Evolution and Human Behavior 40 (2019) 292–300

Contents lists available at ScienceDirect

Evolution and Human Behavior

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

Helping in young children and chimpanzees shows partiality towards friends

Jan M. Engelmann[a,d,*], Lou M. Haux[b], Esther Herrmann[c]

[a] Department of Psychology, Yale University, New Haven, CT 06520-8205, United States
[b] Center for Adaptive Rationality, Max Planck Institute for Human Development, 14195 Berlin, Germany
[c] Minerva Research Group on the Origins of Human Self-Regulation, Max Planck Institute for Evolutionary Anthropology, 04103 Leipzig, Germany
[d] Department of Developmental Psychology, Georg-Elias Müller Institute of Psychology, University of Göttingen, 37073 Göttingen, Germany

ARTICLE INFO

Keywords:
Friendship
Prosociality
Helping
Chimpanzees

ABSTRACT

Friendship naturally leads to treating some people differently from the way we treat everyone else. One manifestation of such preferential treatment is in the domain of prosociality: we are more likely to extend favors towards our friends. Little is known about the developmental and evolutionary roots of such preferential prosociality. Here, we investigate whether young children and chimpanzees show partiality towards friends in helping contexts. Results show that young children at the age of three – when they first form preferential peer relationships – already bias their helping decisions in favor of their friends, both when they have to make a choice whether to help a friend or a neutral peer (Study 1) and when measuring their overall motivation to help (Study 2). In Study 3, by combining observational and experimental methods, we demonstrate similar though less robust motivations to provide help preferentially to friends in our closest living relatives, chimpanzees. Taken together, these studies suggest that partiality towards friends is grounded early in ontogeny and human evolution.

1. Introduction

The ability to foster a large variety of cooperative social relationships has played a central role in human evolution, spurring collaborative subsistence strategies and cooperative childcare to norms, institutions, and politics (Dunbar, 2012; Henrich, 2015; Tomasello, 2016). Within the broad class of alliances, one of the most prominent forms of relationship, friendship - a long-term cooperative relationship that involves the mutual provision of material and emotional support (Silk, 2003) - has received relatively little attention. Different social connections likely evolved to solve distinct and reoccurring adaptive problems; there are strong conceptual and empirical reasons to suggest that friendship solves a particularly important adaptive problem.

The salience of friendship for collaboration is evident when contrasting it with tit-for-tat cooperative relationships. When individuals evaluate whom to recruit for a tit-for-tat relationship (in economic terms: when they make a decision about whom to 'invest' in), potential partners have to be assessed along two main dimensions: willingness to reciprocate and ability to reciprocate (Tooby & Cosmides, 1996). This creates a dilemma. If agents are embedded in social webs that consist exclusively of tit-for-tat associations, then they might not receive help exactly when they need it most. When they are in grave need and their ability to reciprocate cannot be guaranteed, they might represent a bad investment to potential helpers, who consequently refrain from assisting. Tit-for-tat relationships therefore can only solve a subset of cooperative challenges.

Friendship, dubbed 'cooperation without counting' (Silk, 2003), is not limited by such calculated constraints as tit-for-tat unions. When we receive support from our friends, it is usually a result of concern for our welfare, and not a strict matter of immediate gains to be had via tit-for-tat interaction. Friendship might represent a solution to the dilemma raised in the previous section precisely because it lacks the narrow exchange contingency of tit-for-tat reciprocity and associated rigorous monitoring devices about willingness and ability to reciprocate (Clark & Mills, 1979; Mills & Clark, 1994; Tooby & Cosmides, 1996; Xue & Silk, 2012). At the same time, friendships cannot be stable in the complete absence of any form of tracking and monitoring either (McElreath et al., 2003); otherwise these relationships would be susceptible to freeriding and bound to collapse over time. Instead, data suggest that friendships are characterized by both a greater tolerance of imbalances in payoffs and lower levels of tracking compared to relationships among strangers (Xue & Silk, 2012). Friendship thus shares some features with other forms of contingent reciprocity, besides tit-for-tat, that involve matching of favors given and received over longer time spans (Frank & Silk, 2009; Gomes, Mundry, & Boesch, 2009; Hruschka & Henrich, 2006; Jaeggi, De Groot, Stevens, & van Schaik, 2013; Schino & Aureli,

* Corresponding author at: 2 Hillhouse Avenue, New Haven, CT 06520-8205, United States.
E-mail address: jan.maxim.engelmann@gmail.com (J.M. Engelmann).

https://doi.org/10.1016/j.evolhumbehav.2019.01.003
Received 11 July 2018; Received in revised form 10 December 2018; Accepted 2 January 2019

2008).

Given that friendship plays such an important role in cooperation, and gives rise to stable forms of collaboration when other mechanisms fail, we should place especially high value on our friends and develop particularly strong concern for their wellbeing. Not only should we be particularly sensitive and attuned to situations in which friends are in need of help, and particularly adept at reading their mental states to infer their desires and needs, but also strongly motivated to provide that help. While the claim that we should be especially attentive towards the needs of our friends has intuitive appeal and is borne out by work on adult friendships (for a review, see Hruschka, 2010), there is very little we know about preferential prosociality towards friends from an ontogenetic and phylogenetic perspective.

Research with young children has shown that skills and cooperative motives develop early in life and that children are able to solve the two main challenges of cooperation – generating and distributing benefits – from a young age onwards (Warneken, 2018). However, the overwhelming majority of previous work has investigated children's helping tendencies without paying attention to social relationships. The little work that exists on the interaction between prosociality and friendship in young children has focused only on sharing. For example, Moore (2009) and Paulus and Moore (2014) provided evidence that from four years of age children show partiality when they share: especially in contexts where sharing is costly (because their own resources are at stake), children were more likely to share resources with friends than with strangers or non-friends. Birch and Billman (1986) found that preferential sharing with friends interacts with gender in young children: girls, but not boys, shared more with friends than with acquaintances in their study. When the decision to share or not did not affect children's resources (either because their payoff was fixed or because they made sharing decisions on behalf of a second party), children as young as 3.5 years engaged in partial sharing towards friends (House, Henrich, Sarnecka, & Silk, 2013; Olson & Spelke, 2008). Relatedly, recent research has demonstrated that even human infants possess an understanding of the connection between group membership and prosociality (Liberman, Woodward, & Kinzler, 2017). Infants in the second year of life use social partnerships to draw inferences about future behavior (Rhodes, Hetherington, Brink, & Wellman, 2015), expect an ingroup rather than an outgroup member to provide help to a person in need (Jin & Baillargeon, 2017), and even, under some circumstances, expect ingroup support to override fairness considerations (Bian, Sloane, & Baillargeon, 2018).

