

# How Prospective Direct and Indirect Reciprocity Influence 4- to 6-Year-Old's Sharing

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## Abstract

Although an abundance of evidence support that preschoolers use reciprocity as a reply to others, lesser is known about how they use this strategy in *initiating* social interactions. Aiming to explore this question, the current study focused on two forms of prospective reciprocity, direct and indirect (downstream) reciprocity. Two studies were conducted in which the chance for prospective reciprocity was implicit (study 1) and explicit (study 2). Specifically, 4- to 6-year-olds were asked to share stickers with a non-shown recipient, a shown recipient, or a non-shown recipient while a witness was observing. In study 1, preschoolers did not know whether the shown recipient/witness would interact with them later. In study 2, they knew the shown recipient/witness would be asked to share with them subsequently. Results revealed that, despite the implicit/explicit chance of prospective reciprocity, preschoolers shared more in the prospective direct reciprocity condition than the control/prospective indirect downstream reciprocity conditions. In addition, comparing the two studies found no difference found between the implicit and explicit situations. Overall, these findings indicate that preschoolers have taken direct reciprocity, rather than indirect (downstream) reciprocity in guiding their initial sharing with others. Implications of these findings are further discussed.

**Keywords:** prospective reciprocity, sharing, preschoolers, direct reciprocity, indirect downstream reciprocity

## 1. Introduction

Reciprocity is an essential and relatively unique part of human sociality (e.g., Axelrod & Hamilton, 1981; Fehr & Fischbacher, 2003; Nowak & Sigmund, 2005). It can be further divided into two forms, direct and indirect reciprocity (e.g., Dufwenberg et al., 2001; Kato-Shimizu et al., 2013; Stanca, 2009). While direct reciprocity is important in enabling a bond between two genetically unrelated social members, indirect reciprocity is crucial in enabling large-scale cooperative networks (e.g., Herne et al., 2013; Dufwenberg et al., 2001). Although infants and toddlers intuitively grasp a sense of reciprocity in evaluating others' sharing (e.g., Meristo & Surian, 2013), it is not until the preschool years that individuals apply these strategies in adjusting their own sharing, both in retrospect (Paulus, 2016; Vaish et al., 2018; Warneken & Tomasello, 2013; Wörle et al., 2020), and in prospect (Kenward et al., 2015; Kumaki et al., 2018; Sebastián-Enesco & Warneken, 2015; Warneken et al., 2019; Xiong et al., 2016). Nevertheless, most of the studies focus on direct rather than indirect reciprocity, and fewer have compared preschoolers' performance in direct and indirect ones, leaving it unclear how preschoolers apply both forms of reciprocity in sharing. In addition, while many studies examine the retrospect reciprocity, fewer examine prospect ones (for a review, see Leimgruber, 2018), which is especially important for the *initiation* of reciprocity (e.g., Kenward et al., 2015; Sebastián-Enesco & Warneken, 2015; Warneken et al., 2019). Accordingly, the current study aims to fill these gaps by examining how prospective direct and indirect reciprocity affect preschoolers' sharing with a stranger.

### 1.1 Prospective Direct and Indirect Reciprocity in Sharing

The direct reciprocity occurs between only two individuals (e.g., A shares with B initially, then B shares with A in return), while the indirect reciprocity is more complex and occurs between at least three individuals (e.g., Herne et al., 2013; Dufwenberg et al., 2001). There are three sub-forms of indirect reciprocity (Leimgruber, 2018), (1) downstream (e.g., A shares with B, then C shares with A), (2) upstream (e.g., A shares with B, then B shares with C), and (3) generalized (e.g., A shares with B, and C as a witness of A's behavior, then shares with D). The current study focused on the indirect, downstream reciprocity (e.g., Stanca, 2009), which is crucial to preschooler's social

development (e.g., Engelmann et al., 2013; Kenward & Dahl, 2011; Kumaki et al., 2018; Leimgruber et al., 2012; Nowak & Sigmund, 2005).

