource allocation in preschoolers.

Moore (2009) discussed this selective allocation from the viewpoint of reciprocity. In other words, children selectively allocated resources to friends rather than to non-friends because they expected friends to reciprocate compared with non-friends. According to the theory of reciprocity, it is important to be selectively prosocial to individuals who are likely to reciprocate the prosociality (Trivers, 1971). If children decide how to allocate resources based on expectations of others' reciprocation to themselves, it can be considered a behavior based on reciprocity.

In a representative experiment of reciprocal allocation, children take turns playing games of resource allocation with other children or adult experimenters. Studies using this method have revealed that allocations were affected by recipients' previous allocation in children aged 5–7.5 years, but not in children aged 3 and 4 years (House, Henrich, Sarnecka, & Silk, 2013; Sebastián-Enesco, Hernández-Lloreda, & Colmenares, 2013; Sebastián-Enesco & Warneken, 2015). In the study by House et al. (2013), pairs of children aged 3–7.5 years took turns playing the prosocial game. The results showed that children aged 5–7.5 years tended to choose equal allocation rather than selfish allocation when the recipients had chosen equal allocation in the previous trials. In children aged 3 and 4 years, on the other hand, there was no clear relationship between previous recipients' allocation and the participants' consequent choice. These studies show that reciprocal allocation based on previous experience is acquired by 5 years of age.

Several studies support the idea that preschoolers expect their friends to reciprocate prosociality compared with other peers or strangers; however, no experiment in a controlled setting has been conducted to verify this. Naturalistic observation studies have revealed that reciprocity among friends is stronger than that among non-friends in preschoolers' resource sharing and prosocial behavior (Fujisawa, Kutsukake, & Hasegawa, 2008; Howes, 1983). Paulus and Moore (2014) showed that children aged 4 and 5 years tended to expect that people would choose equal allocation more with their friends than with other peers in prosocial and sharing games from a third-person perspective. In this experiment, children were introduced to three puppets: a protagonist, a friend, and a peer. Then, they were asked to state which alternative the protagonist would choose when the recipient was the friend or peer. Children also decided their way of sharing with their own friends and peers; those who expected higher selective allocation from others tended to choose equal allocation more with their friends than with peers in their own allocation. Their findings suggest that preschoolers have the understanding that people are prosocial to their friends, and such an understanding may lead to selectivity based on friendship in their own allocation. In terms of reciprocity, however, children's expectations of others' allocation to themselves, rather than understanding from the third-person perspective, is more important. According to the theory of reciprocity, children would decide their own way of allocation based on their expectations of recipients' prosociality toward them.

Given the previous evidence, it is possible that children aged 4.5–6 years selectively allocate to their friends based on the expectation of reciprocal prosociality. However, little is known about when children develop this expectation-based reciprocity in allocation. Moreover, reciprocity is not the only component of friendship. Researchers have proposed other elements of friendship such as mutual preference for interactions and sharing positive emotions (e.g., Howes, 1983). Previous research about selective allocation based on social relationship has also showed that reciprocity is not the only factor. For example, Renno and Shutts (2015) showed that selectivity to the same gender is based on both preference and expectation. Therefore, in Study 1 we aimed to investigate the developmental change of selective allocation based on expectations and social relationship. We asked children about their expectations of recipients' prosociality and their own allocation. This procedure enabled us to examine the relationship between expectations and children's own allocation directly. Moreover, because many previous studies have paid attention to how the allocation of preschoolers differs between costly and non-costly situations (e.g., Burkart & Rueth, 2013; Fehr et al., 2008), we conducted both prosocial (non-costly) and sharing (costly) trials. Thus, we also investigated differences in the effects of expectations and social relationship on children's allocation between costly and non-costly situations.

If children selectively allocate resources based on the expectation of the recipients' prosociality, it might be considered as future-oriented behavior. Allocation of resources to one who is expected to be prosocial will lead to reciprocal interactions with the recipients in the future. Several studies have shown that preschoolers allocate resources in a manner that increases their future gains from reciprocal interaction. Kenward, Hellmer, Winter, and Eriksson (2015) showed that 4-year-olds share their resources strategically to maximize their future gains. Similarly, Xiong, Shi, Wu, and Zhang (2016) showed that 5-year-olds shared more when the recipient had an opportunity to reciprocate than when he or she did not. These studies may suggest that preschoolers consider future gains when they allocate resources.

If selective allocation is motivated by a future reciprocal relationship with the recipients, the development of future thinking might be one of the important cognitive factors for the acquisition of this behavior. Future thinking has several aspects such as mental time travel, delay of gratification, planning, and prospective memory (Atance & Jackson, 2009). Delay of gratification refers to the ability to inhibit the desire to receive immediate rewards in order to obtain future rewards (Mischel, Shoda, & Rodriguez, 1989). Reciprocity is a long-term cooperative system that provides individuals with long-term gains through reciprocal interactions given that rewards from reciprocal interaction are not provided immediately. Thus, inhibition of immediate desire might be required to obtain long-term gains from the system of reciprocity.

Several studies have already investigated the relationship between delay of gratification and resource allocation in preschoolers. For example, Sebastián-Enesco and Warneken (2015) showed that 5-year-olds with a higher score on delay of gratification tended to share more resources in the alloca-

tion task. [Garon et al. \(2011\)](#) examined the relationship between delay of gratification and selective sharing to friends in children aged 3–4.5 years. In their experiment, children were asked to share various toys with their friends and other peers. The results showed that the tendency to share more attractive toys with their friends was positively correlated with delay of gratification ability. These results suggest that the ability of delay of gratification might relate to selectivity in sharing situations.

Mental time travel comprises reconstruction of personal events from the past and construction of possible events in the future apart from the influence of current mental states ([Suddendorf & Corballis, 1997](#)). Children begin to acquire the ability of mental time travel by 4 years of age ([Suddendorf & Redshaw, 2013](#)). Mental time travel may be an important factor of selectivity depending on friendship. The mental time travel ability might let children imagine what will happen to the relationship with the recipients if they share or do not share the resources. Little is known about the developmental relationship between mental time travel and social behavior in preschoolers. Thus, in Study 2 we aimed to investigate the developmental relationship between selective allocation based on friendship and expectations about recipients' prosociality and future thinking. The developmental change was investigated in Study 1, and the cognitive basis, especially future thinking, was investigated in Study 2.

