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First steps towards an understanding of procedural fairness

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Research Highlights

- 20-month-old infants looked longer when agents acted in a biased rather than unbiased way when providing help to third parties
- This pattern of looking times was not due to perceptual cues or general expectations concerning communicative interactions

- Results suggest that infants' reactions were due to an emerging sense of procedural impartiality

Abstract

In four experiments, we tested whether 20-month-old infants are sensitive to violations of procedural impartiality. Participants were shown videos in which help was provided in two different ways. A main character provided help to two other agents either impartially, by helping them at the same time, or in a biased way, by helping one agent almost immediately while the other after a longer delay. Infants looked reliably longer at the biased than at the unbiased help scenarios despite the fact that in both scenarios help was provided to each beneficiary. This suggests that human infants can attend to departures from impartiality and, in their second year, they already show an initial understanding of procedural fairness.

Keywords: infant cognition, social development, moral development, helping, procedural fairness, justice

Introduction

Suppose that you have been waiting for a long time in a restaurant to be served and the waiter decides to serve some customers who have just arrived. That would not make you very happy. Humans and non-human primates have strong feelings about whether they, and their conspecifics, have been treated fairly or unfairly, and these feelings affect their social conduct (Nichols, 2002; Tomasello, 2016). Often we think that we have not been given what we deserve, that is, we are sensitive to *distributive* fairness (Deutsch, 1975). Alternatively, instead of focusing on the outcomes, our judgments may focus on the procedures to arrive at such outcomes. That is to say, we may take into account *procedural* fairness (Rawls, 1971).

There is a rich and rapidly growing literature on distributive fairness in children (e.g., Fehr, Bernhard, & Rockenbach, 2008; LoBue, Nishida, Chiong, DeLoache, & Haidt, 2011; McCrink, Bloom, & Santos, 2010; Moore, 2009; Ng, Heyman & Barner, 2011; Shaw, Montinari, Piovesan, Olson, Gino, & Norton, 2014; Siegal, 1982; Warneken, Lohse, Melis, & Tomasello, 2011) and infants (e.g., Geraci & Surian, 2011; Schmidt & Sommerville, 2011; Sloane, Baillargeon, & Premack, 2012). There is also some related evidence on inequality aversion in non-human animals (for a review see Brosnan & de Waal, 2014). We will briefly review the infant literature on distributive fairness before turning to the studies on procedural fairness (for more in-depth reviews see Baillargeon et al., 2015; McAuliffe, Blake, Steinbeis, & Warneken, 2017; and Sommerville, 2018).

So far, investigations on the developmental origins of fairness have focused on how infants react to fair and unfair distributors. Infants at 10 months look longer when they see strawberries, or other attractive objects, being distributed unequally rather than equally (Meristo, Strid, & Surian, 2016). This effect has been found in infants aged 10-19 months in several studies, suggesting that infants expect windfall resources to be distributed equally among possible recipients (DesChamps, Eason, & Sommerville, 2015; Meristo & Surian, 2013; Sommerville, Schmidt, Yun, & Burns, 2013; Surian & Franchin, 2017a; Wang & Henderson, 2018; Ziv & Sommerville, 2017).

However, by the end of their second year, infants look reliably longer at egalitarian distributions than at merit-based distributions. At 21 months, they are surprised to see that two recipients are given equal rewards even though one recipient has worked more than the other in fulfilling an assignment (Sloane et al., 2012). At 24 months infants also detect cases where

unequally deserving agents (a helper and a hinderer) are rewarded equally (Surian & Franchin, 2017a). These results suggest that they expect the distributive agents to take the recipients' relative merit into account. At age one and a half years old, infants also take into account group membership when they are shown distributive actions: when resources are scarce, infants are surprised to see an agent sharing that does not favor ingroup over outgroup recipients (Bian, Sloan, & Baillargeon, 2018). Expectations of ingroup support concern not only distributive actions, but also scenarios involving helping actions (Jin & Baillargeon, 2017).