Research with chimpanzees has contributed to our understanding of the phylogenetic origins of human cooperative skills by demonstrating that our closest primate relatives are able to form, maintain and repair long-term cooperative relationships with kin and non kin alike (de Waal, 2008; Melis, 2017; Muller & Mitani, 2005). To our knowledge, there is no experimental study that investigates prosociality towards friends in chimpanzees. As in the case of children, previous experimental studies on prosociality in chimpanzees have not taken social relationships into consideration (Horner, Carter, Suchak, & de Waal, 2011; Melis et al., 2011; Warneken, Hare, Melis, Hanus, & Tomasello, 2007; Yamamoto, Humle, & Tanaka, 2009, 2012). Two previous experiments suggest that social relationships influence cooperative interactions in chimpanzees. Most relevant for the current study, Engelmann and Herrmann (2016) showed that chimpanzees were more likely to select a risky cooperative option that required trust in a partner when they interacted with a friend (see also Engelmann, Herrmann, & Tomasello, 2015). Earlier work by Melis, Hare, and Tomasello (2006) offered evidence that chimpanzees are more successful at solving a mutualistic collaboration task when they are paired with a tolerant partner. In addition, observation of wild populations suggests that chimpanzees are more likely to groom with conspecifics to whom they are bonded, to support them in fights, and to share food with them (Muller & Mitani, 2005; Muller, Wrangham, & Pilbeam, 2017; Samuni et al., 2018; Seyfarth & Cheney, 2012).

In the studies presented here, we explored preferential prosociality by focusing on a particularly promising cooperative context: instrumental helping. Both young children and chimpanzees have been shown to provide help to conspecifics at a personal cost (Warneken et al., 2007; Warneken & Tomasello, 2006), and various factors modulating the level of prosociality have been investigated (Martin & Olson, 2015; Melis, 2017). Thus, we investigated whether helping in young children and chimpanzees shows partiality towards friends. Studies 1 and 2 focused on three-year old children as this is the first age at which young children form preferential peer relationships (Hay, Payne, & Chadwick, 2004). In both studies, we first identified friendships by asking participants a series of questions. In Study 1, subjects were in a room with a friend and a neutral peer and had to choose whom to help obtain a reward. We measured whether children would preferentially help their friend. In Study 2, in a more open paradigm and in the absence of potential recipients, we measured whether children would put more effort into a boring and strenuous task if by doing so they could assist a friend (compared to a neutral peer). Finally, in Study 3, to elucidate the evolutionary roots of preferential helping, we first systematically observed the naturally occurring social interactions of a group of chimpanzees (to determine friendships) and then explored, in a carefully controlled experimental setting, whether chimpanzees would be more likely to pay a small energetic cost if by doing so they could benefit a non-kin friend compared to a neutral peer.

2. Study 1

In a one-shot, forced choice setting, three-year old children had access to a tool which both a friend and a neutral peer needed in order to access a reward. The problem: the tool could only be used once.

2.1. Methods

2.1.1. Participants

In total, seventy children participated in Study 1. Twenty-four three-year old children (age range = 39 months 4 days to 44 months 19 days; mean age = 41 months and 12 days; 12 girls) acted as subjects and were tested in a quiet room in their day-care centers. Three additional children had to be excluded because potential recipients attempted to influence their decision.

In addition, twenty-four children acted as friends (age range = 36 months 21 days to 52 months 30 days; mean age = 42 months and 17 days; 12 girls) and twenty-two children acted as neutral peers (age range = 37 months 18 days to 55 months 20 days; mean age = 45 months and 18 days; 10 girls).

2.1.2. Materials

Each potential recipient (friend and neutral peer) sat in front of a box (70 × 45 × 30 cm, see Fig. 1) that contained a reward (a small toy in a plastic egg). Rewards could be accessed through an opening at the bottom of the box only once a tool (a cylinder shaped wooden structure with a radius of 3 cm and a length of 10 cm) had been inserted into a slot at the top of the box. In order for rewards to become accessible, tools had to be dropped fully into the box and thus could be used only once.

A DV-Walkman was placed outside the testing room and was connected to a camera which filmed the testing room such that the study procedure could be observed from outside.

2.1.3. Procedure

Participants were tested on two days. On day 1, children were interviewed to determine friendship relationships and were introduced to the experimental setup. On day 2, children participated in one trial in which they had to decide whether to help a friend or a neutral peer.