Study 1

In Study 1, we tested children aged 3.5–6 years because several studies have shown the developmental change of reciprocal allocation based on previous allocation by recipients aged 3 and 4 years and 5 and 6 years (e.g., [House et al., 2013](#)). Following the procedure established by [Moore \(2009\)](#), we administered the prosocial game and sharing game for three recipients: a friend, another peer, and a stranger. In addition to this, participants were asked to predict the recipients' allocation to themselves before they chose how to allocate their resources. The aim of adding this procedure was to measure children's expectations about recipients' prosociality and examine its relationship with children's own allocation. We hypothesized that (a) children aged 5 and 6 years would tend to choose more equal alternatives in their own allocation when they expect that the recipients would choose the equal alternative rather than the selfish alternative; (b) on the other hand, for children aged 3.5 and 4 years, expectations about recipients' allocation might not affect their own allocation given that previous studies have shown that allocation based on reciprocity is not observed in that age group (e.g., [House et al., 2013](#); [Sebastián-Enesco & Warneken, 2015](#)).

Method

Participants

The final sample consisted of 48 children aged 3.5–6 years. They were divided into two groups based on age: 3.5 and 4 years ($n = 21$, 15 boys and 6 girls; $M = 51.86$ months, $SD = 4.25$, range = 44–59) and 5 and 6 years ($n = 27$, 15 boys and 12 girls; $M = 70.26$ months, $SD = 6.79$, range = 60–79). A minimum sample size of 20 per group was determined based on a previous study that used a similar procedure ([Paulus, 2016](#)). Six children were excluded from the analyses because of errors in recording data ($n = 1$) or refusing or being unable to identify the names of friends and other peers ($n = 5$). All children were recruited from urban kindergartens in Japan, were not suffering from mental or neurological disorders, and had Japanese as their first language. This study was approved by the ethics committee of Kyoto University (No. 26-P-27). Informed written consent was obtained from the parents of all the participants.

Procedure

The experiment was conducted individually in a quiet room in the kindergartens. The children's responses were videotaped and recorded in real time by an experiment assistant. Following an established protocol ([Moore, 2009](#)), children were first prompted to think of a child in their class with whom they often played (friend) and a child in their class with whom they rarely played (peer). Children were asked to draw the friend and peer from memory. Next, they were shown a photograph of a sex-matched child who was a stranger and were asked to draw a picture of him or her. Each drawing

was made on a different 10 × 14-cm card with color pencils. These drawings were used to indicate the recipients of the allocation games (explained in the following paragraph). Before the games started, the children were asked to identify the person in each drawing by name. All children in the final sample answered the questions correctly.

In the allocation games, children were asked to choose how to allocate colored stickers based on two alternatives. They were given one white tray to keep on their table to save their stickers, and three trays were placed on the opposite side. The pictures of their allocation partners (friend/peer/stranger) were attached to each tray, and their stickers were saved in their respective trays.

Two types of games were administered: a prosocial game and a sharing game (Fehr et al., 2008; House, Henrich, Brosnan, & Silk, 2012). In the prosocial game, children chose their allocation method from two alternatives: 1:1 (1 for themselves and 1 for the partner) and 1:0 (1 for themselves and 0 for the partner). In the sharing game, children chose their allocation method from two alternatives: 1:1 and 2:0. The alternatives were shown to participants using two laminated cards in which two circles were drawn. In each trial, the children were first asked to state which alternative the partner would choose if he or she played (partner question) to make them conscious of recipients' prosociality before their own allocation. In the prosocial game, for example, the experimenter asked, "If [name of friend/peer/stranger] had a chance to choose how to share, which alternative would he/she choose? One for himself/herself and zero for you or one for himself/herself and one for you?" The children pointed at the card showing the alternatives to respond. After the partner question, they were asked to choose their own alternative (own behavior). In the sharing game, for example, the experimenter said, "What would you like to do? Two for you and zero for him/her or one for you and one for him/her?" The participants responded by pointing at the card. After that, children distributed the stickers to each tray according to their own choice. Then, the experimenter provided new stickers for the next trial with different colors or figures from the previous trial. Two trials were conducted for each condition.

The choice test was a 3 (Partner Type: friend, peer, or stranger) × 2 (Game Type: prosocial or share) within-participant design, and every child was presented with 2 trials for each of the six conditions. Therefore, a total of 12 trials were conducted for each child. The responses to the partner question and the own behavior question in all games were recorded, and we computed the ratios of choosing 1:1 out of 2 trials for both the partner question and own behavior question in each condition. The order of presentation of the partner and game type were counterbalanced across participants.

Statistical analyses

All statistical analyses were conducted using R statistical software (Version 3.2.5; R Core Team, 2016). To determine the factors that predicted children's expectation in the partner question and choice in their own behavior, the data were analyzed with generalized linear mixed-effect models (GLMMs) using the *lme4* software package (Bates, Maechler, Bolker, & Walker, 2015).

Results

Figs. 1 and 2 show the descriptive data for each game and question. We first analyzed the predictive factors that explained children's expectation in the partner question using GLMM analyses for each game. The GLMMs for each type of game were computed separately. The ratio of expecting 1:1 out of 2 trials was included in the models as the dependent variable using binomial distribution with logit link. The age group (3.5–4 years or 5–6 years), partner's identity (friend, peer, or stranger), and their interaction were included in the models as independent variables. Participant identification (child ID) was included as a random effect to account for within-participant measures. For the prosocial game, only the effect of age group was significant (*Estimate* = 1.13, *SE* = 0.55, *z* = 2.05, *p* = .04), which means that children aged 5 and 6 years were more likely to expect 1:1 than those aged 3.5 and 4 years. There were no significant effects of partner identity or the interaction between the partner and the age group. For the sharing game, none of the factors predicted the children's expectations significantly.

Next, GLMMs on the own behavior question were computed to determine the predictive factors of the children's responses in the own behavior. The dependent variable was the ratio of choosing 1:1 out of 2 trials in the own behavior question, and participant identification (child ID) was included as a random effect to account for the within-participant measures. As possible predictors, age group, partner's iden-