Infants also prefer fair distributors over unfair distributors (Burns & Sommerville, 2014; Franchin, Savazzi, Neira-Gutierrez, & Surian, 2019; Geraci & Surian, 2011), and they selectively help fair agents more than unfair agents (Surian & Franchin, 2017b; for a meta-analysis on infants' preference for prosocial agents see Margoni & Surian, 2018). Moreover, infants differentially associate fair and unfair distributions to praise and admonishments. At 15 months they look longer if they are presented with an unfair rather than a fair distributor, and they hear a praise such as "She is a good girl, she did a good job", indicating that they may have detected a mismatch between the verbal praise and the agent's distributive behavior (DesChamps et al., 2015). At 10 months, infants look longer when rewards are delivered to unfair distributors (Meristo & Surian, 2013). Longer looking times for unfair rather than fair distributions are associated with the willingness to share a favorite toy altruistically with an unfamiliar experimenter (Schmidt & Sommerville, 2011). Thus, the available evidence reveals an early emerging ability to evaluate distributions and distributing agents. However, this evidence is mute on whether infants can take into account the procedural fairness: the way in which a distributional outcome has been intentionally achieved.

There is a gap in the literature on the ontogeny of human reactions to unfairness. On the one hand, there are numerous studies on children's and adults' understanding of distributive justice and there is also a rich literature on adults' intuitions on procedural fairness (e.g., Tyler, 2000). On the other hand, there are only a handful of studies on children's intuitions about procedural fairness (Gold, Darley, Hilton, & Zanna, 1984; Grocke, Rossano, & Tomasello, 2015; Qiu, Yu, Li, Cheng, & Zhu, 2017; Shaw & Olson, 2014) and, to our knowledge, there are no published studies on human infants.

Deciding whether a procedure is fair or unfair is a central topic in jurisprudence as well as in moral philosophy and psychology (Rawls, 1971). A long-standing line of research in social

psychology investigated the psychological bases of judgments concerning procedural justice and their implications for social behavior (Helweg-Larsen & Lo Monaco, 2008; MacCoun, 2005; Thibaut & Walker, 1978; Tyler & Blader, 2000; Greenberg, 1986). Social psychologists investigated people's judgments about procedural justice and their implications for rule compliance and cooperative behavior (Tyler, 2000). Researchers of some pioneering work asked people to reason about fictitious judicial trials modeled on the Anglo-American 'adversary' tradition (which allows for greater parties participation and control over the proceedings) or the Continental European 'inquisitorial' tradition (which gives more power to the judges and less to the parties). This research found that, even in continental Europe, people prefer 'adversarial' to 'inquisitorial' procedures (Thibaut & Walker, 1975).

Following this work in social psychology, early developmental studies focused on children's evaluations of procedures involved in the delivery of punishments. For example, school-aged children were told a story about a mother who, upon finding a broken vase in the living room, decided to punish her daughter. Many children not only disapproved of the mother's decision, but also showed an appreciation of procedural justice by citing lack of proof (Gold et al., 1984).

In recent work, developmental psychologists have focused instead on the links between procedural and distributive fairness. Children aged five-to-eight prefer to rely on principles of procedural fairness when they are asked to distribute resources. Shaw and Olson (2014) gave six- and eight-year-old children the choice of using a fair or an unfair procedure to decide who will get more erasers, an attractive resource. The fair procedure employed the spinning of an unbiased wheel whereas the unfair procedure involved a biased wheel in which recipients did not have equal chances of winning. Both younger and older children preferred the former to the latter. In another situation, where children could choose between either throwing away a resource in order to maintain equality or using a fair wheel to determine an unequal division that avoided discarding any resources, they chose to use the wheel. However, when the choice was between discarding the resource and using an unfair wheel, they preferred throwing away the extra-resource. In other words, school-aged children tend to approve procedures only insofar as they are unbiased. That is, they prefer giving everybody an equal chance of receiving a larger portion of resources when desirable goods cannot be split equally. These studies show that six- and eight-year-olds choose a fair rather than an unfair procedure to decide who will benefit from an unequal split of attractive

resources. Even by the age of five, children are aware of the unfairness of the biased wheel, as shown in their conversations (Grocke et al., 2015), and after five years they increasingly avoid unfair procedures, even when their use would be advantageous for them (Qiu et al., 2017).