Research on retrospective reciprocity revealed that both direct and indirect (downstream) reciprocity mediate preschoolers' sharing (for a review, see Leimgruber, 2018). For instance, 3- to 6-year-olds shared more with the recipient who had shared with them (e.g., Paulus, 2016; Vaish et al., 2018; Warneken & Tomasello, 2013; Wörle et al., 2020), and/or with others (e.g., Kenward & Dahl, 2011; Wörle et al., 2020). The mechanism underneath both forms of reciprocity are partly overlapped, as they both require cognitive abilities to discriminate those who had or had not shared, track the number of resources shared (Schino & Aureli, 2009), and motivations such as affiliation, gratification, and obeying the reciprocity norm (Gouldner, 1960). In addition, indirect (downstream) reciprocity requires the motivations such as rewarding the prosocial members. In summary, preschoolers are cognitively capable, motivated, familiar with, and frequently apply both forms of reciprocity when they respond to others.

Nevertheless, lesser is known about how they apply future-oriented, *prospective* reciprocity in sharing. This is important because preschoolers not only reply to other social members but also frequently *initiate* social interactions (e.g., Sebastián-Enesco & Warneken, 2015). For the mechanisms, the prospective reciprocity requires for additional prerequisites than the retrospective ones. Both the prospective direct reciprocity and prospective indirect (downstream) reciprocity require for the ability to delay gratification (Sebastián-Enesco & Warneken, 2015), and identify the potential social interactions in the future (Axelrod & Hamilton, 1981). In addition, reputation management is the key element of prospective indirect, downstream reciprocity (Nowak & Sigmund, 1998; Engelmann et al., 2013). Around age 5, preschoolers are likely capable of and motivated to use both the prospective direct and indirect (downstream) reciprocity. Specifically, five-year-olds begin to show the general ability to make decisions based on future needs (e.g., Lemmon & Moore, 2007), adjust their behavior according to the possibility of further interactions (e.g., Warneken et al., 2019), and implicitly take part in reputation management in sharing (e.g., Engelmann et al., 2013; Fu et al., 2016; Leimgruber et al., 2012).

Empirically, a few studies supported that prospective direct reciprocity begins to shape preschoolers' sharing at age 5 (Kenward et al., 2015; Kumaki et al., 2018; Sebastián-Enesco & Warneken, 2015; Warneken et al., 2019; Xiong et al., 2016). One of the first studies examined 3- and 5-year-olds' sharing with the specific partner over repeated rounds (Sebastián-Enesco & Warneken, 2015), and found that 5-year-olds, rather than 3-year-olds, took the opportunity for future reciprocity into account. A more recent study compared 3-year-olds' and 5- to 7-year-olds' sharing with the recipient who may choose a partner (between the child and another individual) subsequently to play with (Warneken et al., 2019). Over repeated trials, 5- to 7-year-olds, rather than 3-year-olds, adjust their sharing by favoring the recipient, for the purpose of influencing the partner's choice subsequently. Nevertheless, because preschoolers shared with their partners over repeated rounds in these studies, their sharing was likely based on both retrospective and prospective reciprocity. Accordingly, a further examination of the prospective reciprocity is warranted to address the question of how preschoolers apply these strategies when they initiate social interactions.

### 1.2 The Current Study

The current study aims to explore how preschoolers adjust their sharing based on the anticipation of two specific forms of prospective reciprocity (direct and indirect downstream reciprocity), which have drawn great research attention and could have been grasped by preschoolers during this age. Two studies were planned. In study 1, the opportunity for prospective reciprocity is implicit, as preschoolers were asked to share 5 stickers with a non-shown recipient (control condition), a shown recipient (the recipient-shown condition), or a non-shown recipient and being observed by a third party (the witness-shown condition) but they did not know whether the shown recipient/witness would share with them subsequently or not. Based on theoretical framework of reciprocity (e.g., Axelrod & Hamilton, 1981; Trivers, 1971) and the empirical evidence that comparing preschoolers sharing under direct reciprocity context with no-reciprocity context (Sebastián-Enesco & Warneken, 2015; Warneken et al., 2019), we expected that preschoolers in the recipient-/witness-shown condition would share more than their peers in the control condition, as they might anticipate the recipient or the witness to reciprocate later (Hypotheses 1:  $Mean_{\text{control condition}} < Mean_{\text{recipient-shown condition}}$ ; Hypotheses 2:  $Mean_{\text{control condition}} < Mean_{\text{witness-shown condition}}$ ). However, due to the limited evidence, we did not make a specific hypothesis on the sharing between the recipient-shown and the witness-shown conditions.