2.1.3.1. Day 1. In a quiet room of their day-care center, the first

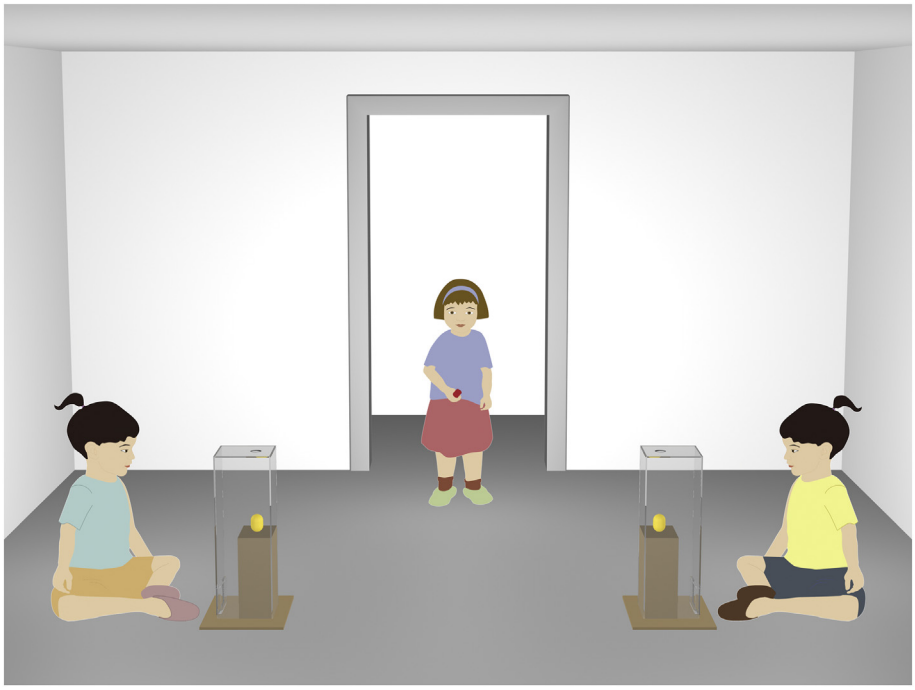

Fig. 1. Experimental setup in Study 1. Because she had only one tool that could not be reused, the participant (standing in the door) had to make a choice between helping her friend or a neutral peer to access a reward.

experimenter (E1) posed three questions to the participant in order to determine the identity of the two children that the participant would interact with during the test phase: the friend and the neutral individual. These questions were: (i) *who do you like playing with most in your kindergarten?* (ii) *who don't you like playing with in your kindergarten?* (iii) *who else is in your kindergarten group?* In response to each question, E1 aimed to elicit three names. If the child only mentioned one name, E1 followed-up by asking *who else?* The identity of the friend and the neutral peer for the test phase were determined as follows: the friend was the first individual that was mentioned in response to question (i), independent of whether she/he was of the same gender as the participant or not and whether she/he was in the same kindergarten group or not. The neutral peer was the first individual that was mentioned in response to question (iii) and who was of the same gender as the friend. In thirteen cases the friend (and thus the neutral peer as well) was of the same gender as the participant and in eleven cases they were of different genders. There was one exception to this general rule: since we wanted to exclude reciprocal pairings (i.e. Amanda is the friend of Sophie and Sophie is the friend of Amanda), in these cases we selected as friend the individual that was named second in response to question (i) by the participant. We wanted to exclude such pairings in order to rule out the possibility that behavior during the experiment might be affected by previous experiences within the same context (e.g. Amanda helping Sophie because Sophie had previously helped her). Note that, to determine friends, we asked children who they most liked playing with, rather than directly asking who was their friend, since we did not want to influence children's behavior (for example, using the term friend might prime children to help that individual more). When determining neutral individuals, we selected children from the same kindergarten group as participants to make some effort to control for familiarity (i.e. we wanted participants to have a certain level of familiarity with neutral peers as well).

After the interview, participants were introduced to the materials that would be used during the test phase. E1 first drew the participant's attention to one of the two boxes and told her that she could take the reward that was inside the box. After the participant had tried unsuccessfully to obtain the reward, E1 told her that she needed a tool in order to access it, handed her the tool, and waited until the participant obtained the reward. Crucially, E1 pointed out to the participant that once she had dropped the tool into the box to obtain the reward, the tool couldn't be reused (because it was stuck in the box). E1 then repeated the same procedure for the second box. After this, E1 showed the camera to the child, told her that the camera filmed the room, and informed her that the room could be observed from outside the testing room via a screen. E1 then took the participant outside the testing room, where the DV-Walkman was located, and pointed out to the child that from here she could observe the two boxes in the testing room. While they were looking at the screen, a second experimenter (E2) placed new rewards in the boxes, an orange plastic egg in one box and a black plastic egg in the other box (both plastic eggs contained a toy). E1 told the participant that she only had one more tool, and that the subject had to choose to retrieve either the orange or the black egg. Then E1 opened the door to the testing room, and waited until the participant made a choice and obtained one of the two plastic eggs. This phase was included in order to familiarize subjects with the necessity and finality of making a choice (as would be the case during the test phase on Day 2).

2.1.3.2. Day 2. Three children participated in a test trial: the participant, the friend, and the neutral peer. E2 asked the friend and the neutral peer to accompany her to the testing room and told each of them to sit by one of the boxes. E2 told them that they should sit quietly behind their boxes and not speak to the participant who would enter the room soon. E2 also promised the two children that they would receive the toy in the plastic egg in front of them if they remained silent. E2 stayed in the testing room but in a location where the camera would not film her. E1 now brought the participant to the outside of the testing room and, using the DV-Walkman, pointed out that 'friend' and 'neutral peer' (E1 referred to them only by their names throughout the procedure) were sitting beside the boxes and wanted to obtain the plastic eggs, but that they did not have the necessary tools. E1 then told the participant that unfortunately there was only one tool left and that consequently she had to make a choice between helping 'friend' or

'neutral peer' (E1 mentioned names with order counterbalanced across subjects). E1 then handed the tool to the subject and opened the door to the testing room (see Fig. 1 for a depiction of this moment). Once the participant had made her choice by dropping the tool in the box of the friend or the neutral peer, E1 asked her to come back out and posed her two questions: *who did you help? Why did you help her/him?* In the meantime, inside the testing room, E2 'coincidentally' found a second tool and thus helped the child who did not retrieve her egg to obtain the reward as well.

2.1.4. Coding, reliability, and analysis

Whether children helped their friend or the neutral peer was coded from tape by the first author. A research assistant, who was unaware of the study design and hypothesis, independently coded 25% of all trials. Interrater agreement was excellent (Cohen's $\kappa = 1$). In addition, children's responses to the last question (*Why did you help her/him?*) were coded as involving a friendship-related reason (e.g. *because she is my friend* or *because I like her*), an instrumental reason (e.g. *because she couldn't get the reward* or *because she wanted the egg*), or no reason (either no answer at all, or *I don't know*).