Many questions remain to be addressed regarding the development of a sense of fairness in humans. We will point out some of these questions in the final discussion. For now, we wish to emphasize that while we know something about preschoolers' and school-aged children's intuitions about procedural fairness, no previous study has investigated the emergence of these intuitions in children younger than three years old. The aim of the present study was to conduct an initial investigation into infants' sensitivity to violations of procedural impartiality. To pursue this goal, we recorded how long 20-month-old infants look at agents who provide help in ways that conform to or violate the impartiality principle. Finding that infants look longer at events that violate such principle would provide evidence for an early understanding of a core aspect of procedural fairness.

Experiment 1

Participants saw a video of a recorded puppet show involving three characters, a helper (either an elephant or a lion) and two beneficiaries (giraffes, see Fig. 1). In front of each giraffe there was a closed box and each giraffe, in turn, asked for help to open it. The helper always satisfied these requests, bringing about the desired outcome. However, the helper's actions were performed differently in each of the two test events, construed as procedurally fair or unfair. In the fair event, the helper responded after a giraffe had asked twice for help, and the delay between help request and help delivery was the same for each beneficiary. In the unfair test event, the helper provided help immediately to one giraffe, following her first request, and after a much longer delay to the other giraffe, only after her third request. Two different helpers were shown in the two test events, an elephant and a lion. After witnessing both events, infants were offered the lion and the elephant puppets and asked to pick one.

Method

Design

Infants received two familiarization trials and two test trials. Infants saw a first familiarization trial followed by a first test trial. Next, they saw a second familiarization trial followed by a second test trial.

In each familiarization trial, infants saw a 55-s recorded puppet show event that introduced the two beneficiaries (giraffes) and a helper (a lion or an elephant) (see Movie-S1[1]). The helper appeared from an opening in the back black curtain of the apparatus, and the two giraffes (beneficiaries) appeared from openings in the right and left sides of the apparatus. In front of each giraffe there was a small clear box containing a cookie. The event began with the first giraffe attempting but failing to open the box twice while the helper was turned towards the giraffe, as though to observe her actions. After two attempts, the giraffe turned towards the helper and asked him "Can you help me?" (in Italian, "*Mi aiuti*?"), and, immediately after, the giraffe attempted but failed two more times to open the box. The other giraffe repeated the same movements and made a similar request for help. Next, the two giraffes asked one more time for help, so that each giraffe asked for help twice. The video could be seen once or twice (see Apparatus and procedure for criteria chosen for ending a trial).

In each test trial, infants watched a 64-s event that began in the same way as the familiarization trial, with a giraffe asking for help. In the *fair test event,* the helper responded to each giraffe after she had asked twice for help (each helper-helpee interaction lasted for 32 s; Movie-S2). In the *unfair test event*, the helper provided help to a giraffe immediately after her first request (16 s), and then helped the other giraffe after three requests (48 s) (Movie-S3). Before and after each request for help, the beneficiaries always tried twice to open their boxes. To provide help, the helper moved close to the box, leaned down to it, and opened it. Then, the helper moved backward to his original position at the center of the rear of the stage. Once a giraffe was helped, she made a brief 'dance' to express her joy. After 64 seconds, during the final phase of the trial, the last frame of the scene was paused on the screen for the infants until the trial ended (see Apparatus and procedure for criteria). Fair and unfair events were presented on alternate trials (after the corresponding familiarization trial), with order counterbalanced across infants.

Participants

Participants were 16 healthy full-term infants (9 male; mean age = 20 months, 24 days, age range = 18 months, 20 days – 23 months, 16 days) from Italian-speaking families. Another 5 infants were excluded because they became overly fussy or active (4), or their test looking time deviated more than 3 SDs from the experiment mean (1).

[1] Examples of familiarization and test video (Movies S1-S11) used in all experiments can be seen here: https://osf.io/4yrpa/?view_only=8d1db031b4304601966fe38635f4eafa

Sample size, for Experiments 1 and 2, was determined by an a-priori power analysis using G*Power for a 2 × 2 mixed analysis of variance (ANOVA). To detect a medium effect size (f = 0.30) with alpha set at .05 and a power of .80, a minimum sample size of 24 participants was required (12 for each experiment). However, we recruited 64 participants (16 for each experiment) to align with previous studies in infants' sociomoral cognition (e.g., Sloane et al., 2012). Parents provided written informed consent, and the protocol was approved by the local Ethics Committee (University of Trento).