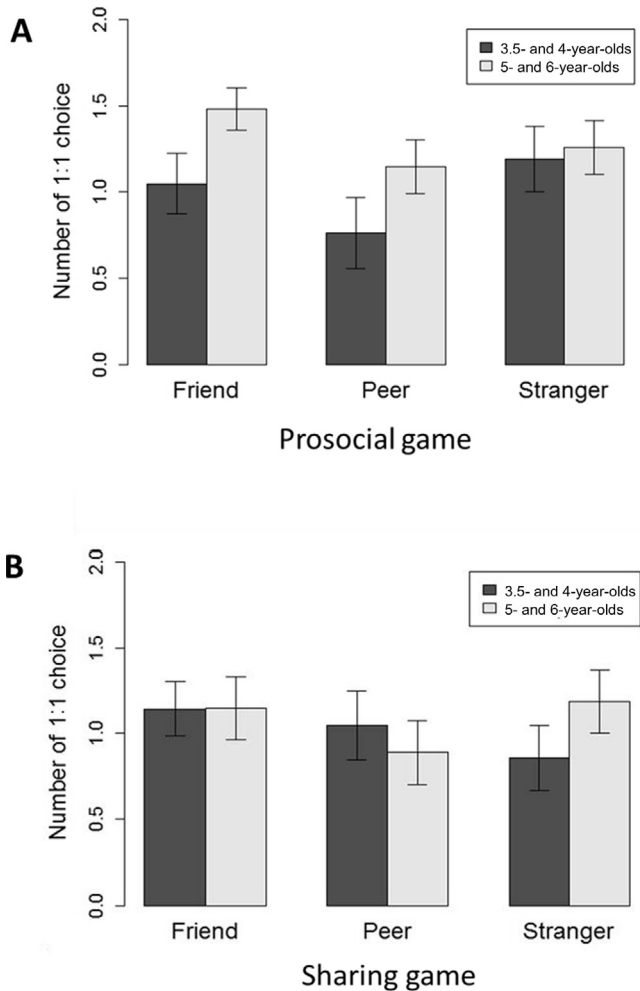


Fig. 1. Mean numbers of trials in which children expected 1:1 in the partner question in the prosocial and sharing games: (A) prosocial game; (B) sharing game. Error bars represent standard errors.

tity, the response to the partner question for each partner, and all their first-order interactions were included in the analyses. Hence, there were many possible variables, and the final model was determined based on the forward stepwise model selection based on the Akaike information criterion (AIC).

Table 1 shows the final model for the prosocial game. The model including the interaction between age and expectation in the partner question improved data fit ($AIC = 316.2$) compared with the null model ($AIC = 344.5$). The main effect of age group ($Estimate = 1.71$, $SE = 0.57$, $z = 3.01$, $p = .003$) and the interaction between age and expectation ($Estimate = -3.63$, $SE = 0.79$, $z = -4.58$, $p < .001$) significantly predicted the children's own choice. The main effect of expectation in the partner question was not significant. The significant effect of age group indicates that children aged 5 and 6 years were more likely to choose 1:1 than those aged 3.5 and 4 years. In terms of the interaction between age group and the partner question, we used a generalized linear model (GLM) for each age group to examine the difference of the effect of the partner question in the two age groups. The ratio of choosing 1:1 in the own behavior question was the dependent variable using binomial distribution with logit link, and the ratio of expecting 1:1 in the partner question was the independent variable. In children aged 3.5 and 4 years, we could not find a clear relationship between the children's response to

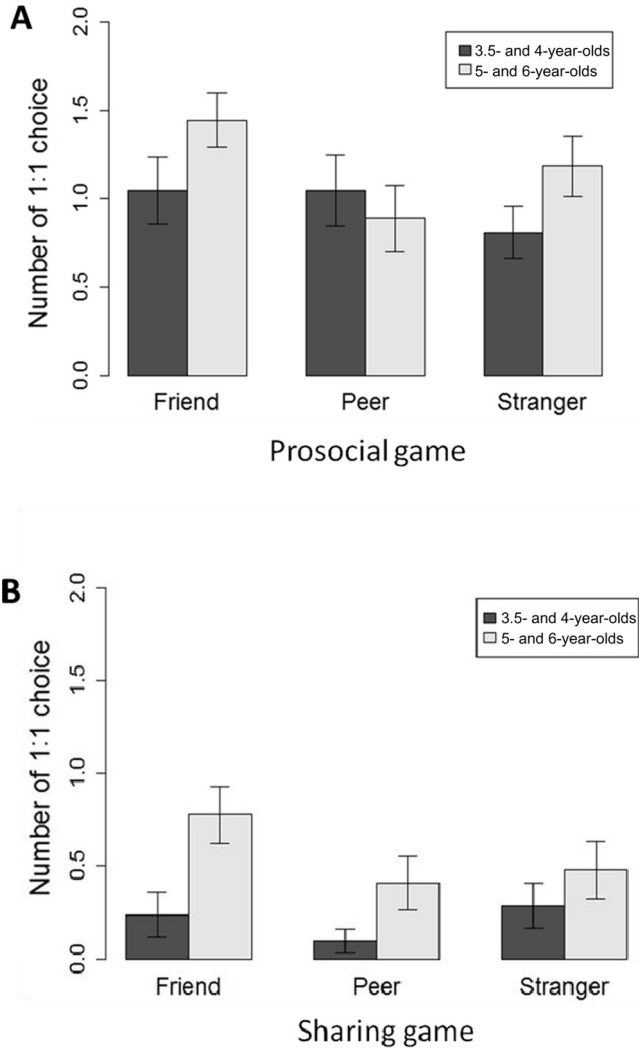


Fig. 2. Mean numbers of trials in which children chose 1:1 in the own behavior question in the prosocial and sharing games: (A) prosocial game; (B) sharing game. Error bars represent standard errors.

Table 1

Final model for children's choice in the own behavior question in the prosocial game.

Factor	Estimate	SE	z Value	Pr
Age group	1.71	0.57	3.01	.003**
Expectation in partner question	0.69	0.49	1.40	.16
Age Group × Expectation	−3.63	0.79	−4.58	<.001***
Random effect (child ID)	−0.27	0.36	−0.77	.44

** $p < .01$.

*** $p < .001$.

the partner question and their own behavior question ($Estimate = -0.42$, $SE = 0.41$, $z = -1.02$, $p = .31$) (see Fig. 3A). On the other hand, in children aged 5 and 6 years, those who expected 1:1 in the partner question tended to choose 1:1 in the own behavior question ($Estimate = 2.61$, $SE = 0.50$, $z = 5.23$, $p < .001$) (Fig. 3B).

