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# Capuchin monkeys judge third-party reciprocity

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ABSTRACT

Increasing interest is being shown in how children develop an understanding of reciprocity in social exchanges and fairness in resource distribution, including social exchanges between third parties. Although there are descriptions of reciprocity on a one-to-one basis in other species, whether nonhumans detect reciprocity and violations of reciprocity between third parties is unknown. Here we show that capuchin monkeys discriminate between humans who reciprocate in a social exchange with others and those who do not. Monkeys more readily accepted food from reciprocators than non-reciprocators or partial reciprocators. However, when exchange asymmetry was due to one partner starting out with fewer goods, the initially impoverished reciprocator was not discriminated against. These results indicate that the cognitive or emotional prerequisites for judging reciprocity in third-party social exchanges exist in at least one other primate species.



## 1. Introduction

Cooperation and a sense of fairness are mainstays of human society. This is reflected in the growing interest in children's developing ability to detect the presence or absence of prosocial behaviors not only in relation to themselves, but also between third parties. In one recent study, after witnessing an adult either helping or "harming" another adult, preschool children were more likely to help a third (neutral) adult than the harmful one (Vaish, Carpenter, & Tomasello, 2010). Even much younger infants show preferences – measured by looking time and explicit choice – for agents that behave prosocially toward others to those that do not (geometric shapes: Hamlin, Wynn, & Bloom, 2007, 2011; animal hand puppets: Hamlin & Wynn, 2011). Fourteen-month-old infants are clearly capable of representing the actions of two people in terms of collaborative goals (Henderson & Woodward, 2011).

One critical constituent of cooperation is the fair distribution of resources; this includes reciprocity in social exchanges. Among adults, violations of reciprocity, for example defaulting on payment owed for goods or services received, may elicit punishment (Fehr & Fischbacher, 2004). People even punish others who are perceived to act unfairly against a third party (Fehr, Fischbacher, & Gachter, 2002; Fehr & Gachter, 2002). School-age children can detect failures to reciprocate in social exchanges between third parties depicted in stories; increased schooling is associated with greater accuracy (Harris, Nunez, & Brett, 2001). Fifteen-month-old infants who observed a scenario in which one person distributed food (crackers) between two receivers looked longer at an unfair outcome than at a fair outcome (Schmidt & Sommerville, 2011). Furthermore, it was shown that infants' sensitivity to violations of fairness was related to the infants' own readiness to share toys either altruistically or selfishly. The authors framed discussion of their findings in terms of the evolutionary emergence of "other-regarding preferences".

A fuller understanding of the evolutionary basis of human prosociality and cooperation requires studies from a phylogenetic perspective. Reciprocity has been described

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in the context of exchanges of resources (e.g., food) or services (e.g., grooming and agonistic support) in several species of nonhuman primates (de Waal, 1997; Mitani & Watts, 2001; Seyfarth & Cheney, 1984), and failure to reciprocate may lead to punishment by individuals who lose out (Clutton-Brock & Parker, 1995). However, debate persists about the psychological mechanisms underlying cooperation in other species. Although monitoring of third-party interactions is widespread (Cheney, 2011), it is unknown whether nonhuman primates are sensitive to reciprocity in exchanges between third parties. To be so would be advantageous, as this could feed into individuals' decision-making about potential exchange partners, supplementing mental records of their own direct interactions with them. Here, we ask whether tufted capuchin monkeys would respond differentially to humans who behaved reciprocally in a social exchange with another and those who did not fully reciprocate. Discrimination was assessed through the monkeys' preference for engaging with reciprocators or non-reciprocators after witnessing full, partial, or no exchange. Given capuchin monkeys' well-documented pro-social tendencies and tolerant social disposition (de Waal, Luttrell & Canfield, 1993; Fragaszy, Visalberghi, & Fedigan, 2004; Takimoto, Kuroshima, & Fujita, 2010), we predicted that the monkeys would express a preference for individuals who behaved reciprocally.