Apparatus and Procedure

Infants sat on a parent's lap centered in front of the apparatus positioned in a brightly lit room. This apparatus consisted of a display booth with a large opening and a curtain in its front wall that a supervisor lowered between trials. Inside the apparatus was a computer monitor (34 cm × 59 cm) on which the videos were shown to infants. Parents were told to remain silent and close their eyes during the two test trials. Two observers hidden on either side of the apparatus monitored the infants' looking behavior. The primary observer's responses were used in the analyses. Interobserver agreement in the familiarization and test trial was calculated by dividing the number of 100-ms intervals in which the two observers agreed by the total number of intervals in the trial. Across experiments, average agreement was 91%.

Each trial began with an attention-getter (a baby's face). Each familiarization trial ended when the infant either (a) looked away for 2 consecutive seconds after having looked for at least 50 cumulative seconds (to allow infants to see the main part of one event loop) or (b) looked for a maximum of 110 cumulative seconds (corresponding to two event loops of 55 s). Each test trial began with an initial phase (pre-trial) that was computer-controlled, which lasted 64 s for each infant, and ended after the last puppet received help and all the puppets paused. After this phase, the video was paused and the test trial ended when the infant either (a) looked away for 2 consecutive seconds after having looked for at least 2 cumulative seconds or (b) looked for a maximum of 60 cumulative seconds.

Following the presentation of events on the computer screen, the curtain was lowered for the last time, and parents rotated their child clockwise 90° from the stage and were instructed to close their eyes. The primary observer (naïve about which of the two puppets was the fair helper) held the fair and the unfair puppet (i.e. the lion and the elephant) in front of the infant, approximately 30 cm apart and initially out of reach. Only after the infant had looked at both

puppets were the puppets moved within his or her reach. In this manual choice task, the choice was determined as the first puppet infants touched with a visually-guided reach.

Order of test trials (first fair event or first unfair event), type of animal (lion in the first test trial and elephant in the second test trial or vice versa), start order of giraffes (whether the giraffe on the left or the one on the right of the scene started the event), and position of the puppets during the manual choice task (lion or elephant on the infant's right) were counterbalanced across participants.

Preliminary analyses showed that looking times were not normally distributed. We therefore performed parametric analyses on the log-transformed data. Note, however, that for ease of communication, raw looking times are provided in the report. Moreover, preliminary analyses of all log-transformed data in this report revealed no significant interaction of experiment and event with either infants' sex or test order, both Fs$(3, 48) \leq 0.71$, ps $\geq .548$; the data were thus collapsed across the latter two factors.

Results and Discussion

We found that infants looked longer at unfair events ($M = 24.57$, $SD = 17.76$) than at fair events ($M = 9.44$, $SD = 5.7$), $t(15) = 4.67$, $p < .001$, Cohen's $d = 1.31$ (Fig. 2). However, infants' manual choices did not reveal any significant preference for one of the two agents (7 infants did not choose, 4 chose the fair agent and 5 chose the unfair agent). These results suggest that infants reacted to the procedural difference in helping actions and, following the Violation-of-Expectation paradigm, the results suggest that infants expected an agent to act in conformity with a fairness principle. However, infants did not display any preference for either the fair or unfair helper.

While the pattern of looking times found in Experiment 1 is consistent with the hypothesis that infants were sensitive to procedural unfairness, it is also possible that the difference we found was simply due to a very general expectation, unrelated to fairness. Infants may have expected that the helper would respond similarly to the same communicative acts directed towards him by two similar agents. If this is the case, they should look longer when the central agent interacts in a different rather than in a similar way towards similar communicative partners that address him with the same ostensive signals. We tested this hypothesis in Experiment 2.

Experiment 2

Method

Design

Familiarization and test events of Experiment 2 were identical to those of Experiment 1 with a few exceptions. Instead of asking for help, the giraffes said enthusiastically "How nice! How nice!" (in Italian, "Che bello! Che bello!") (see Fig. 1). The boxes were already open at the beginning of the familiarization event (Movie-S4). So, instead of trying to open the box, a giraffe leaned down to reach the cookie placed inside it. Moreover, in the test events, the lion (or the elephant) did not provide help, but instead he moved towards the box, leaned down to it, and then made a little 'dance'. Next, the giraffe responded with the same 'dance' to express her joy (Movie-S5 and Movie-S6).

