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Original Article

The development of contingent reciprocity in children

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ABSTRACT

Cooperation between nonrelatives is common in humans. Reciprocal altruism is a plausible evolutionary mechanism for cooperation within unrelated pairs, as selection may favor individuals who selectively cooperate with those who have cooperated with them in the past. Reciprocity is often observed in humans, but there is only limited evidence of reciprocal altruism in other primate species, raising questions about the origins of human reciprocity. Here, we explore how reciprocity develops in a sample of American children ranging from 3 to 7.5 years of age, and also compare children's behavior to that of chimpanzees in prior studies to gain insight into the phylogeny of human reciprocity. Children show a marked tendency to respond contingently to both prosocial and selfish acts, patterns that have not been seen among chimpanzees in prior studies. Our results show that reciprocity increases markedly with age in this population of children, and by about 5.5 years of age children consistently match the previous behavior of their partners.

1. Introduction

Cooperation among kin is widespread in nature, but humans differ from most other species because we regularly cooperate with both relatives and non-relatives (Henrich & Henrich, 2007). Kin selection can lead to the evolution of prosocial behaviors that confer benefits on others that are related through descent from a common ancestor (Hamilton, 1964), but cannot account for cooperation between nonkin. Reciprocal altruism provides a mechanism for cooperation to evolve among pairs of nonrelatives (Axelrod & Hamilton, 1981; Trivers, 1971). Selection is expected to favor mechanisms that lead individuals to conditionally help others as long as the costs of helping are outweighed by the future benefits scaled by the likelihood of future interactions. For example, cooperation will be sustained if the benefits of cooperating are at least twice the costs, and if there is more than a 50% chance that interactions will be repeated. Reciprocal altruism requires individuals to keep track of past interactions in some way, assess the likelihood of future interactions, and condition their own behavior on the previous behavior of their partners (Axelrod & Hamilton, 1981; Trivers, 1971). Humans engage in contingent cooperation in at least some settings (Gurven, 2006), but we know very little about how the capacity for contingent reciprocity develops as children mature. The goal of this paper is to fill this gap by exploring the development of contingent prosocial behavior in children using an experimental task similar to one previously used with captive chimpanzees. This affords insight both into the developmental trajectory of human reciprocity, and also the phylogeny of this behavior.

There is considerable evidence that humans condition their own cooperation on the cooperation of others. In some small-scale societies, individuals and family units transfer greater quantities of goods to those that previously transferred greater quantities to them (Bliege Bird, Bird, Smith, & Kushnick, 2002, Gurven, 2004, 2006; Gurven, Hill, & Kaplan, 2002; Gurven, Hill, Kaplan, Hurtado, & Lyles, 2000). There is also evidence that these transfers are contingent on past behavior. Among the Ache, the quantity of food received by one family from another in one time period was positively related to the quantity of food given to the same family in a subsequent time period (Gurven, 2006).

Several studies have explored the development of reciprocal behavior in children (see Supplementary Materials, available on the journal's Web site at www.ehbonline.org, Table 1). Fujisawa, Kutsukake, and Hasegawa (2008) studied naturally occurring interactions among 3–4 year-old Japanese children, and found that children's tendency to provide help and give objects (e.g. toys) to peers correlated with the peers' tendency to act prosocial towards them. Children were not given explicit instructions about how they should behave during these observations, so this study provides a good source of naturalistic data on reciprocity in children, but correlational data do not provide clear evidence of contingency in behavior.

Experimental studies allow a more explicit analysis of contingency. Testing pairs of American fourth graders Staub and Sherk (1970) allocated a number of candies to one child in each pair, and allowed them to transfer some to the other child or keep them all. Later, the children were allowed to draw pictures, but only one crayon was

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provided, and it was given to the child who was non-endowed previously. Children shared crayons more with children who had shared the most candy with them. Levitt, Weber, Clark, and McDonnell (1985) placed a barrier in the middle of a playroom to separate a pair of children aged 2.5–3 years, one of whom was provided with a toy and instructed by their parent to pass the toy to the child on the other side of the barrier. Later in the session, the second child was provided with a toy, and in 9 out of 10 dyads this child only shared if the first child had shared before. These data suggest a contingency in children's willingness to share, but it is possible that children were responding to the adult's instructions to share, not the behavior of their partners. In Fishbein and Kaminski (1985) pairs of 6–11 year old American children played a game in which each player had the opportunity to help the other advance toward a goal. Children helped their partner (actually a stooge who had been trained to always help) about 68% of the time after their partner had helped them. However, subjects were less likely to reciprocate help if their partners had been instructed to help by the experimenter, than if their partners helped them without explicit instructions. This suggests that children condition their prosocial behavior on the perceived intentions of their partners, and on the actions and desires of adults, and raises concerns about the interpretation of results from studies in which children are instructed to share by their parents or other adults.