2.2. Results

Out of the twenty-four children that participated in Study 1, nineteen helped their friend and five helped the neutral peer. Children were significantly more likely to help their friend than the neutral peer ($p = 0.006$, two-tailed binomial test). Of the nineteen children that helped their friend, eight children gave a friendship-related reason for doing so, six gave an instrumental reason, and five children gave no reason. Of the five children that helped the neutral peer, one gave a friendship-related reason, three gave an instrumental reason, and one child gave no reason.

2.3. Discussion

Children start forming their first friendships around age 3. Study 1 provides evidence that these relationships already involve partiality: Three-year-old children were more likely to provide help to a friend than to a neutral peer. Importantly, this cannot be explained by more requests from friends: both potential recipients remained quiet during the test phase (as they had been instructed to; the three friends that attempted to influence the subject's decision were excluded from the sample, see participants section). Study 1 thus raises the possibility that children are intrinsically motivated to help friends, prompted, for example, by greater concern for the welfare of their friend than for the well-being of the neutral peer, and not explainable in terms of external reasons (such as requests). The children's behavior in Study 1, however, lends itself to alternative explanations. Since friends were present in the testing room, children might have simply conceived the situation as an opportunity to be physically close to and interact with their friend, rather than as a context in which their friend needed help. In addition, children might have preferentially helped their friends for instrumental motivations, for example because they might have expected their friend to repay that help in the future.

3. Study 2

To test the strength of preferential helping in young children, and to rule out these alternative explanations, Study 2 investigated the interaction between helping behavior and preferred social relationships among children using a novel paradigm. Instead of studying whether children would help a friend or a neutral peer in a forced-choice setting, Study 2 investigated whether children would provide more help to a friend than to a neutral peer. There were two key methodological changes in Study 2 in comparison to Study 1. First, potential recipients were absent. While children engaged in helping behavior, they did not interact with the recipient. Second, participants did not make a forced-choice between helping their friend or a neutral peer. Rather, children helped both recipients and we measured whether they would be more motivated to provide help to their friend, as measured by the amount that they helped.

3.1. Methods

3.1.1. Participant

We tested forty-four three-year old children (age range = 39 months 6 days to 44 months 25 days; mean age = 41 months and 14 days; 23 girls) in a quiet room in their day-care centers. Twenty children participated in the friend condition and twenty-four children participated in the neutral peer condition. Six additional children had to be excluded because the camera did not work (and thus behaviors couldn't be coded), two children because they expressed an interest to clean up the larger pile of paper shreds (see procedure below), two children because their best friend could not be determined, one child because his friend didn't want to be helped, and two children due to experimenter error.

In addition, seventeen children acted as friends (age range = 36 months and 1 day to 73 months 12 days; mean age = 43 months and 10 days; 8 girls) and twenty-two children acted as neutral peers (age range = 36 months 8 days to 75 months 20 days; mean age = 50 months and 16 days; 13 girls).

3.1.2. Materials

The study setup was a modified version of the setup used previously by Kanngiesser, Köymen, and Tomasello (2017) and Rapp, Engelmann, Herrmann, and Tomasello (2017) to measure prosocial motivation. Two piles of paper shreds – one large and one very small – were placed on two carpets (140 × 145 cm). On each carpet, there was also a cardboard box (12 × 15 × 23 cm) with a slot (1 × 4 cm) on top. Two identical spades (8 × 6 cm with a 12 cm handle) could be used to move the paper shreds from the carpet into the cardboard box (via the slot on top of the box). Finally, a marble run was positioned at a distance of 2.5 m from the carpet containing the large pile of paper shreds.

3.1.3. Procedure

Using the same procedure as in Study 1, the first (E1) and second experimenter (E2) identified either a friend or a neutral peer (depending on the condition subjects had been randomly assigned to) for each potential participant. In contrast to Study 1, friendship assessment and the experimental procedure were conducted on the same day.

E1, the participant, and the partner (depending on condition either friend or neutral peer) entered the testing room together. E1 introduced the two children to the marble run by first playing with one marble and then letting the children play with one marble each as well. E1 then invited the two children to sit down on the floor and asked them for help cleaning up the paper shreds. E1 demonstrated how to clean up the paper shreds by using the shovel to first place shreds from the large pile into the cardboard box, followed by shreds from the small pile. Next, E1 asked the participant to clean up the small pile and the partner to clean up the large pile and handed each of them a shovel. Once the participant had finished cleaning up her pile (which usually lasted about 30 s), E2, who was observing the procedure from outside using a DV-Walkman, opened the door to the testing room and asked E1 to take the partner back to her kindergarten group where she was needed for another activity. E1 replied that the partner was still in the process of cleaning up the pile of paper shreds (cleaning up the large pile required at least 5 min of uninterrupted activity) and wondered how to resolve the situation. E1 then proposed that the participant could help the partner to clean up the pile of paper shreds and explicitly highlighted that the participant could help as much as she wanted. Once the participant had begun cleaning up the large pile of paper shreds, E1 and E2 left the room with the partner.

For forty-five seconds, the participant was in the room on her own.

Then, to exclude the possibility that the child would continue helping simply because there was not much else to do, and also to make helping increasingly more costly, E2 re-entered the room and carried out a series of five prompts to entice the child away from the helping activity and towards the marble run. Prompts increased in degree of enticement, with new prompts given every 45 s. First, E2 said *'I will play with the marble run'* and played one marble (each new prompt was associated with a new marble throw). Then, E2 played a second marble, saying *'Wow, these marbles move really fast'*. Next, E2 said *'Playing with the marble run is a lot of fun'*. Afterwards, E2 looked directly at the participant, stating *'Check out how great the marble run is!'* Finally, E2 asked the child *'Do you want to play with the marble run with me'*? After this final prompt, E2 waited another 45 s, and then left the room to get E1. E2 always carried out the entire sequence of prompts, independent of the child's behavior. This represented the end of the trial.

