

The effects of being watched on resource acquisition in chimpanzees and human children

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Abstract Animals react in many different ways to being watched by others. In the context of cooperation, many theories emphasize reputational effects: Individuals should cooperate more if other potential cooperators are watching. In the context of competition, individuals might want to show off their strength and prowess if other potential competitors are watching. In the current study, we observed chimpanzees and human children in three experimental conditions involving resource acquisition: Participants were either in the presence of a passive observer (observed condition), an active observer who engaged in the same task as the participant (competition condition), or in the presence of but not directly observed by a conspecific (mere presence condition). While both species worked to acquire more resources in the competition condition, children but not chimpanzees also worked to acquire more resources in the observer condition (compared to the mere presence condition). These results suggest evolutionary continuity with regard to competition-based observer effects, but an additional observer effect in young children, potentially arising from an evolutionary-based concern for cooperative reputation.

Keywords Competition · Cooperation · Reputation · Social evaluation · Observer · Audience

Introduction

Being watched by others has a strong effect on animal behavior, from fear and behavioral inhibition to attraction and “showing off” (Clayton 1978). In fitness terms, it pays to be sensitive to the presence of others and modify one’s behavior accordingly. While a considerable body of work investigates the general effects of being watched by others on individual performance in both human (Guerin 1986) and non-human subjects (Chen 1937; Platt et al. 1967), very little is known about the mechanisms underlying such effects from an evolutionary and ontogenetic point of view.

These mechanisms depend on context. Following Zajonc’s classic distinction (1965), in the context of competition, being watched by others is argued to influence performance by competitive arousal. In the context of cooperation, being watched by others is argued to influence performance by enhancing arousal through a concern for social evaluation, leading to individuals caring about their reputations.

Thus, in the context of cooperation, individuals might be aware that others evaluate them as potential partners and strategically attempt to present themselves in a positive light, so-called reputation management (Milinski et al. 2002). Evidence from laboratory and real-world settings confirms that human adults show a stronger motivation to adhere to prosocial norms when they are in the presence of an observer (Nowak and Sigmund 2005; Sylwester and Roberts 2010) or even just subtle audience cues (Bateson et al. 2006; Haley and Fessler 2005; Nettle et al. 2013b). In addition, humans also perform better on performance-related tasks, from running to word-learning, when in the presence of observers (Guerin 1986; Zajonc 1965). The extent to which being watched can elicit a concern for

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social evaluation also in other animals remains little understood.

Two previous experimental studies have investigated reputational concern in chimpanzees. Engelmann et al. (2012) found no effect of a high-ranking observer on subjects' tendency to steal food from or give food to a conspecific. And Nettle et al. (2013a) placed an image of a chimpanzee face above a food platform and measured participants' willingness to take high-quality food. Chimpanzees did not show a robust and consistent behavioral change compared to a control condition in which a scrambled image was presented. Crucially, both of these studies investigated cooperation-based observer effects. Although chimpanzees cooperate in a variety of contexts, their natural social life seems to be dominated by competition (Muller and Mitani 2005) and, correspondingly, chimpanzees show some of their most advanced behaviors and cognitive abilities in competitive contexts (Hare and Tomasello 2004). It is thus possible that chimpanzees show effects of being watched in more competitive situations.

The relative absence of studies on effects of being watched in chimpanzees is matched by the limited number of studies on such effects in children. However, a small number of recent studies suggest that already at preschool age children show reputational concern and selectively modify their behavior when in the presence of a peer observer (Engelmann et al. 2013; Leimgruber et al. 2012; Shaw et al. 2014).

Therefore, in the current study, we presented chimpanzees and 5-year-old human children with a familiar reward-retrieval task and measured their performance in three different conditions: mere presence, competition and observed. To control for low-level arousal resulting from the presence of a conspecific alone, a conspecific was present in all conditions. In the mere presence condition, a conspecific was present but not in full sight of the subject (i.e., not directly observing the subject). In the competition condition, participants were in the presence of a conspecific engaging in the same activity. Finally, in the observed condition, participants were observed by a passive spectator.