Infants were shown two test events again presenting either a balanced or an unbalanced delay in the elephant's (or lion's) responses to the two giraffes. However, this time the two giraffes did not ask for help, they just looked alternately at the elephant and into their box and said enthusiastically "How nice! How nice!". This gaze alternation between the elephant and the box, accompanied by the excited verbal comments, presents a typical shared attention interaction that is quite familiar to infants, which they often use as a means to provoke communicative and attentional reactions from their communicative partner (Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998; Deák, Flom, & Pick, 2000; Grosse, Moll, & Tomasello, 2010; Tomasello, 2008). Therefore, it is plausible that infants in the present study understood the giraffe's comments and gaze as implicit requests to come and see the contents of the box, or comment on it. Following these comments, the elephant (or lion) also went to look into the box, but he did so in either a balanced way, after each giraffe uttered two comments, or in an unbalanced way, immediately after the first comment from one giraffe and only after the third comment from the other giraffe.

Participants

Participants were 16 healthy full-term infants (6 male; mean age = 20 months, 26 days, age range = 18 months, 22 days – 23 months, 14 days) from Italian-speaking families. Another 5 infants were excluded because they became overly fussy or active.

Apparatus and Procedure

The apparatus and procedure were identical to those used in Experiment 1. Looking times during the two familiarization trials were averaged and compared using an ANOVA with experiment as a between-subject factor. This test revealed longer looking times in Experiment 2 (M = 100.84, SD = 10.71) than in Experiment 1 (M = 91.54, SD = 9.11), $F(1, 30) = 6.61$, $p = .015$, suggesting a greater interest for the events shown in Experiment 2.

Results and Discussion

Looking times during the two test events were compared using an ANOVA with experiment as a between-subject factor and test event as a within-subject factor. We found a main effect of Event, $F(1, 30) = 4.80$, $p = .036$, $\eta_p^2 = 0.14$, Cohen's $f = 0.40$, that was qualified by a significant Experiment × Event interaction, $F(1, 30) = 10.77$, $p = .003$, $\eta_p^2 = 0.26$, Cohen's $f = 0.59$. In Experiment 2, infants looked about equally at the unbalanced test event ($M = 15.94$, $SD = 12.18$) as at the balanced test event ($M = 19.63$, $SD = 17.06$), $t(15) = 0.67$, $p > .250$, Cohen's $d = 0.19$ (Fig. 2). Moreover, infants' manual choices did not reveal any significant preference for one of the two agents (3 infants did not choose, 4 chose the balanced and 9 chose the unbalanced agent), $p = .133$ (cumulative binomial probability). This result suggests that, in Experiment 1, infants did not just react to the presence of balanced and unbalanced communicative interactions, but they reacted to the fairness and unfairness of the main character.

Experiment 3

Experiments 1 reported evidence that infants expected agents to provide help in conformity with the impartiality principle. Experiment 2 reported evidence that infants' expectations were unlikely to be due to general expectations about communicative interactions. However, it is possible that in Experiment 1 infants did not react to the violation of impartiality, but simply looked longer when presented with a test event that ended with one giraffe being helped only after she asked three times for help. Perhaps it was the salience of delayed help that affected infants' responses, rather than the unequal treatment of the two beneficiaries. Indeed, in the unfair test events of Experiment 1, the *immediate help* (i.e. help given after the first request) was always performed first, followed by the *delayed help* (i.e. help provided after the third request). So, it is possible that infants just looked longer when an agent provided help after three requests than after two (as in the balanced help scenario). To rule out this alternative interpretation, in Experiment 3 we sought to replicate the findings of Experiment 1, but half of the infants were presented with unfair test events that ended with a delayed help (as in Experiment 1), and the other half were presented with unfair test events that ended with immediate help. Finding in Experiment 3 that infants look reliably longer at the unfair test events would rule out the possibility that infants in Experiment 1 had simply reacted to the fact that videos ended with an agent being helped after three requests instead of one or two.