In study 2, the opportunity for prospective reciprocity is explicit. Preschoolers were asked again to share with a non-shown recipient (control condition), a shown recipient (the direct reciprocity condition), or a non-shown recipient and being observed by a third party (the indirect downstream reciprocity condition). In addition, they were told explicitly that the shown recipient/witness would share with them subsequently. Following the same

rationales as in study 1, we expected that preschoolers in the direct and indirect, downstream reciprocity condition would share more than their peers in the control condition, and preschoolers in the direct reciprocity condition would share more than their peers in the indirect, downstream reciprocity condition (Hypotheses 3:  $Mean_{\text{control condition}} < Mean_{\text{prospective direct condition}}$ ; Hypotheses 4:  $Mean_{\text{control condition}} < Mean_{\text{prospective indirect, downstream condition}}$ ; Hypotheses 5:  $Mean_{\text{prospective indirect, downstream condition}} < Mean_{\text{prospective direct condition}}$ ).

Moreover, across two studies, we also expected that preschoolers would share more if the chance of reciprocity is explicit than implicit. Namely, preschoolers in the direct reciprocity condition would share more than their peers in the recipient-shown condition, and preschoolers in the indirect (downstream) condition would share more than their peers in the witness-shown condition.

## 2. Study 1, Methods

### 2.1 Participants

A total of 80 4- to 6-year-olds ( $M_{\text{age}} = 62.57$  months,  $SD_{\text{age}} = 8.69$  months, range = 46.33 – 79.33 months, 43 boys) participated in this study. Participants were recruited from a middle-class community in urban Nanjing city, China, and more than 90% of the parents have a bachelor's degree or higher. Written consent forms were collected from all participants' parents, and the study was conducted in the participants' daycare. This study was approved by the ethical committee of biomedical studies at Nanjing Normal University. Before the experiment, participants were randomly assigned to one of the three conditions (control, recipient-shown, and witnesses-shown) by a research assistant who was blind to the research aim. Age and gender were counterbalanced across conditions,  $p_s > .819$ .

### 2.2 Procedure

Each participant was tested individually in a quiet, separate room in the daycare. A female experimenter who was blinded to the research aim conducted the study. In the beginning, the experimenter asked the preschooler to sit alongside the table and introduced two plates. Then she manipulated the condition as stated in the following.

#### 2.2.1 The Manipulation and the Manipulation Check Phase

(a) Control condition. The experimenter told the preschooler that one plate was for the preschooler and another for a recipient who could not be here but also liked the stickers. Next, she brought out 5 stickers, gave them all to the preschooler, and told her/him that these were all hers/his. In addition, she gave instructions on sharing ("if you want, you can leave stickers as many as you like to the *non-shown recipient* by putting the stickers into the plate accordingly"). Then, she asked the following questions to check whether the preschooler understood the condition (a manipulation-check phase), including "Could you point out which plate is yours? Could you point out which plate is the recipient? Whom would you share with?" If the preschooler answered correctly to all the questions, then she moved to the sharing phase. Otherwise, she stated the instruction again and asked the question again. All the participants answered correctly.

(b) Recipient-shown condition. The experimenter told the preschooler that one plate was for the preschooler and another for the recipient (a stuffed animal) who was sitting alongside the table and also liked the stickers. Next, she brought out 5 stickers, gave them all to the preschooler, and told the preschooler that these were all hers/his. In addition, she gave instructions on sharing ("if you want, you can leave stickers as many as you like to the *sitting recipient* by putting the stickers into the plate accordingly"). Then, in the manipulation-check phase, she asked: "Could you point out which plate is yours? Could you point out which plate is the recipient? Whom will you share with? Who is looking at you?" All the participants answered correctly.

(c) Witnesses-shown condition. The experimenter told the preschooler that one plate was for the preschooler and another for another recipient who could not be there but also liked the stickers. Next, she introduced the witness (a stuffed animal). Next, she brought out 5 stickers, gave them all to the preschooler, and told the preschooler that these were all hers/his. In addition, she gave instructions on sharing ("if you want, you can leave stickers as many as you like to the *non-shown recipient* by putting the stickers into the plate accordingly, *while the witness is watching you*"). Again, she asked a series of questions as the same in the recipient-shown condition, and all the participants answered correctly.