Materials and methods

A total of 26 chimpanzees (14 males, 12 females), ranging in age from 4 to 30 years, and living in Sweetwaters Chimpanzee Sanctuary, Kenya, participated in this study. Nine chimpanzees participated in the mere presence condition, eight in the competition condition, and nine in the observer condition.

In addition, 48 children (age range 59 months and 30 days to 66 months and 27 days; 24 girls, 24 boys) were

tested in their day-care centers. A total of 16 children participated in each condition.

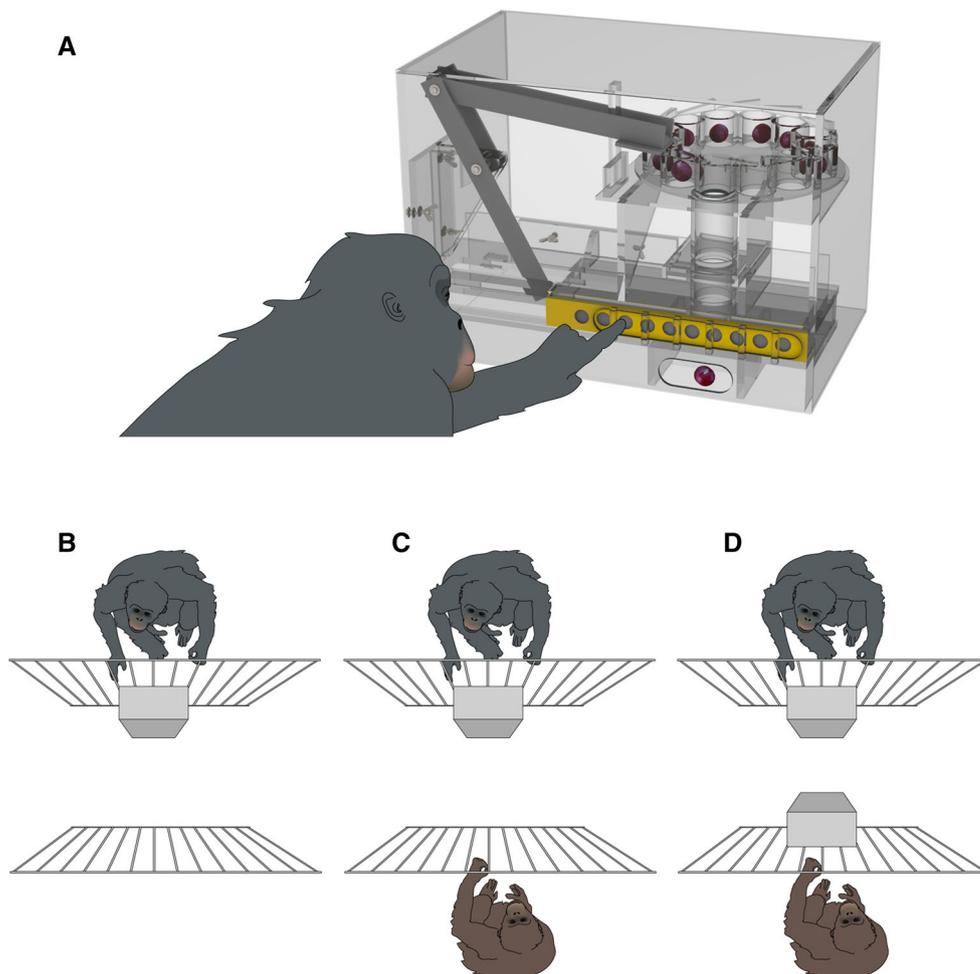
Two chimpanzees of the mere presence condition were chosen as observers and competitors. Likewise, children who had participated in the mere presence condition were later used as observers and competitors.