3.1.4. Coding and reliability

All testing was videotaped. The number of spades children shoveled into the box was coded from tape by the first author. A research assistant (blind to condition and hypotheses) coded a random 20% of the sample. Inter-rater reliability was perfect (Cohen's $\kappa = 1$). As a second measure, the amount of time children spent on the shoveling task was coded. Specifically, time (in seconds) was measured from the moment when children took the shovel and started to clean up until children stopped the cleaning activity and joined E2 at the marble run (or, if children did not join E2, until E2 left the room, see above).

3.2. Results

When helping their friend, children cleaned on average 12.3 spades of paper shreds. When helping the neutral peer, children cleaned on average 7.7 spades (see Fig. 2). To compare the number of spades of shreds children cleaned for their friend with the number of spades of shreds children cleaned for the neutral peer we ran a Mann-Whitney-U exact test. We found a significant difference between the two conditions, indicating that children provided more help to their friend than to the neutral peer ($U(20,24) = 129.5$, $p = 0.009$, two-tailed).

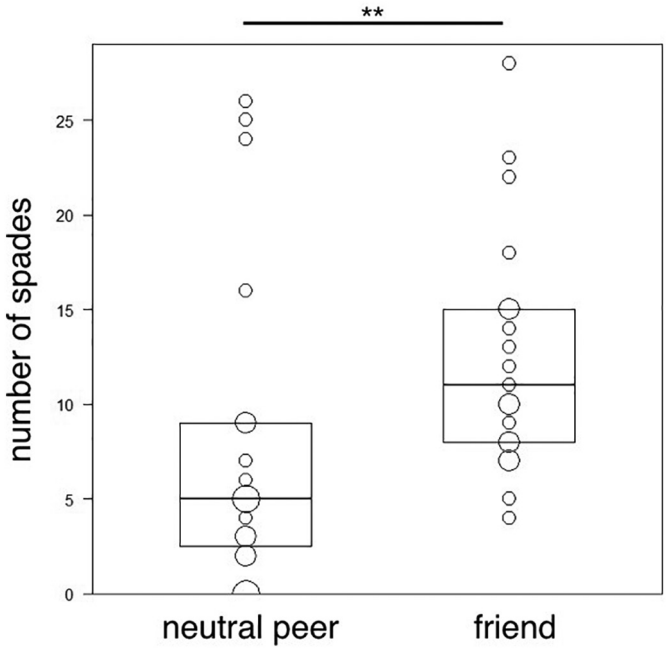

Fig. 2. Number of spades that children cleaned up, separated by condition. Data points are depicted by dots, with bigger dots representing more data points. Each box represents a quantile. Horizontal lines within boxes represent medians.

The amount of time children spent on the helping task corroborates this finding. Children helped their friends, on average, for 230 s and the neutral peers for 138 s. Children helped their friends significantly longer than the neutral peers (Mann-Whitney-U exact test: $U(20,24) = 90.5$, $p \leq 0.001$, two-tailed).

3.3. Discussion

Study 2 provides evidence that children preferentially help their friends and that their behavior cannot be explained by more simple social motivations (such as a tendency to play with or to be physically close to their friends). In addition, children's partiality is evident not only in situations where they are forced to make a choice but extends to more open settings as well. These findings also suggest that the instrumental motivations highlighted in our discussion of Study 1 (that children might help their friend due to an expectation of reciprocation) cannot account for children's partial treatment of their friends. In Study 2, recipients of help were absent, suggesting that direct reciprocity or reputational concerns do not explain partial helping of friends. Taken together, Study 1 and Study 2 suggest that children engage in partiality early in development. These findings complement previous work on infants' expectation of ingroup support. Already at 17 months of age, infants expect third parties to provide help selectively as a function of shared group membership (Jin & Baillargeon, 2017). The current results show that, from the time children first form their own friendships, which is, according to previous work, at around three years of age (Hay et al., 2004), these expectations are reflected in behavior as children preferentially extend favors towards their close relations.

4. Study 3

The early developmental onset of preferential prosociality towards friends raises the question of its evolutionary origins. Do chimpanzees, one of our closest living relatives, who have been shown to associate more with some individuals than others (Muller & Mitani, 2005), similarly display partiality in their prosocial decision-making? In Study 3 we explored the evolutionary origins of preferential helping by asking whether chimpanzees would be more motivated to help a friend than a neutral peer. Study 3 consisted of two parts. First, an observation phase during which the naturally occurring social interactions of chimpanzees were recorded in order to determine friendship dyads. Second, an experimental phase during which chimpanzees were selectively paired with their friend or a neutral individual from their group to determine whether chimpanzees would be more motivated to help their friend.

4.1. Methods

4.1.1. Participants

Twenty-five chimpanzees (15 females) ranging in age from 11 to 30 years (M = 20.1 years), and living at Sweetwaters Chimpanzee Sanctuary, Kenya, participated in this study. Participants were tested in dyads with chimpanzees acting as both subjects and partners (friend or neutral peer). Whether chimpanzees started as subjects or partners was counterbalanced across individuals. For more information on subjects and their partners, please refer to table S1 of the supplementary material.

Chimpanzees had access to a large outdoor enclosure (29 ha) during the day, received regular daily feedings, and water ad libitum. Subjects voluntarily participated in the study and were never food or water deprived. Animal husbandry and research complied with the 'PASA Primate Veterinary Healthcare Manual' and the policies of Sweetwaters Chimpanzee Sanctuary, Kenya.