#### 2.2.2 The Sharing Phase

After the manipulation checks, the experimenter let the preschooler share the stickers while she was turning her face away from the participant and pretending to look for some objects for the daycare teacher until the preschooler finished sharing. We coded how many stickers the preschoolers shared, ranging from 0 to 5.

### 2.2.3 Coding

Two coders (one coded all and another coded 40% of the participants) who were blind to the research aim coded the data. The inter-rater reliability (Intra-class coefficient) = 1.

## 3. Study 1, Results

The descriptive information is shown in Figure 1. We conducted Bayesian analyses using the R package (R Core Team, 2013) “Bayesian informative hypothesis testing” (Bain: Mulder et al., 2019; Gu et al., 2019; Hoijtink et al., 2019), and using the Bayes factor ( $BF$ ) < 3 as weak support,  $3 \leq BF < 10$  as moderate evidence, and  $BF \geq 10$  as moderate evidence in supporting the chosen hypothesis (van Doorn et al., 2021). The Bayesian analysis is suitable for examining small-sample data (McNeish, 2016). We analyzed the data in the following three parts.

First, we examined our two hypotheses (Hypotheses 1:  $Mean_{\text{control condition}} < Mean_{\text{recipient-shown condition}}$ ; Hypotheses 2:  $Mean_{\text{control condition}} < Mean_{\text{witness-shown condition}}$ ). The results yielded support of H1,  $BF = 347.977$ , but weak evidence supporting H2,  $BF = 0.580$ . Second, we explored the potential difference between the witness-shown and the control/recipient-shown conditions. There was moderate evidence to support that the preschoolers from the witness-shown condition shared a similar number of items as peers from the control condition,  $BF = 5.323$ , and strong evidence that these preschoolers shared less than peers from the recipient-shown condition,  $BF = 1150.003$ .

Follow-up, frequentist analyses. We added frequentist analyses to provide further insight into the current findings. The ANOVA analyses found a main effect of condition,  $F(2, 70) = 7.46$ ,  $p < .001$ ,  $\eta^2_p = 0.176$ . The post hoc analyses showed preschoolers in the recipient-shown conditions shared more than preschoolers from the witness-shown condition, Cohen's  $d = 1.080$ ,  $p < .001$ , and the control condition,  $d = 0.751$ ,  $p = .034$ , while no significant difference was found between the latter two,  $d = 0.329$ ,  $p = .760$ .

## 4. Study 1, Discussion

Consistent with our expectations, 4- to 6-year-olds shared more items when observed by the recipient (the recipient-shown condition), compared with when there was no observer (control condition). Unexpectedly, we failed to find the difference between the control and witness-shown conditions. In addition, preschoolers from the recipient-shown condition shared more with peers who were observed by a third party (the witness-shown condition). Because the role of the witness is unknown to the preschoolers, they may not take the witness into account in adjusting their sharing. Also, the chance for reciprocity is implicit as we did not explicitly inform the preschoolers how many rounds the game would be. In study 2, we addressed these limitations by explicitly stating the role of the witness, and the possibility of prospective reciprocity to the participants.

## 5. Study 2, Methods

### 5.1 Participants

A total of 73 4- to 6-year-olds ( $M_{\text{age}} = 62.89$  months,  $SD_{\text{age}} = 6.26$  months, range = 51.73 – 75.93, 44 boys) participated in this study. Additional 5 preschoolers were initially included, but they failed to complete the study due to fussiness ( $n = 3$ ) and failures in the manipulation check phase ( $n = 2$ ). Participants were recruited the same as in study 1 and were randomly assigned into one of the three conditions (the control, the prospective direct reciprocity, and the prospective indirect (downstream) reciprocity) before the study, with age and gender counterbalancing across three conditions,  $p_s > .953$ .

### 5.2 Procedure

The procedure was largely the same as in study 1, except for the manipulation of the prospective direct reciprocity, and the prospective indirect (downstream) reciprocity condition, which is stated as follows:

#### 5.2.1 The Manipulation and the Manipulation Check Phase

(a) Control condition. same as in study 1.