The final model for the sharing game is shown in Table 2. In the first step, the model that includes the interaction between age group and the partner question improved data fit ($AIC = 197.3$) compared with the null model ($AIC = 204.9$). In the second step, including the main effect of the partner's identity further improved the model ($AIC = 193.0$). The final model showed a significant main effect of partner (peer: $Estimate = -1.48$, $SE = 0.56$, $z = -2.65$, $p = .008$) and interaction between age group and expectation ($Estimate = 3.87$, $SE = 1.58$, $z = 2.44$, $p = .014$). The main effect of partner indicates that the ratio of choosing 1:1 was smaller when the partner was a peer ($M = .48$, $SD = .30$) compared with a friend ($M = .64$, $SD = .37$) or stranger ($M = .51$, $SD = .35$). In terms of the interaction between age group and the partner question, GLMs for each age group were conducted separately to examine the difference of the effect of partner question in the two age groups. In children aged 3.5 and 4 years, there was no significant relationship between the children's response to the partner question and the own behavior

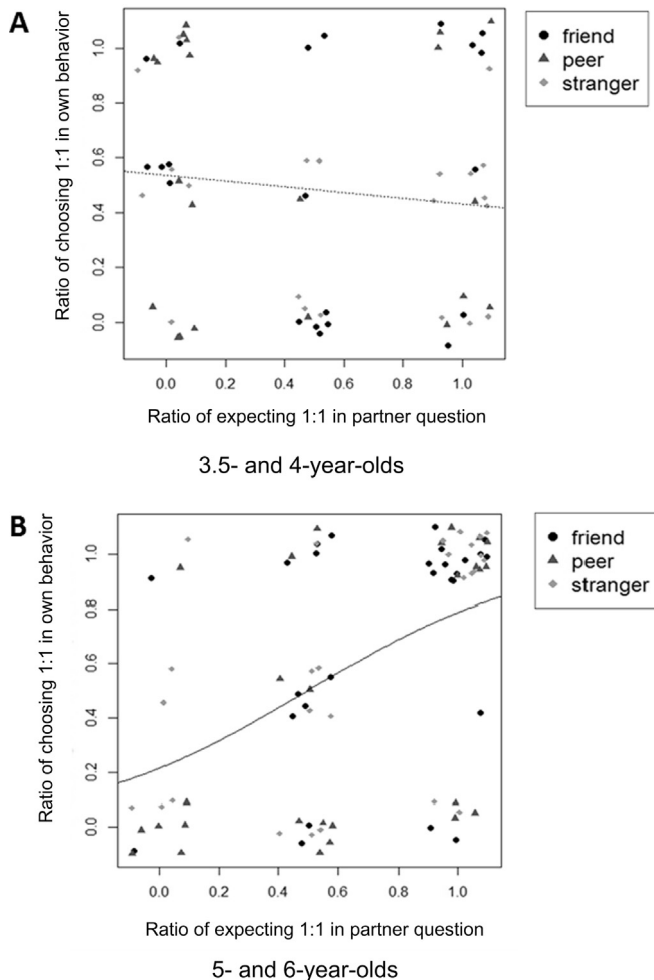


Fig. 3. Relationship between responses to the partner question and the own behavior question in the prosocial game: (A) 3.5- and 4-year-olds; (B) 5- and 6-year-olds.

Table 2

Final model for children's choice in the own behavior question in the sharing game.

Factor	Estimate	SE	z Value	Pr
Age group	-0.29	1.20	-0.24	.81
Partner (peer)	-1.48	0.56	-2.65	.008**
Partner (stranger)	-0.92	0.50	-1.83	.07
Expectation in partner question	-1.73	1.22	-1.42	.16
Age Group × Expectation	3.87	1.58	2.44	.014**
Random effect (child ID)	-2.09	0.98	-2.14	.03 [*]

^{*} $p < .05$.

^{**} $p < .01$.

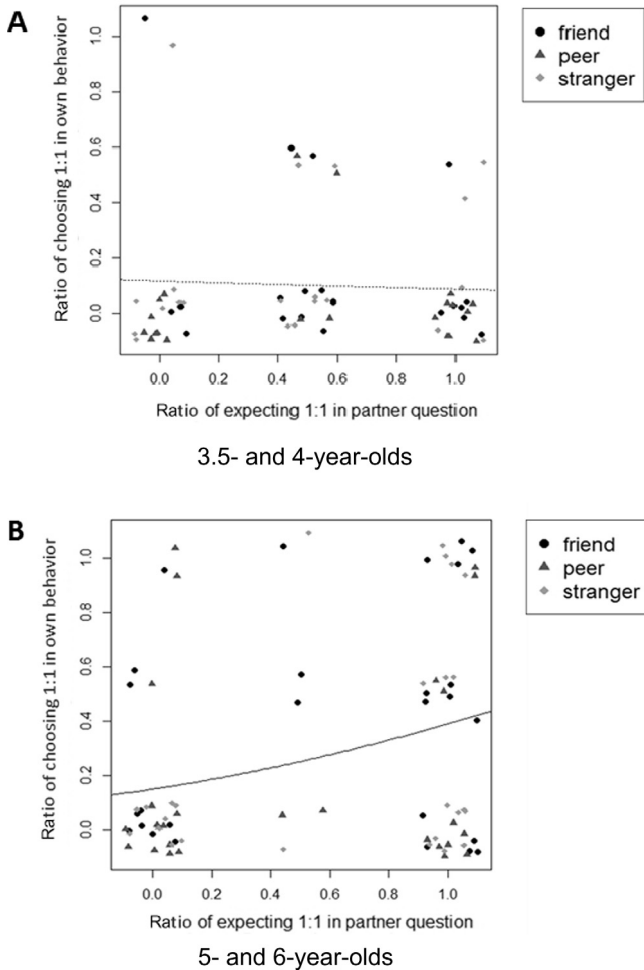


Fig. 4. Relationship between responses to the partner question and the own behavior question in the sharing game: (A) 3.5- and 4-year-olds; (B) 5- and 6-year-olds.

question ($Estimate = -0.32, SE = 0.73, z = -0.44, p = .66$) (see Fig. 4A). In children aged 5 and 6 years, those who expected 1:1 in the partner question tended to choose 1:1 in the own behavior question ($Estimate = 1.29, SE = 0.41, z = 3.16, p = .002$) (Fig. 4B).

Discussion

Our findings indicated that in the prosocial game, the effects of expectations about recipients' allocation on children's own allocation were different for the two age groups. Children aged 5 and 6 years tended to choose an equal allocation for individuals who they expected would reciprocate the prosociality. On the other hand, in children aged 3.5 and 4 years, expectations about recipients' allocation did not significantly predict their own allocation. The result of the sharing game was similar to that of the prosocial game; hence, age influenced expectations about recipients' allocation. In children aged 3.5 and 4 years, expectations of the recipients' allocation did not predict their decisions, whereas children aged 5 and 6 years were more likely to choose equal allocation when they expected an equal allocation by the recipients.

These results suggest that reciprocal allocation based on expectations about recipients' prosociality might be acquired between 4 and 5 years of age. Studies have shown that reciprocal allocation based on previous allocation by the recipients is acquired at around 5 years (House et al., 2013; Sebastián-Enesco & Warneken, 2015). Our results suggest that reciprocity based on this expectation might also be acquired during the same period.