4.1.2. Design and materials

Study 3 consisted of two parts: an observation phase followed by an experimental phase. During the initial phase, research assistants

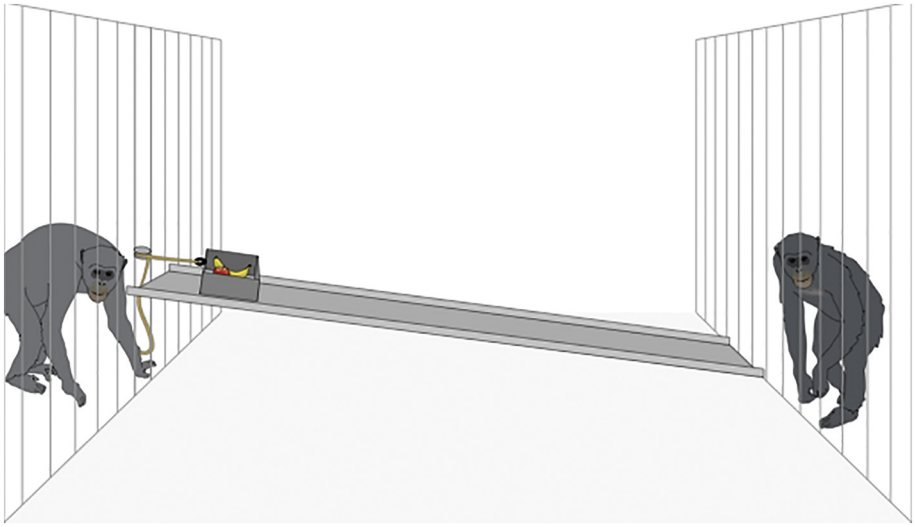

Fig. 3. Experimental setup and apparatus in Study 3. The subject – located on the left – could pull a rope to deliver food to a recipient (who was either a friend or a neutral peer). The overhead raceway, which connected the subject's and the partner's room (and which was closed during the test phase) is not depicted.

collected observational data using a Samsung tablet equipped with CyberTracker software (Version 3.389). During the experimental phase, subjects could pull a short rope (20 cm) to release a vehicle which transported one piece of apple and one piece of banana down a ramp towards a partner (see Fig. 3).

4.1.3. Procedure: observation phase

This phase consisted of the collection and analysis of observational data.

4.1.3.1. Collection of observational data. Three research assistants collected observational data (237 h) between May and November 2015. Observations were recorded as follows. Scan samples were collected for 60 min. During this time, research assistants conducted a scan every 10 min, noting the activities of each group member in the same predefined order. These activities included *grooming* (assistant noted who the focal animal groomed and/or who she was groomed by), *contact* (defined as any affiliative body contact between two individuals), *arm's reach* (two individuals sitting at a distance that would allow them to have contact if both extended their arms), and *co-feeding* (two individuals eating simultaneously while within arm's reach). In addition, it was noted whether a given individual was *present* or not.

4.1.3.2. Analysis of observational data. We first calculated the frequency with which each individual was grooming, in contact, at arm's reach, or co-feeding with all other individuals (by, for example, dividing the number of grooming events between individual A and B by the number of times A and B were simultaneously present). The frequencies of the four activities were positively correlated within dyads and consequently cannot be considered independent sources of information about relationship quality. Using the obtained frequencies, we then calculated the composite index of sociality (CSI) for each dyad using the following formula (based on Silk, Cheney, & Seyfarth, 2013):

$$CSI_{xy} = \frac{\sum_{i=1}^{4} \frac{f_{ixy}}{\overline{f}_i}}{4}$$

In this equation, f_{ixy} is the frequency of behavior i for dyad xy, and $\overline{f}_i$ is the mean frequency of behavior i across all dyads. Since the CSI involves the division of the frequency of a given behavior within a dyad (f_{ixy}) by the average of that behavior across all dyads ($\overline{f}_i$), its outcome describes the extent to which a particular dyad deviates from the average of all dyads. Dyads with a high score are more closely bonded than the average dyad, and, conversely, dyads with a low score are less closely bonded than the average dyad.

4.1.3.3. Determination of friend and neutral peer. To determine friends and neutral peers, we selected as friend the chimpanzee that exhibited the highest CSI with a given individual, and as neutral peer the chimpanzee that exhibited the lowest CSI with the same individual. In doing so, we strictly adhered to the results of the CSI computations, and did not, for example, selectively focus on same-sex dyads. While both male-male (Muller & Mitani, 2005; Watts, 2000) and female-female (Langergraber, Mitani, & Vigilant, 2009) bonds are common in chimpanzees, recent work by Langergraber, Mitani, Watts, and Vigilant (2013) suggests that bonds between sexes also exist. The one exception to this general rule was kinship. Since we were interested in social bonds among unrelated partners, we selected as friend for the one mother-daughter dyad in our sample not the individual with the highest CSI (which would have been the mother for the daughter, and vice versa) but the individual with the second-highest CSI.

4.1.4. Procedure: experimental phase

The experimental phase consisted of two parts: a familiarization phase during which subjects were introduced to the apparatus and setup, and a test phase during which subjects could help a friend and a neutral peer to access rewards. The Experimental Phase took place three months after the Observation Phase.

4.1.4.1. Familiarization phase. All subjects were individually introduced to the experimental setup in a series of two steps. In the first step, subjects were exposed to the helping apparatus in an open door condition. In order to demonstrate apparatus understanding, subjects had to pull the rope, move to the recipient's room via an overhead raceway, and eat the food (for a schematic representation of the setup, please refer to Fig. 3). In order to pass criterion, subjects had to obtain the food eight out of ten times in two consecutive sessions (one session per day). During the second step of familiarization, subjects were exposed to the helping apparatus in a closed-door condition. Subjects were in their testing room with the baited helping apparatus for 30 s. As the overhead raceway was closed, subjects could pull the rope, but could not move to the recipient's room, and thus had no access to the food. Subjects participated in two sessions (one session per day) of ten trials each. There was no criterion.

The rationale of the first step was to familiarize subjects with the helping apparatus and how it worked. The second step was meant to

ensure subjects understood the setup of the test phase and to give them the crucial experience that they could not obtain food themselves during the test.

4.1.4.2. Test phase. In a within-subjects design, subjects participated in two test conditions, a *friend* condition (in which the potential recipient was their friend) and *neutral peer* condition (in which the potential recipient was a neutral peer). Subjects participated, in counterbalanced order, in two sessions of six trials in each condition (for a total of 12 trials in each condition). In both conditions, the following procedure was carried out. At the beginning of trials, the recipient (friend or neutral peer) was located in the recipient's room and the subject was located in a room next to the subject's room. A first experimenter baited the helping apparatus. Then, a second experimenter opened the door for the subject allowing them to enter the subject's room. Subjects then had 30 s to either help the recipient (by pulling the rope) or not to help the recipient (by not pulling the rope). If the subject pulled the rope, the trial ended once the recipient had consumed the food. If the subject did not pull the rope, the trial ended after 30 s.