(b) Prospective direct reciprocity. In addition to the procedure the same as in the recipient-shown condition in study 1, we added the following procedure. After the experimenter gave instructions on sharing, the experimenter found another 5 stickers, and told the preschooler that, after the preschooler made her/his decision, the recipient would make a new decision on how to distribute the extra 5 stickers between the recipient and the preschooler. Then, in the manipulation-check phase, she asked “Could you point out which plate is yours? Could you point out which plate is the recipient? Whom will you share with? Who will make the decision after you?” All the participants answered correctly.

(c) Prospective indirect downstream reciprocity. In addition to the procedure as the same as in the witness-shown condition in study 1, we added the following procedure. After the experimenter gave instructions on sharing, the

experimenter found another 5 stickers and told the preschooler that, after the preschooler made her/his decision, the *witness* would make a new decision on the extra 5 stickers between the witnesses and the preschooler. Then, in the manipulation-check phase, she asked a series of questions as the same in the prospective direct reciprocity condition. Two participants were excluded in this condition.

### 5.2.2 The Sharing Phase

Same as in study 1.

### 5.2.3 Coding

Two coders coded in the same manner as in study 1, ICC = .998.

## 6. Study 2, Results

The descriptive information is shown in Figure 1. We first examined our three hypotheses (Hypotheses 3:  $Mean_{\text{control condition}} < Mean_{\text{prospective direct condition}}$ ; Hypotheses 4:  $Mean_{\text{control condition}} < Mean_{\text{prospective indirect, downstream condition}}$ ; Hypotheses 5:  $Mean_{\text{prospective indirect, downstream condition}} < Mean_{\text{prospective direct condition}}$ ). The results yielded strong evidence in support of H3,  $BF = 210.501$ , weak evidence in support of H4,  $BF = 0.143$ , and strong evidence in support of H5,  $BF = 12284.532$ .

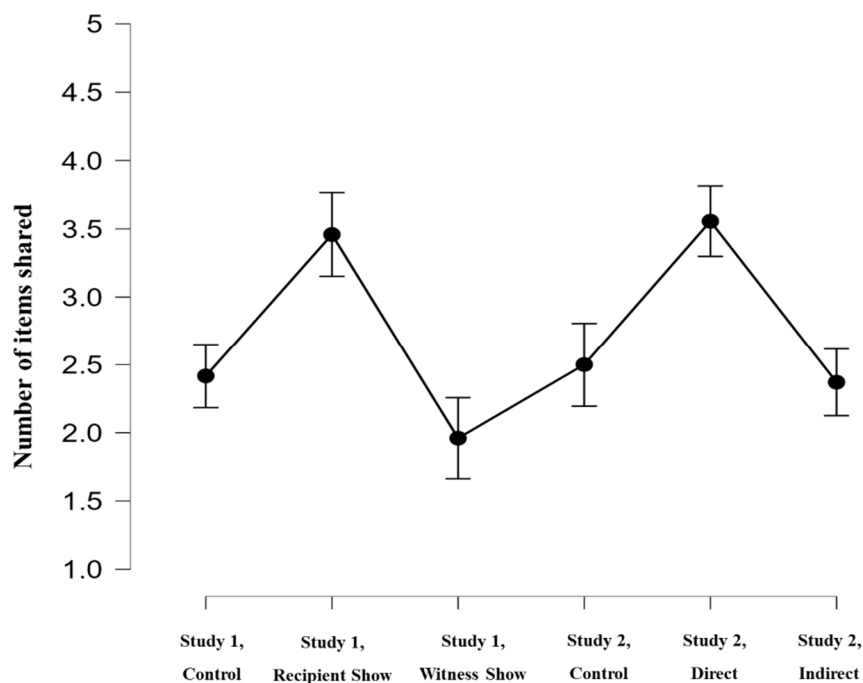


Figure 1. Mean number of Items Shared in Study 1 and 2

*Note.* Error bars indicate standard errors of the means.

Second, we explored the potential difference between the prospective indirect (downstream) condition and the control condition. Moderate evidence was found in support that preschoolers in the control condition shared more items than peers in the prospective indirect, downstream condition,  $BF = 6.985$ . For all other comparisons tested, please see Table 1.