All subjects were individually introduced to the apparatus. The apparatus (see Fig. 1) consisted of a Plexiglas box that was placed on the ground (children) or attached to the vertical bars of a testing room (chimpanzees). The Plexiglas box contained twelve food compartments. Each compartment contained two pieces of apples and two peanuts for the chimpanzees and four gummy bears for the children. When participants moved a bar first to the left and then to the right, a food revolver was set into motion that dispensed food from one compartment to the subject (Fig. 1). During the introduction phase, subjects received training sessions of 5 min in which the experimenter drew their attention to the basic functioning of the apparatus. Subjects were considered to be skillful when they emptied two food compartments within a time frame of 1 min without the help of the experimenter. Once subjects had passed this criterion, they moved to the test phase of the study. Chimpanzee subjects passed this criterion within 1–4 sessions; all human children passed the criterion within the first session.

During the test phase, subjects could interact with the apparatus for 2 min. The amount of food compartments emptied was coded. Subjects were randomly assigned to one of three groups. In all three groups, subjects were in the presence of a conspecific. What varied according to condition was the location and activity of the conspecific. In the mere presence condition, the conspecific was just outside the room, with the door opened and her back toward the participant (for the children) or in an adjacent room, visible to the participant only from one side of the testing room (for the chimpanzees). Importantly, both species were aware of the presence of the conspecific in the mere presence condition because the conspecific was moved to the adjacent room (chimpanzees) or just outside the testing room (children) in full sight of the subject. In the observed condition, a conspecific was located in full view of the subject, in an opposite room (chimpanzees) or in the same room, but at an equal distance as in the chimpanzees, 2.5 m (children). In the competition condition, the conspecific was positioned in the same location as in the observed condition, and engaged in the same task as the subject using a second, identical apparatus.

All trials were recorded with two cameras, allowing the first author to code all trials from videotape. A research assistant, who was unaware of the study design and hypothesis, independently coded 25 % of all trials. Inter-rater agreement was very good (Cohen's $\kappa = .8$).

Fig. 1 Schematic drawing of the apparatus (**a**; the same apparatus was used with chimpanzees and human children) and the three different conditions: mere presence (**b**), observed (**c**) and competition (**d**)



Results

Figure 2 presents the average number of food compartments emptied by participants in the respective conditions. We first conducted an analysis of variance (ANOVA) on the number of food compartments emptied with species and condition as between-subject factors. This analysis revealed a statistically significant interaction of species and condition, $F(2, 68) = 15.9$, $p < .001$, $\eta^2 = .32$. To investigate the interaction effect, we conducted ANOVAs separately by species. These analyses revealed that there was a difference between conditions for both chimpanzees, $F(2, 34) = 21.5$, $p < .001$, $\eta^2 = .65$, and children, $F(2, 34) = 6.2$, $p = .004$, $\eta^2 = .21$. Post hoc tests using least significant differences (LSD) for chimpanzees showed a significant difference between the mere presence and competition conditions ($p < .001$), but not between the mere presence and observed conditions ($p = .44$), whereas

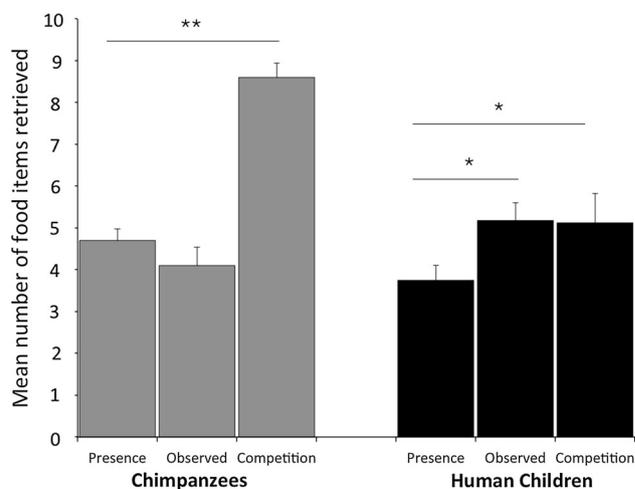


Fig. 2 Mean number of food items retrieved in each of the three conditions for both species. Asterisks indicate significant differences between conditions ($*p \leq .005$; $**p < .001$)

for children there was a significant difference between the mere presence and competition conditions ($p = .005$) as well as the mere presence and observed conditions ($p = .003$). In addition, chimpanzees showed a significant difference between the competition and observed conditions ($p < .001$), whereas children did not ($p = .89$).