The noticeable difference between the prosocial game and the sharing game was the ratio of choosing equal allocation. In the prosocial game, the ratio of choosing 1:1 was much larger than in the sharing game. In the prosocial game, the children did not need to consider their own gains because they could get the same number of stickers regardless of the alternatives they chose. On the other hand, they needed to take their self-interest into account in the sharing game. Previous research has repeatedly revealed that resource allocations of preschoolers were strongly affected by their self-interest (e.g., Blake, McAuliffe, & Warneken, 2014; Blake & Rand, 2010; Kogut, 2012; Smith, Blake, & Harris, 2013). Children might choose the selfish alternative more often in the sharing game than in the prosocial game for this reason.

Burkart and Rueth (2013) pointed out that the prosocial game entails higher attentional demands compared with the sharing game, and this lowers the performance of young children in the prosocial game. According to these authors, children may choose the way of allocation less carefully in the prosocial game than in the sharing game because their own gains are the same between the two alternatives in the prosocial game. However, the children in Study 1 were more likely to choose equal allocation in the prosocial game than in the sharing game. This result suggests that children paid attention to both the recipients' gains and their own gains when they decided their way of allocation not only in the sharing game but also in the prosocial game. Moreover, the effect of expectation and its developmental change was consistent between the two allocation tasks. Thus, the prosocial game worked as the sharing game in terms of the effect of expectations in the current study.

Study 2

The purpose of Study 2 was to investigate the developmental relationship between future thinking and selectivity in resource allocation. We focused on children aged 5 and 6 years because the effect of expectations and social relationship with the recipients on children's own behavior were observed only in 5- and 6-year-olds in Study 1. Among the facets of future thinking, we focused on two facets: delay of gratification and mental time travel.

Delay of gratification may relate to selective allocation through the process of controlling children's own behavior for future gains. It includes aspects of both future thinking and inhibition. Previous studies have shown that the ability of delay of gratification relates to costly sharing in preschoolers. For example, Moore, Barresi, and Thompson (1998) showed that delay of gratification and performance in a costly allocation task, which is very similar to the sharing game, were positively correlated in 3- and 4.5-year-olds. Moreover, Garon et al. (2011) revealed a positive correlation between delay of gratification and selectivity in costly resource sharing. Costly sharing tasks demand higher ability to inhibit self-interest. Thus, this relationship can be explained by inhibition of self-interest rather than by future thinking. To clarify whether the relationship between delay of gratification and allocation is based on the aspect of future thinking or only on inhibition, it is necessary to examine the relationship

between delay of gratification and non-costly allocation, which does not demand inhibition of self-interest. If we find a relationship between selectivity in non-costly allocation and delay of gratification, it will indicate that the aspect of future thinking in delay of gratification is related to selective allocation. Thus, we focused on the relationship between delay of gratification and the non-costly prosocial game in Study 2.

The ability of mental time travel might be related to selective allocation depending on friendship because it enables children to imagine the future interaction with recipients. To our knowledge, no study has investigated the developmental relationship between mental time travel and selectivity in resource allocation. Thus, we conducted a task measuring delay of gratification and mental time travel and investigated its relationship with the allocation task.

Method

Participants

The final sample consisted of 31 children aged 5 and 6 years to match the age group of Study 1 (20 boys and 11 girls; $M = 68.5$ months, $SD = 5.71$, range = 58–78). Two children were excluded from the analyses because they either refused or were unable to identify their friends or other peers. All children were recruited from urban kindergartens in Japan, were not suffering from mental or neurological disorders, and had Japanese as their first language. Informed written consent was obtained from the parents of all the participants.

Procedure

The experiment was conducted individually in a quiet room of kindergartens and took about 20–30 min for each child. The order of tasks was fixed for all children: (1) picture book task (Atance & Meltzoff, 2005), (2) delay of gratification task (Thompson, Barresi, & Moore, 1997), and (3) resource allocation task (Moore, 2009). All sessions were videotaped, and responses for each task were recorded by an experiment assistant simultaneously.

Picture book task. This task is used to measure children's mental time travel ability (Atance & Meltzoff, 2005). This task seems to be appropriate to measure individual differences because the range of possible values is larger compared with the other tasks such as the two-room task (Suddendorf, Nielsen, & von Gehlen, 2011) or interview task (Busby & Suddendorf, 2005).

Children were presented with the following six photographs: a desert, a rocky stream surrounded by a forest, a long dirt road bordered by trees, snow-covered mountains with trees, a mountain surrounded by fresh verdure, and a waterfall. After describing what they saw in the photograph, children were asked to imagine a scenario in which they were at that location. After this, the experimenter presented three cards for each photograph and said, "Which one of these would you want to take with you?" The three items consisted of one correct item, one semantic associate item, and one distracter. The items for each photograph were as follows: Band-Aids, fish, and a pillow for the stream; sunglasses, a shell, and soap for the desert; water, a plant, and a present for the road; a winter coat, an ice cube, and a bathing suit for the snow; a lunchbox, sticks, and a bowl for the mountain; and a raincoat, a rock, and a coin for the waterfall. In the stream scenario, for example, the correct item is Band-Aids, the semantic associate is fish, and the distracter is pillow. Children received a score of 1 for each correct item choice (i.e., Band-Aids, sunglasses, water, winter coat, lunchbox, and raincoat, respectively).

Delay of gratification task. As a measurement of delay of gratification, the choice task (Thompson et al., 1997) was used. In this task, children were asked to choose either small immediate rewards or bigger delayed rewards. This task was selected because previous research has shown the relationship between this task and resource allocation in preschoolers (Garon et al., 2011; Moore et al., 1998).

As a warm-up, children were given one small colored sticker and a card. The experimenter told them to attach the sticker to the card. After that, children were shown a set of trays. There was one sticker in one tray and two stickers in the other tray. The experimenter explained that if children chose the tray with one sticker, they could receive and use the sticker immediately, but if they chose the tray with two stickers, they could use the stickers only at the end of the experiment. After this explanation,

the children were asked to choose one of the trays over nine trials. Three types of sticker (star, flower, and animal) were used, and three trials were conducted for each type of sticker. The order of the sticker types provided to children was counterbalanced across the participants. Children received a score of 1 for choosing the delayed reward.

Resource allocation task. The resource allocation task was the same as in Study 1 with slight modifications. First, we conducted only the prosocial game and not the sharing game because our aim was to investigate the relationship between future thinking and selective allocation, which does not require inhibition. Furthermore, because children were asked to do two future thinking tasks in addition to the allocation task, we needed to reduce their burden. Second, we considered only friends and peers because the findings from Study 1 showed that the difference between the friend and the peer was the most salient. Third, the number of trials was changed; all children completed four trials for each partner. Similar to Study 1, children were asked about their expectation of the recipients' allocation to themselves (partner question) and their own behavior.