4.1.5. Coding and reliability

All trials were videotaped with two cameras. The first author coded all trials live as well as later from videotape. Pulling the rope was coded as helping behavior. A research assistant, who was unaware of the study design and hypothesis, independently coded 25% of all trials. Interrater agreement was excellent (Cohen's $\kappa = 1$). We also coded requests made by partners in the current setup. Following Melis et al. (2011), we coded as request (i) any form of interaction with the apparatus that created sound (e.g. hitting the apparatus) and/or (ii) any attention getter by the partner directed at the subject (e.g. banging against the bars, clapping, drumming on the floor) that were shown for at least three seconds. Coding started once Experimenter 1 had baited the apparatus and ended once the subject had made a choice.

4.2. Results

Fig. 4 presents the number of times each individual helped in the friend and neutral peer condition in Study 3. Sixteen chimpanzees helped their friend more, five chimpanzees helped the neutral peer more, and four chimpanzees did not differentiate based on recipient. A significantly greater number of chimpanzees helped their friend more than the neutral peer than vice versa, as determined by a McNemar's test, $p = 0.029$, two-tailed. To test whether chimpanzees helped their friends more than the neutral peers we conducted a Wilcoxon matched-pairs exact test. We found a trend towards significance, indicating that chimpanzees showed a weak preference for helping their friends more, ($n = 25$), $z = -1.79$, four ties, $p = 0.074$, two-tailed.

A second analysis targeted the recipients' behavior. Overall, requests from the partner (see coding section) were extremely rare. Recipients showed requests in 5.5% of trials in the friend condition and in 1.5% of trials in the neutral peer condition. To test whether subjects were more likely to receive requests from friends than neutral peers, we conducted a Wilcoxon matched-pairs exact test. There was no difference when comparing the behavior of recipients across the two conditions ($n = 22$), $z = -0.96$, seventeen ties, $p = 0.336$, two-tailed.[1]

4.3. Discussion

Study 3 supports the view that preferential helping in close relationships – even outside of kinship ties – has deep evolutionary roots. We found evidence that chimpanzees show distinct helping behavior depending on their relationship with the recipient. The results on the level of the group were clear-cut: a greater number of chimpanzees were more likely to pay a small energetic cost to benefit a friend compared to a neutral peer than vice versa. However, we found a somewhat weaker signal on the level of individual behavior: there was a trend for chimpanzees to help their friends more than neutral peers. Importantly, preferential treatment of friends by chimpanzees was not simply a function of differing partner behavior, for example more requests by friends than neutral peers.

5. General discussion

Although intuition and theory suggest that individuals treat their friends in special ways, this question has rarely been addressed from a comparative point of view. Here, we report the first set of experiments on the effects of friendship on helping in young children and chimpanzees. The picture that emerges suggests that preferential helping of friends originates early in development and is a trait shared by our common ancestors. Studies 1 and 2 provide evidence that even the first peer relationships that young children form invoke preferential prosocial treatment. Three-year old children were not only more likely to help a friend than a neutral peer in a one-shot, forced choice setting (Study 1), but also displayed a greater overall motivation – as measured by the amount helped – to benefit a partner if that partner was a friend (Study 2). Study 3 provided evidence, although less robust, that close social relationships influence prosociality in one of our closest primate relatives: chimpanzees showed a trend to help their friends more than neutral peers.

The finding that three-year old children show preferential prosociality towards their friends helps refine the precise age at which children start forming friendships. While there is widespread agreement that preferential peer relationships emerge around the third and fourth year of life (Hay et al., 2004), the nature of these relationships is more contentious. Specifically, some scholars have questioned whether these early peer relationships include mutual help and support, preferring the descriptor 'playmates', and reserving the term friendship for children from about five years onwards (for a review, see Hruschka, 2010). Together with the results of Moore (2009) and Paulus and Moore (2014), the current findings shed doubt on this view by showing that two key prosocial behaviors characterize the close peer relationships of young children well before age five. Specifically, preferential helping seems to emerge at age three and preferential sharing at age four. This is not to say that the friendships of three-year old children are identical to adult friendship; complex developments have yet to come. It is to say, however, that even in young children, friendship shows one of the key signatures of adult friendship: preferential treatment in terms of prosociality.

The current results also provide important new insights into chimpanzee helping. Study 3 provides the first experimental evidence that chimpanzee helping is selective towards individuals they are bonded with. While previous research has shown that chimpanzees help both human experimenters and conspecifics in a variety of experimental settings (reviewed in Melis, 2017), the present findings extend these results by showing that chimpanzees take their social relationship with the potential recipient into consideration when deciding whether to help or not. This finding is also relevant with regard to recent discussions about prosociality in chimpanzees (Melis, Engelmann, & Warneken, 2018). While there is agreement about the behaviors shown by chimpanzees, there is some debate about their underlying motivations. Specifically, while some authors argue that chimpanzee helping is genuine in that it is motivated by concern and sympathy for the partner, others have argued that what looks like helping on the behavioral level is in fact explainable in terms of non-prosocial motivations, such as stimulus enhancement (Tennie, Jensen, & Call, 2016). The current findings provide support for the view that chimpanzee helping is

[1] We could not code recipient behavior for three of the subjects due to camera failure (explaining the reduced sample size of twenty-two individuals). For each trial, one camera was positioned on the subject and one camera on the partner. For these three subjects, the partner camera did not work.