Table 1. Results (BFs) per Set of Model Comparisons in Study 1 and 2

Study 1			Study 2		
	BF. c	PMP a	BF.c	PMP a	
<b>Control &lt; Recipient-shown</b>	<b>347.977</b>	<b>0.047</b>	<b>Control &lt; Prospective direct</b>	<b>210.501</b>	<b>0.023</b>
Control = Recipient-shown	0.124	0.001	Control = Prospective direct	0.185	0.002
Control > Recipient-shown	0.003	<.001	Control > Prospective direct	0.005	<.001
Control < Witness-shown	0.580	0.009	Control < Prospective indirect	0.143	0.003
<b>Control = Witness-shown</b>	<b>5.323</b>	<b>0.063</b>	Control = Prospective indirect	2.801	0.033
Control > Witness-shown	1.723	0.015	<b>Control &gt; Prospective indirect</b>	<b>6.985</b>	<b>0.021</b>
<b>Witness-shown &lt; Recipient-shown</b>	<b>1150.003</b>	<b>0.024</b>	<b>Prospective indirect &lt; Prospective direct</b>	<b>12284.532</b>	<b>0.023</b>
Witness-shown = Recipient-shown	0.042	<.001	Prospective indirect = Prospective direct	0.004	<.001
Witness-shown > Recipient-shown	0.001	<.001	Prospective indirect > Prospective direct	<.001	<.001

Note. BF. c denotes the Bayes factor of the hypothesis at hand versus its complement. PMP a contains the posterior model probabilities of the hypotheses specified. All PMPs are based on equal prior model probabilities. The best model per set of comparisons was shown in bold.

Follow-up, frequentist analyses. The ANOVA analyses found a main effect of condition,  $F(2, 77) = 5.85, p = .004, \eta^2_p = 0.132$ . The post hoc analyses showed preschoolers in the direct reciprocity conditions shared more than preschoolers from the indirect (downstream) reciprocity condition,  $d = 0.851, p = .008$ , and the control condition,  $d = 0.758, p = .022$ , while no significant difference was found between the latter two,  $d = 0.093, p = 1.000$ .

### 6.1 Comparisons between Study 1 and 2

Three sets of comparisons were conducted. First, we compared the results from the control conditions. Evidence revealed moderate support for the lack of difference between the two control conditions,  $BF = 5.352$ , and weak support for the difference between the two control conditions,  $BF_s < 1.403$ , indicating a lack of difference between the two control conditions in study 1 and 2, and further implying the comparability between two studies. Second, we compared sharing in the recipient-shown condition and the prospective direct reciprocity condition. Evidence revealed moderate support for the lack of difference between the recipient shown and direct reciprocity conditions,  $BF_{\text{recipient-shown} = \text{prospective direct}} = 5.353$ , and weak evidence for other comparisons,  $BF_s < 1.490$ . Third, we compared sharing from the witness-shown condition and the prospective indirect (downstream) condition. Evidence revealed moderate support for the lack of difference between the two conditions,  $BF_{\text{witness-shown} = \text{prospective indirect}} = 5.953$ , and moderate to weak evidence to support other comparisons,  $BF_s < 3.171$ . Additionally, the frequentist analyses found no difference between the direct and recipient-shown conditions,  $t(50) = 1.07, p = .289, d = 0.297$ , nor between the indirect and the witness-shown conditions,  $t(49) = 0.24, p = .808, d = 0.069$ . Overall, these findings indicate that preschoolers' sharing was based on the chance of prospective direct reciprocity (rather than indirect ones).

## 7. Study 2, Discussion

Consistent with our expectations, 4- to 6-year-olds shared more when there was a chance of prospective direct reciprocity, compared with when there was no chance (control condition), or a chance of indirect, downstream reciprocity. Nevertheless, and unexpectedly, we failed to find strong evidence to support the difference between the latter two. These findings are consistent with previous studies on prospective direct reciprocity (e.g., Herrmann et al., 2019; Sebastián-Enesco & Warneken, 2015; Warneken et al., 2019). Also, the differences between preschoolers' sharing behavior across forms of prospective reciprocity are consistent with studies in adults (e.g., Stanca, 2009), implying that preschoolers have grasped the perception that the direct recipient is more likely to reciprocate than the third-party observer of the indirect reciprocity. Moreover, the lack of difference between the indirect and control conditions was not in line with the previous study (Engelmann et al., 2013). We further discuss these findings in the following.