Statistical analysis

As in Study 1, all statistical analyses were conducted using R statistical software, and the *lme4* software package was used for GLMM analyses.

Results

Future thinking

We first report the results of mental time travel and delayed gratification. The score of the mental time travel task ($M = 4.26$, $SD = 1.61$) was significantly correlated with the participant's age (Spearman's $\rho = .40$, $p < .01$). The correlation between the score on the delay of gratification task ($M = 3.84$, $SD = 3.18$) and the participant's age was marginally significant (Spearman's $\rho = .22$, $p = .09$). To examine the relationship between mental time travel and delayed gratification, a partial correlation test controlling for age effects was computed. Consistent with previous research (Atance & Jackson, 2009), the result showed no significant correlation between these two aspects of future thinking (Spearman's $\rho = -.13$, $p = .33$). Because there was no correlation between the two aspects, we treated them separately in the following analyses.

Resource allocation

We used the GLMM to detect the factors that predicted children's choice in the own behavior question. In the GLMM, the ratio of choosing 1:1 was included as the dependent variable using a binomial distribution with logit link. As possible predictors, partner's identity (friend or peer), response to the partner question for each partner, mental time travel, delayed gratification, and all the first-order interactions were included. Participant identification (child ID) was included as a random effect to account for within-participant measures. The final model was determined using a forward stepwise model selection based on the AIC.

In the first step, the model including the interaction between the partner's identity and mental time travel improved data fit ($AIC = 177.8$) compared with the null model ($AIC = 196.0$). In the second step, including the main effect of the partner question improved the model ($AIC = 175.9$). Thus, the model that included the partner question and interaction between partner's identity and mental time travel was selected as the final model. The final model is shown in Table 3. The significant effect of the partner's identity shows that children were more likely to choose 1:1 when the partner was a friend ($Estimate = 3.57$, $SE = 1.17$, $z = 3.04$, $p = .001$). Consistent with Study 1, the effect of expectation was significant ($Estimate = 0.48$, $SE = 0.24$, $z = 1.99$, $p = .047$), which indicates that children who expected 1:1 in the partner question tended to choose 1:1 in the own behavior question. The final model also included a significant interaction between partner's identity and mental time travel ($Estimate = -0.98$, $SE = 0.26$, $z = -3.75$, $p < .001$). GLMs for each partner were computed to examine differences in the effect of mental time travel between the two partners. The results showed that when the partner was a friend, children who had higher scores on the mental time travel task were more likely to choose 1:1 in the own behavior question ($Estimate = 0.32$, $SE = 0.13$, $z = 2.57$, $p = .001$) (see Fig. 5A). On the

Table 3

Final model for children's choice in the own behavior question in the allocation task.

Factor	Estimate	SE	z Value	Pr
Partner	3.57	1.17	3.04	.001**
Expectation of partner question	0.48	0.24	1.99	.047*
Mental time travel	0.45	0.29	1.54	.12
Partner × Mental Time Travel	-0.98	0.26	-3.75	< .001***
Random effect (child ID)	-1.74	1.40	-1.24	.22

* $p < .05$.
 ** $p < .01$.
 *** $p < .001$.

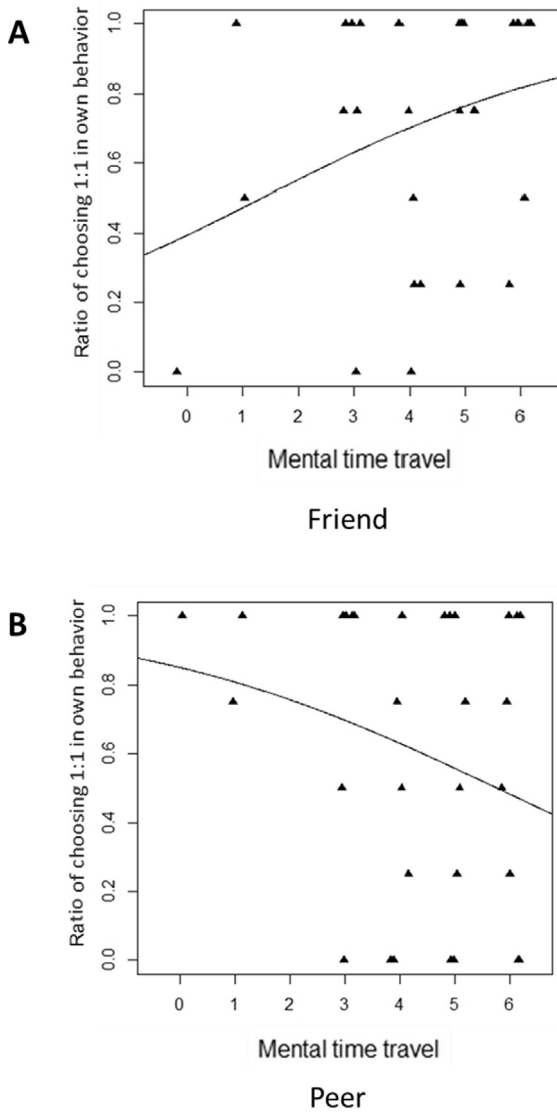


Fig. 5. Relationship between mental time travel and children's choice of own behavior question for each partner: (A) friend; (B) peer.

other hand, children who had higher scores on the mental time travel task were less likely to choose 1:1 alternatives when the partner was a peer ($Estimate = -0.30, SE = 0.13, z = -2.30, p = .002$) (Fig. 5B).

Discussion

Consistent with the results of Study 1, children aged 5 and 6 years decided how to allocate resources based on the expectation of recipients' prosociality. They tended to choose equal allocation for recipients who they expected to be prosocial. Friendship also predicted children's choice of allocation, and children were more generous to their friends than to peers. This effect of friendship was consistent with previous research (Lu & Chang, 2016; Moore, 2009; Paulus & Moore, 2014).

The main finding of Study 2 was that mental time travel was significantly related to selective allocation depending on friendship. Children who had a higher mental time travel ability were more likely to choose equal allocation for friends and less likely to choose it for peers. Mental time travel includes the ability to imagine future events. Therefore, one possible explanation about their relationship is that imagining future interaction with the recipients affected the selective allocation. That is, children with higher mental time travel ability imagined what would happen if they did or did not allocate resources to their friends or peers, and this imagination of the future may have led them to allocate resources to friends to maintain a good relationship with them.