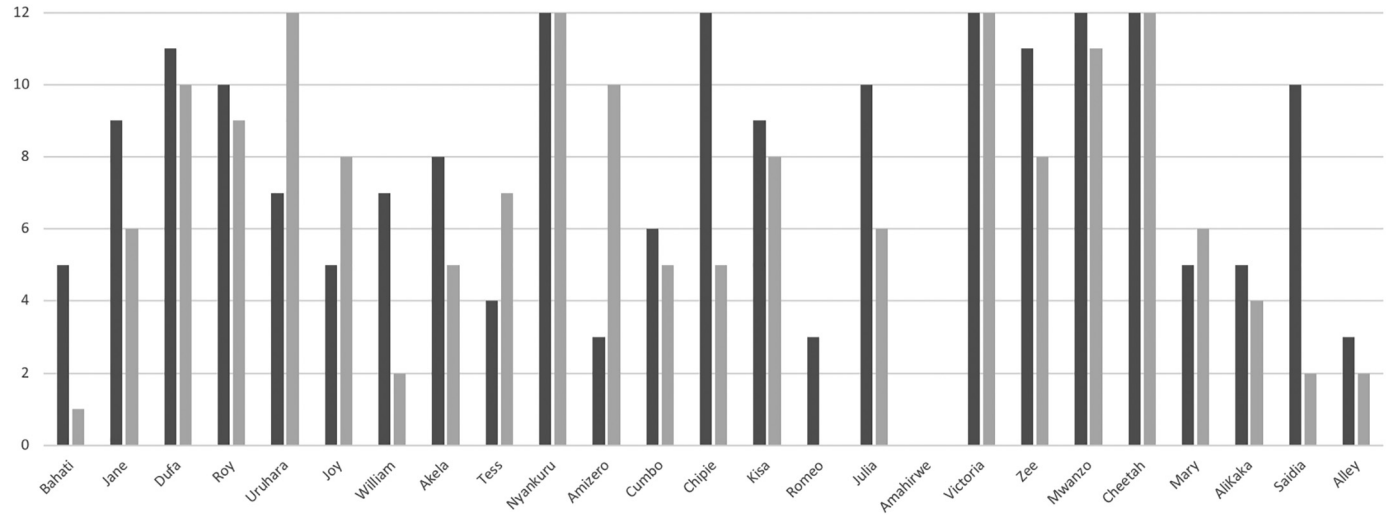

Fig. 4. Number of times each chimpanzee helped their friend (dark bars) and neutral peer (light bars).

authentic in two ways: first, both conditions in the present setup – friend and neutral peer – featured a partner, thereby eliminating any general effects due to the mere presence of a partner. This is in contrast to previous studies, where social test conditions are often compared to non-social control conditions. Second, we did not find evidence that our (weak) effect of preferential helping of friends can be reduced to more requests – and thus potentially greater stimulus enhancement – from friends than neutral peers.

Here we have referred to the preferential associations of chimpanzees as friendships. Primatologists have recently converged on using this term (Goffe, Zinner, & Fischer, 2016; Massen & Koski, 2014; Seyfarth & Cheney, 2012; Silk, 2002; Smuts, 1985). Preferential associations in chimpanzees and other nonhuman primates seem to share the key elements of human friendship: they are stable and long-term (Mitani, 2009) social bonds that are characterized by mutually cooperative behaviors (see current study as well as observational data from the wild: Muller & Mitani, 2005), strengthened by bonding hormones such as oxytocin (Crockford et al., 2013; Wittig et al., 2014). There is also evidence that chimpanzees (de Waal, 1997; Engelmann & Herrmann, 2016) and bonobos (Surbeck & Hohmann, 2015) are less likely to immediately reciprocate a prosocial act when they interact with a closely bonded individual compared to a neutral individual, a pattern that is well-known from human friendships (Silk, 2003).

Although a connection between friendship and prosociality has great intuitive appeal, the precise nature of this interaction has received relatively little theoretical and empirical attention. One potential reason for this is that friendship involves partiality and preferential treatment, while most modern moral theories stress notions of universality, impartiality, and equal treatment as core concepts and ideals. Indeed, in a theoretical framework that highlights equality and impartiality, friendship seems to contain the threat of moral wrongdoing. It is a fact that friendship and morality sometimes pull in opposite directions. Future research should investigate how young children and chimpanzees weigh different obligations and, for example, solve tensions between concepts such as need, equality, and merit on the one hand and friendship on the other hand. Paulus (2016) presents some of the first evidence on a dilemma situation contrasting the moral notion of need with preference for friends: 3 to 6 year-old children were more likely to direct resources to wealthy friends than needy strangers.

If taken too far, preferential treatment of friends can have unwelcome and large-scale negative consequences even on a societal level, e.g. nepotism and corruption. At the same time, living without close friends and refraining from all forms of special treatment does not seem to be an option either. While many people subscribe to equality and impartiality, most would agree that the person who follows a moral ideal of impartiality to the extreme, not engaging in any distinctive interactions with friends or family, is, at least in some ways, falling short of living a good life. From this perspective, the finding that young children and chimpanzees are partial towards friends has mixed significance. Some may find it heartening that young children and even our closest primate relatives seem to form important relationships that include mutual help and support and which are therefore likely to contribute to happiness and wellbeing. Others may feel cautioned to consider the challenge of developing a society that aims for equality when the results suggest that partiality has such a strong evolutionary and developmental basis.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.evolhumbehav.2019.01.003.

Declaration of interests

None.

Acknowledgement

For the child studies, we thank Katharina Haberl, Jana Jurkat, and Lydia Fiedler for their help. For the chimpanzee study, we thank Richard Vigne, George Paul, Stephen Ngulu, and the board members and all the staff of Sweetwaters Chimpanzee Sanctuary in Kenya for their crucial support during all stages of this research. Special thanks go to David Mundia, Steven Mukundi, Charles Mussasia and John Kiama for data collection. We also thank Ol Pejeta Conservancy, Kenya Wildlife Service (KWS) and National Council for Science and Technology (NCST) for approving our research. In addition, we thank Roger Mundry for statistical advice and Silvio Tuepke for the apparatus figures. Finally, we want to thank Felix Warneken and Anna-Claire Schneider for very helpful comments on previous versions of this manuscript. Jan Engelmann was supported by a P.R.I.M.E. Fellowship from the German Academic Exchange Service (DAAD).

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