Discussion

The current study investigated effects of being watched on a reward-retrieval task in children and chimpanzees. Both species improved their performance in the presence of a competitor. Contrary to previous studies (Engelmann et al. 2012; Nettle et al. 2013a), the current results thus suggest that the performance of chimpanzees is affected by an observer, but only if that observer is a competitor. Furthermore, and in line with previous research, children showed an additional effect of being watched. Preschoolers improved their performance when observed by a passive spectator, which indicates a sensitivity to peer observation from a young age onwards.

A potential explanation for the species difference is that distinctive mechanisms underlie effects caused by the two observers. Whereas a competitor increases motivation in the subject through competition, an observer increases motivation through social evaluation concern. Since social evaluation is grounded in partner choice, it relies ultimately on a cooperative lifestyle (Barclay 2013; Baumard et al. 2013). This distinction between competitive and cooperative observer effects might account for the fact that children displayed both types of effects. One possibility is that children have retained the evolutionarily older form and added to it a potentially species-unique tendency to engage in reputation management (Tomasello 2014). While there is some partner choice occurring in chimpanzees (Melis et al. 2006), Muller and Mitani (2005) argue that competition, and not cooperation, is the dominant force governing chimpanzee social interactions.

Aside from this socio-ecological explanation, one might account for the absence of observer effects in chimpanzees in terms of missing cognitive machinery. Banerjee (2002) argues that second-order mental reasoning (“I am thinking about what you are thinking about me”) is required for any form of self-presentation. While this of course remains a possibility, we are not certain whether such cognitive requirements are indeed necessary for self-presentational behavior; after all, humans are influenced by subtle audience cues without being aware of this and so there might be a more automatic and less cognitively demanding psychological pathway to self-presentational behavior (Nettle et al. 2013b).

Last but not least, one might explain the species difference in the current study in terms of differences in

experimental setup. Chimpanzees might have paid less attention to the conspecific in the observed condition because they were located in different rooms, whereas the child observer was in the same room as the participant. However, this alternative interpretation is unlikely to account for the present results for at least two reasons. First, both chimpanzee and child observers were located in full view of and at the same distance from the subject. Second, and more importantly, results from the competition condition clearly show that chimpanzees paid attention to the behavior of a conspecific in the current setup.

In the present study, we have interpreted the improved performance of chimpanzees in the competition condition in terms of competitive arousal. Contrary to this interpretation, one might argue that chimpanzees were in fact not competing with each other as they were manipulating distinct food sources. However, many studies with human and non-human subjects have demonstrated that actual competition, for example for a single food source, is not a necessary prerequisite for competitive arousal to occur—the presence of a co-actor is sufficient (Allport 1920; Dashiell 1935).

Thus, in conclusion, we would argue that chimpanzees’ socio-ecological niche, which has been argued to be characterized by competition and not cooperation, is the ultimate reason for the improved performance of chimpanzees with a competitor, but not with an observer. This of course does not exclude the possibility that chimpanzees may show observer effects in particular contexts, such as when signaling their dominance to the group.

Ethics Statement

Children

The presented study was noninvasive and strictly adhered to the legal requirements of the country in which it was conducted. Informed written consent was obtained from all the parents of the children who participated in this study.

Chimpanzees

Research at the Sweetwaters Chimpanzee Sanctuary was performed in accordance with the recommendations of the Weatherall report “The use of non-human primates in research.” Groups of apes were housed in semi-natural indoor and outdoor enclosures with regular feedings, daily enrichment and water ad lib. Subjects voluntarily participated in the study and were never food or water deprived. Research was conducted in the sleeping and/or observation rooms. No medical, toxicological or neurobiological research of any kind is conducted at Sweetwaters

Chimpanzee Sanctuary. Research was noninvasive and strictly adhered to the legal requirements of Kenya. The full procedure of the study was approved by the local ethics committee at the Sanctuary (the board members and the veterinarian).

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Author contribution J.M.E., E.H., M.T. designed the study; J.M.E. & E.H. conducted the study; J.M.E., E.H., M.T. analyzed the data; J.M.E., E.H., M.T. wrote the manuscript.

Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

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