There is another possibility about the relationship. Mental time travel includes not only the ability to imagine future events but also the ability to reconstruct personal events from the past (Suddendorf & Corballis, 1997), and these two abilities develop together (Busby & Suddendorf, 2005; Suddendorf, 2010). Furthermore, the recipients of Study 2 (i.e., friends and peers) were classmates of participants, and the participants had interacted with them. Children who had a higher mental time travel ability might be able to consider not only future interactions but also past experiences with the recipients such as whether they had received prosociality from the recipients. Thus, it is also possible that the relationship between mental time travel and selective allocation is mediated by participants' memories of the recipients rather than expectations of the future.

Unlike mental time travel, we could not find any significant relationship between delay of gratification and selectivity in resource allocation. We also could not find an effect of delay of gratification on children's choice of allocation even though previous research has shown a positive correlation between delay of gratification and sharing (Moore et al., 1998; Sebastián-Enesco & Warneken, 2015). Delay of gratification includes the ability to inhibit immediate desire. The sharing task used in these studies required children to inhibit their immediate self-interest. On the other hand, we conducted a non-costly prosocial game in this study. The absence of the process of inhibition, thus, might be why there was no significant relationship between delay of gratification and children's allocation in this study. Our result suggests that the relationship between delay of gratification and resource allocation, which was shown in previous research, might be mediated by the inhibition of current self-interest rather than future-oriented thinking. An experiment that compares costly and non-costly situations may clarify how delay of gratification and resource allocation are related.

General discussion

The results of Studies 1 and 2 consistently showed that children aged 5 and 6 years decided how to allocate resources based on expectations of recipients' prosociality to themselves. Previous studies have revealed that children of this age group allocate more resources to individuals who had allocated resources to them (e.g., House et al., 2013). Findings of the current study indicate that children aged 5 and 6 years decide their sharing way based not only on their experience of having received allocation but also on expectations about recipients' allocation toward them. In the current study, children were asked to state their expectation about recipients' allocation to themselves before their own allocation. This procedure might make them strongly conscious of recipients' prosociality. Reciprocal allocation in previous studies (e.g., House et al., 2013) could explain selectivity only toward individuals who participants had interacted with in the past. On the other hand, expectation-based reciprocity could explain selectivity to individuals who they had not interacted with in the past. Previous research

has shown that 5-year-old children selectively allocate resources depending on social relationships such as in-groups they belong to even if they have had no interaction (e.g., Dunham et al., 2011). Future research about the relationship between such kinds of selectivity and expectation-based reciprocity may help our understanding about the role of expectation of recipients' prosociality on selective allocation in preschoolers.

The participants in this study had interacted with their friends and peers. Therefore, there is a possibility that their allocations were affected by their experience. For example, they might have experiences of prosociality or aggression with friends and peers, which might have affected their allocation decision. Even though the experience of the interaction affected children's allocation, previous studies (e.g., House et al., 2013) have shown the effect of recipients' allocation just before their own allocation. On the other hand, the current study implies that experiences of interaction with the recipients in children's daily life rather than just before the allocation may affect their allocation.

Study 2 examined the relationship between mental time travel and selectivity based on friendship. To the best of our knowledge, this is the first study to reveal the developmental relationship between mental time travel and selective resource allocation. This relationship between mental time travel and selective allocation can be interpreted by two facets of mental time travel: imagining the future and reconstructing a past event. The ability to imagine future events might enable children to imagine what would happen as a result of their allocation. This imagination might motivate them to selectively allocate to their friends rather than to peers in order to maintain a good relationship with friends in the future. On the other hand, the ability to reconstruct a past event can also lead to selective allocation. Because they had experienced interaction with the recipients in the past, they might decide how to allocate resources depending on their memory of it. For example, they selectively allocate to friends based on their memory that they had received prosocial behavior from the friends. To detect which aspect of mental time travel affected children's allocation, further research is needed.

The results of Studies 1 and 2 also showed that resource allocation of children aged 5 and 6 years was affected by the social relationship with the recipients. Specifically, they were more generous to their friends than to peers, which is consistent with many recent studies (e.g., Lu & Chang, 2016; Moore, 2009; Paulus & Moore, 2014). On the other hand, several studies showed different results about the relationship between friendship and resource allocation. For example, Staub and Noerenberg (1981) showed that elementary school students share more resources with their acquaintances than with friends. These studies suggest that there might be a developmental change of the effect of friendship between the preschool and elementary school periods.

The current study has several limitations. First, we measured children's expectations about recipients' prosociality only with expectations of resource allocation. In theories of reciprocity, various types of prosocial behavior can be exchanged. Observational studies have shown that preschoolers can exchange different types of prosocial behavior such as helping and sharing (Fujisawa et al., 2008; Kato-Shimizu, Onishi, Kanazawa, & Hinobayashi, 2013). However, whether expectations of other types of prosocial behavior affect preschoolers' resource allocation or not remains unclear. If children consider expectations of other types of prosocial behavior, such as helping and comforting, while allocating resources, it will provide more powerful evidence of expectation-based reciprocity in preschoolers.

Second, the relationship between mental time travel and selectivity based on friendship, which was shown in Study 2, does not imply causality between them. For example, there is a possibility that a third variable, such as general intelligence, relates to both mental time travel and selectivity in resource allocation. Thus, we need to be careful in interpreting this result. Future research that requires children to imagine specific interactions with the recipients will be needed to reveal the role of the future aspect of mental time travel on selective allocation in preschoolers. For instance, an experiment that asks children to allocate resources to someone who has a chance to either reciprocate or not might be beneficial.

In sum, the current study demonstrated that children aged 5 and 6 years decide how to allocate resources based on expectations about recipients' prosociality and their social relationship with them. Moreover, children with a higher mental time travel ability tend to allocate resources selectively based on social relationship. These findings suggest that the reconstructed past and expected future interaction with the recipients may lead to selective resource allocation in preschoolers.

Acknowledgments

We thank the children and teachers of the kindergarten. We also thank Kotone Kan, Asami Shinohara, and Yosuke Naruto for support during data collection and thank Yasuhiro Kanakogi for advice. This work was supported by a Ministry of Education, Culture, Sports, Science and Technology – Japan Grant-in-Aid for Scientific Research on Innovative Areas, “Constructive Developmental Science,” to Masako Myowa-Yamakoshi (No. 24119005), Japan Society for the Promotion of Science Grant-in-Aid for Research Activity Start-up to Yuto Kumaki (No. 17H06921), and by the Mayekawa Foundation to Masako Myowa-Yamakoshi and Yuto Kumaki (2015–2017).