## 2. Experiment 1

### 2.1. Method

#### 2.1.1. Subjects

The subjects were three adult male and four adult female capuchin monkeys (*Cebus apella*) ranging in age from 7 to 17 years, all captive-born and group-reared. Group-housed in a multi-cage complex of over 3 $m^2$, they were never food deprived, but earned a portion of their daily intake in a variety of cognitive and social tasks, followed by the remainder (commercial primate pellets, fruits, egg, vegetables) every afternoon. They were highly familiar with short-term separations from the group, the test environment (a transparent acrylic test box in a room adjacent to the colony room) and the human actors involved in the test sessions. Housing and care of the monkeys adhered to Kyoto University Primate Research Institute's *Guide for the Care and Use of Laboratory Primates* (2nd ed.). The experimental procedures received approval from the Animal Experiment Committee of the Graduate School of Letters, Kyoto University.

#### 2.1.2. Materials and procedure

To start each trial an opaque screen was removed from the front of the test box to reveal two humans (actors "*A*" and "*B*") sitting side by side at a table about 50 cm in front of the subject and 25 cm apart. In front of each actor was a pair of transparent plastic containers, one empty and one containing three small balls. After a few seconds *A* held out her empty container toward *B*, requesting the latter's balls. *B* responded by picking up and transferring her three balls one by one to *A*'s container (see Fig. 1i). When the transfer was complete *A* returned the container to the table. *B* then likewise requested *A*'s balls. In 50% of sessions *A* always reciprocated by transferring her own balls just as *B* had done ("reciprocity sessions") (Fig. 1ii). In the other 50% of sessions *A* failed to reciprocate ("non-reciprocity sessions"). To portray non-reciprocity, *A* responded to *B*'s request by briefly turning her head away then simply manipulating her own balls one by one, returning them to their original container (Fig. 1iii). At the end of these manipulations *B* returned the empty container to the table; *A* thus ended up with all six balls, *B* with none (Fig. 1iv). The start and end states of the balls in each condition are illustrated in Fig. 2. Each manipulation of a ball took approximately one second. During the demonstrations the actors remained silent and focused on the balls and containers; they made no eye contact with each other or the monkey. After each completed exchange or non-exchange the opaque screen was replaced in front of the test box and the containers were removed from the table.

Approximately 5 s later the screen was removed to reveal each actor offering the monkey a piece of food by hand. Each food item was a small primate pellet that rested between the 3rd and 4th fingers of the hand nearest the midline of the table; the hands lay palm up on a mark on the table 10 cm from the screen and 5 cm apart. The actors fixated a spot on the table just beyond their fingertips and maintained a neutral expression. The monkey indicated which offer was accepted by extending an arm through a 3-cm high gap that ran along the front of the test box. The chosen actor allowed the monkey to take the food while the other actor's hand withdrew. After this the screen was again placed in front of the box and the inter-trial interval (ITI) began. ITIs lasted approximately 10 s, during which the next trial was prepared, including changing the actors' positions if required by the pseudo-randomization schedule. Each session contained 12 trials. Six reciprocity and six non-reciprocity sessions were run in alternation. Every trial in this and subsequent experiments was video recorded using a Sony HDD Handycam (Model No. DCR-SR220) mounted on a tripod and positioned between and slightly behind the two actors to provide an unobstructed view of the monkey. In this and all subsequent experiments the two actors played the roles of *A* and *B* equally frequently across sessions.

#### 2.1.3. Analysis

The frequency of accepting food from *A* versus *B* summed across the six sessions of each type (total number of trials per monkey per session type: 72) was analyzed using the exact variant of the Wilcoxon signed-ranks test, as recommended for small sample sizes (Mundry & Fischer, 1998). All tests were run on SPSS version 20. Alpha was set at 0.05.

### 2.2. Results and discussion

In reciprocity sessions monkeys showed a slight but nonsignificant preference for accepting food from *A*, the reciprocator (Wilcoxon signed-ranks test, $n = 7$, $Z = -1.70$, $p = 0.109$) (see Fig. 3). More strikingly, in non-reciprocity sessions they strongly preferred actor *B* to