## 8. General Discussion

Aiming to examine how preschoolers adjust sharing according to the chance of prospective reciprocity, two studies were conducted in which implicit (study 1) and explicit (study 2) chances were provided. Prospective direct and

indirect (downstream) reciprocity were compared between 4- to 6-year-olds' initial sharing with the stranger. Compared with a non-shown recipient, or a third-party witness, preschoolers shared more with a shown recipient. Also, preschoolers shared more if there was a chance of direct rather than indirect (downstream) reciprocity/no chance.

These findings support the claims that preschoolers are highly sensitive to their environment and may benefit from portraying a generous person in the observer's mind (for a review, see Engelmann & Rapp, 2018). However, the difference between the prospective direct and indirect reciprocity also pinpointed the importance of whom is observing/reciprocating. Similar to adults, preschoolers may expect the possibility of direct reciprocity to be higher than indirect ones (e.g., Dufwenberg et al., 2001; Kato-Shimiz et al., 2013; Stanca, 2009). Also, preschoolers may empathize more with the recipient when they see the recipient present (Leimgruber et al., 2012; Leimgruber, 2018). In addition, although preschoolers engage in both forms of reciprocity in their daily activities (Kato-Shimizu et al., 2013), they may be more familiar with the direct, rather than indirect reciprocity norms (Engelmann & Rapp, 2018; Herrmann et al., 2019; Warneken et al., 2019).

This study also fills in the gap in the literature by focusing on *prospective*, rather than retrospective reciprocity. Prospective reciprocity is more cognitively sophisticated than retrospective ones (Sebastián-Enesco & Warneken, 2015). Combining the findings that retrospective direct, rather than indirect reciprocity affects preschooler's sharing, the practical implication is that educators (parents, daycare teachers) need to encourage preschoolers to engage in retrospective indirect reciprocity (e.g., as a bystander) as the first step to scaffold preschooler's initiation of prospective, indirect reciprocity in daily activities. More specifically, parents may scaffold preschoolers to engage in reciprocity by encouraging them to recall what the recipient had interacted with the preschooler, and also to estimate how the recipient would behave if the preschooler may or may not share with them. Daycare teachers can encourage preschoolers to engage in reciprocity in the class, and once they did, the teacher should use this as good example to other preschoolers. Also, teachers should elaborate on the social norms of reciprocity accordingly. As for the practitioners in Higher Education Institutions and in teacher training programs, it is also important to remind the teacher that preschoolers may not be fully cognitively capable of engaging in indirect prospective reciprocity. Thus, teachers need to provide more cognitive scaffolding in their daily teaching activities.

Unexpectedly, we failed to find the difference between the control and indirect reciprocity conditions. Preschoolers may not recognize the link between the observer's subsequent sharing behavior and the preschooler's initial sharing behavior (Sylwester & Roberts, 2010). However, we did not directly examine this explanation, and more studies are needed to further address it, for instance, by examining preschoolers' level of theory of mind and asking directly about their understanding of how their own behavior may or may not affect observers' behavior. Nevertheless, we used standardized behavioral assessments, which have been widely used in the field and have been proven to have high credibility (Warneken et al., 2019; Xiong et al., 2016). Thus, it is reasonable to assume that the current data showed good validity.

The current study has several limitations. This study did not tease apart preschoolers' general level of prosociality, which may be covariant in the current study. Although we randomly assign preschoolers to conditions and included the control condition in both studies to address this limitation, future studies can directly examine this variable through behavioral tasks, and/or through teacher/parent's reports. Also, we used a puppet as the recipient/third party. This is based on two considerations, (1) it is too challenging to include the preschooler as the experimenter, and (2) adults may present as authoritative, which also affects sharing during this age. Nevertheless, it would be ideal to include peers as the recipient/third party.

## 9. Conclusion

Preschoolers are sensitive to the chance of prospective direct reciprocity, while not to the prospective indirect (downstream) reciprocity, further indicating a low efficiency of building large social interactions towards multiple social members during this age. Nevertheless, preschoolers are actively joining in the establishment of positive, exclusive social relationships during this period, and this could be the first step in building a larger range of social relationships.

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## Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## Declarations of Interest

None.

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