References

- Atance, C. M., & Jackson, L. K. (2009). The development and coherence of future-oriented behaviors during the preschool years. *Journal of Experimental Child Psychology*, *102*, 379–391.
- Atance, C. M., & Meltzoff, A. N. (2005). My future self: Young children's ability to anticipate and explain future states. *Cognitive Development*, *20*, 341–361.
- Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*, 1–48.
- Berndt, T. J. (1981). Effects of friendship on prosocial intentions and behavior. *Child Development*, *52*, 636–643.
- Birch, L. L., & Billman, J. (1986). Preschool children's food sharing with friends and acquaintances. *Child Development*, *57*, 387–395.
- Blake, P. R., McAuliffe, K., & Warneken, F. (2014). The developmental origins of fairness: The knowledge–behavior gap. *Trends in Cognitive Sciences*, *18*, 559–561.
- Blake, P. R., & Rand, D. G. (2010). Currency value moderates equity preference among young children. *Evolution and Human Behavior*, *31*, 210–218.
- Brownell, C. A., Svetlova, M., & Nichols, S. (2009). To share or not to share: When do toddlers respond to another's needs? *Infancy*, *14*, 117–130.
- Burkart, J. M., & Rueth, K. (2013). Preschool children fail primate prosocial game because of attentional task demands. *PLoS ONE*, *8*(7), e68440.
- Busby, J., & Suddendorf, T. (2005). Recalling yesterday and predicting tomorrow. *Cognitive Development*, *20*, 362–372.
- Dunfield, K., Kuhlmeier, V. A., O'Connell, L., & Kelley, E. (2011). Examining the diversity of prosocial behavior: Helping, sharing, and comforting in infancy. *Infancy*, *16*, 227–247.
- Dunham, Y., Baron, A. S., & Carey, S. (2011). Consequences of “minimal” group affiliations in children. *Child Development*, *82*, 793–811.
- Fehr, E., Bernhard, H., & Rockenbach, B. (2008). Egalitarianism in young children. *Nature*, *454*, 1079–1083.
- Fujisawa, K. K., Kutsukake, N., & Hasegawa, T. (2008). Reciprocity of prosocial behavior in Japanese preschool children. *International Journal of Behavioral Development*, *32*, 89–97.
- Garon, N., Johnson, B., & Steeves, A. (2011). Sharing with others and delaying for the future in preschoolers. *Cognitive Development*, *26*, 383–396.
- House, B. R., Henrich, J., Brosnan, S. F., & Silk, J. B. (2012). The ontogeny of human prosociality: Behavioral experiments with children aged 3–8. *Evolution and Human Behavior*, *33*, 291–308.
- House, B., Henrich, J., Sarnecka, B., & Silk, J. B. (2013). The development of contingent reciprocity in children. *Evolution and Human Behavior*, *34*, 86–93.
- Howes, C. (1983). Patterns of friendship. *Child Development*, *54*, 1041–1053.
- Kato-Shimizu, M., Onishi, K., Kanazawa, T., & Hinobayashi, T. (2013). Preschool children's behavioral tendency toward social indirect reciprocity. *PLoS ONE*, *8*(8), e70915.
- Kenward, B., Hellmer, K., Winter, L. S., & Eriksson, M. (2015). Four-year-olds' strategic allocation of resources: Attempts to elicit reciprocation correlate negatively with spontaneous helping. *Cognition*, *136*, 1–8.
- Kogut, T. (2012). Knowing what I should, doing what I want: From selfishness to inequity aversion in young children's sharing behavior. *Journal of Economic Psychology*, *33*, 226–236.
- Lu, H. J., & Chang, L. (2016). Resource allocation to kin, friends, and strangers by 3- to 6-year-old children. *Journal of Experimental Child Psychology*, *150*, 194–206.
- Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science*, *244*, 933–938.
- Moore, C. (2009). Fairness in children's resource allocation depends on the recipient. *Psychological Science*, *20*, 944–948.
- Moore, C., Barresi, J., & Thompson, D. (1998). The cognitive basis of future-oriented prosocial behavior. *Social Development*, *7*, 199–218.
- Paulus, M. (2016). Friendship trumps neediness: The impact of social relations and others' wealth on preschool children's sharing. *Journal of Experimental Child Psychology*, *146*, 106–120.
- Paulus, M., & Moore, C. (2014). The development of recipient-dependent sharing behavior and sharing expectations in preschool children. *Developmental Psychology*, *50*, 914–921.
- R Core Team (2016). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. <<https://www.R-project.org/>>.
- Renno, M. P., & Shutts, K. (2015). Children's social category-based giving and its correlates: Expectations and preferences. *Developmental Psychology*, *51*, 533–543.
- Rheingold, H. L., Hay, D. F., West, M. J., Rheingold, H. L., Hay, D. F., & West, M. J. (1976). Sharing in the second year of life. *Child Development*, *47*, 1148–1158.

- Sebastián-Enesco, C., Hernández-Lloreda, M. V., & Colmenares, F. (2013). Two and a half-year-old children are prosocial even when their partners are not. *Journal of Experimental Child Psychology*, *116*, 186–198.
- Sebastián-Enesco, C., & Warneken, F. (2015). The shadow of the future: 5-year-olds, but not 3-year-olds, adjust their sharing in anticipation of reciprocation. *Journal of Experimental Child Psychology*, *129*, 40–54.
- Smith, C. E., Blake, P. R., & Harris, P. L. (2013). I should but I won't: Why young children endorse norms of fair sharing but do not follow them. *PLoS ONE*, *8*(3), e59510.
- Staub, E., & Noerenberg, H. (1981). Property rights, deservingness, reciprocity, friendship: The transactional character of children's sharing behavior. *Journal of Personality and Social Psychology*, *40*, 271–289.
- Suddendorf, T. (2010). Linking yesterday and tomorrow: Preschoolers' ability to report temporally displaced events. *British Journal of Developmental Psychology*, *28*, 491–498.
- Suddendorf, T., & Corballis, M. (1997). Mental time travel and the evolution of the human mind. *Genetic, Social, & General Psychology Monographs*, *123*, 133–167.
- Suddendorf, T., Nielsen, M., & von Gehlen, R. (2011). Children's capacity to remember a novel problem and to secure its future solution. *Developmental Science*, *14*, 26–33.
- Suddendorf, T., & Redshaw, J. (2013). The development of mental scenario building and episodic foresight. *Annals of the New York Academy of Sciences*, *1296*, 135–153.
- Thompson, C., Barresi, J., & Moore, C. (1997). The development of future-oriented prudence and altruism in preschoolers. *Cognitive Development*, *12*, 199–212.
- Trivers, R. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology*, *46*, 35–57.
- Xiong, M., Shi, J., Wu, Z., & Zhang, Z. (2016). Five-year-old preschoolers' sharing is influenced by anticipated reciprocation. *Frontiers in Psychology*, *7*. <https://doi.org/10.3389/fpsyg.2016.00460>.