Birch and Billman (1986) endowed pairs of 3–5 year-old children (from the same school) with asymmetrical quantities of food (10 pieces vs. 1 piece). They then observed whether the 'rich' child shared with the 'poor' child. Of 14 children who received food when they were 'poor', 13 subsequently shared when they were 'rich'. However, of 13 children who had not received food when they were 'poor', only 7 shared later when they were 'rich'. This finding suggests a contingency between sharing and being shared with, but because children are not re-paired with the same child who shared with them before, their responses may be evidence either for generalized reciprocity (Barta, McNamara, Huszár, & Taborsky, 2011) or for a norm psychology that is trying to learn relevant rules about sharing (Chudek & Henrich, 2011).

Dahlman, Ljungqvist, and Johannesson (2007) conducted a study in which children were paired with anonymous recipients, and played a series of three 'games'. In each game, one child (the actor) was allowed to choose between two outcomes that had different payoffs for themselves and another child. Then, the recipients were informed of their decisions and were allowed to choose from the same set of options. Three to five year old children's choices were not affected by the choices that their partners had made, but 6–8 year old children tended to match the previous behavior of their partners. However, the difference in the extent of reciprocity among the younger and older children was only significant in one of the three games, which has come to be known as the Prosocial Game (Fehr, Bernhard, & Rockenbach, 2008; House et al., 2012). In this game, actors chose between one option that provided a reward to themselves and a reward to the other child, and a second option that provided a reward to the actor, but nothing to the other child.

These studies do not provide a clear picture of the development of contingent reciprocity as children mature. Observational evidence suggests that 3–4 year old children are most helpful to those that are most helpful to them, but correlational data do not provide evidence that children are using contingent behavioral strategies. Similarly, evidence that toddlers shared more with those who have previously shared with them is confounded by the fact that the children had been instructed to share. Fishbein and Kaminski (1985) found no effects of age on the reciprocal behavior of the 6–11 year old children that they tested, but it is not clear when contingent strategies first emerge. Moreover, most experimental studies have been limited to a single round of exchanges, and do not tell us whether children's behavior changes as they gain experience with the task and the behavior of their partners.

The current study is designed to examine the development of contingent reciprocity as children mature, but also to provide a direct comparison between the behavior of human children and that of non-human primates. Reciprocity is a plausible foundation for cooperation in non-human primates, raising additional questions about the phylogeny of the human reciprocity that we are exploring in the present study. Questions about phylogeny are best answered by comparing experimental data across humans and closely related primates. Surprisingly, experimental evidence for contingent reciprocity among our closest primate relatives, chimpanzees, is limited. de Waal (1997) found that chimpanzees were 6% more likely to share food with individuals that had groomed them within the past two hours than with individuals who had not groomed them within this period. Melis, Hare, and Tomasello (2008) found a weak tendency towards reciprocity in a task in which chimpanzees could help a familiar group member gain access to a food reward by unlocking a door. However, in a task in which chimpanzees could insert tokens into a vending machine that delivered a food reward to a conspecific in an adjacent enclosure, individuals given free access to the apparatus didn't deliver many rewards to their partners or develop a contingent strategy (Yamamoto and Tanaka 2009). Similarly, Brosnan et al. (2009) presented pairs of familiar chimpanzees with a variant of the Prosocial Game in which one animal, the actor, could choose between two options: Option 1 delivered a food payoff to the actor and its partners, while Option 2 delivered a payoff only to the actor. Thus, Option 1 was prosocial (and equitable) and Option 2 was selfish (and inequitable). Prosocial choices were not costly to actors because they could not obtain higher payoffs by choosing the alternative outcome. Subjects alternated between playing the role of actor and recipient across trials. Actors' choices were not consistently affected by the choices of their partners in previous trials. Similar results were obtained in a subsequent study of chimpanzees using the same payoff distributions (Yamamoto and Tanaka 2010). These methods can be easily adapted for use with children.

Following the procedures of Brosnan et al. (2009), in the current study we paired familiar children aged 3–7.5 years in face-to-face interactions and allowed them to interact repeatedly across multiple rounds in the Prosocial Game. Our results suggest that the propensity to respond in a contingent manner does not develop until about 5.5 years of age, but by this age the performance of children clearly differs from the performance of captive adult chimpanzees in a similar experimental setting.

2. Methods

2.1. Participants

Children were recruited at preschools near the University of California, Irvine. Children received a toy when parents signed the consent form, but at the time of testing children did not receive compensation for their participation beyond the payoffs obtained during the experiment. N = 80 children (43 female) between the ages of 3 and 7.5 years (age 3–4: N = 33, mean age = 4.17, SD = .58; age 5–7.5: N = 47, mean age = 6.12, SD = .60). Pairs of children were about the same age, and usually drawn from the same class to emulate the methods of chimpanzee studies in which subjects are drawn from the same social groups. Pairs could be either same-sex or mixed-sex pairs, but were never composed of kin. Two participants were excluded from the analyses due to inattention or unwillingness to complete the experiment.

2.2. The experimental task

Children were seated across from one another on the floor, with the experimenter seated on one side. Two 8.5" × 14" cards were placed on the floor between the children (see Fig. 1), and each card had one