Method

Design

Familiarization and test events of Experiment 3 were identical to those of Experiment 1 with two exceptions. First, in each familiarization trial, infants now saw a 30-s recorded puppet show event, in which the two giraffes asked for help only once. Second, while 8 infants saw the exact same unfair test events presented to infants in Experiment 1 (in which the helper provided help to a giraffe immediately and then helped the other giraffe only after having received three requests from her), the remaining 8 infants saw unfair test events in which the helper first provided help to a giraffe after three requests (*delayed help*, 48 s) and then helped the other giraffe immediately (*immediate help*, 16 s) (Movie-S7).

Participants

Participants were 16 healthy full-term infants (7 male; mean age = 21 months, 9 days, age range = 18 months, 10 days – 23 months, 25 days) from Italian-speaking families. Another 4 infants were excluded because they became overly fussy or active.

Apparatus and Procedure

The apparatus and procedure were identical to those used in Experiments 1-2, with the exception that each familiarization trial ended when infants either (a) looked away for 2 consecutive seconds after having looked for at least 30 cumulative seconds (to allow infants to see one event loop) or (b) looked for a maximum of 60 cumulative seconds (corresponding to two event loops of 30 s).

Results and Discussion

In Experiment 3, infants looked longer at unfair events (M = 20.52, SD = 10.21) than at fair events (M = 11.45, SD = 6.10), $t(15) = 4.54$, $p < .001$, Cohen's d = 1.05. Looking times during the two test events in Experiment 3 were compared to those observed in Experiment 2 using an ANOVA with experiment as a between-subject factor and test event as a within-subject factor. We found only a significant Experiment × Event interaction, $F(1, 30) = 6.71$, $p = .015$, $\eta_p^2 = 0.18$, Cohen's f = 0.47. Thus, in Experiment 3, but not in Experiment 2, infants looked longer at the biased than at the unbiased action.

In the unfair event test trials, half of the infants saw *immediate help* first and the other half saw *delayed help* first. Infants that saw immediate help first looked longer at unfair test events (M = 21.66, SD = 9.90) than at fair test events (M = 13.70, SD = 6.59), and the same pattern was found in those that saw delayed help first (M = 19.38, SD = 11.06 and M = 9.20, SD = 4.98

respectively). To assess whether *order of help type* in the unfair test events (i.e. immediate help presented first vs. delayed help presented first) had a significant influence on the results, we compared looking times of the two test events of Experiment 3 using an ANOVA with order of help type as a between-subject factor and test event as a within-subject factor. The Order of help type × Event interaction did not reach statistical significance, $F(1, 14) = 0.97$, $p > .250$, $\eta_p^2 = 0.06$, Cohen's $f = 0.26$.

Finally, infants' manual choices did not reveal any significant preference for one of the two agents (5 infants did not choose, 6 chose the fair agent and 5 chose the unfair agent).

In summary, these results replicate those found in Experiment 1 and rule out the hypothesis that the pattern of looking times found in Experiment 1 was an artifact due to having always seen immediate help prior to delayed help.

Experiment 4

In Experiments 4 we sought to (a) replicate our findings for the second time, and (b) collect more evidence to exclude the possibility that in Experiments 1 and 3 infants were looking longer at the unfair test event simply because this event deviated from the balanced pattern of the familiarization event, where each giraffe makes two requests to the helper. To fulfill these aims, in Experiment 4 infants were presented with two familiarization trials that did not involve the presence of any helper, but only the two beneficiaries (giraffes). Thus, the giraffes did not make any requests directed towards an observing helper, but simply verbalized their interest for the cookie inside the box and attempted to open the box two times each. To make the pattern of requests during the test events even more different from the pattern of behaviors displayed during the familiarization events, in Experiment 4 the fair helpers helped each giraffe after three requests and the unfair helpers helped one giraffe immediately and helped the other giraffe after five requests. Finding evidence in this experiment that infants look reliably longer at the unfair procedures would rule out the hypothesis that in the previous experiments infants looked longer at the unfair events than at the fair events simply because they had responded to a deviation from the balanced pattern of helpees-helper interaction witnessed in the familiarization trials.

Method

Design

Infants saw two familiarization trials followed by two test trials. In the first familiarization trial, infants saw a 20-s recorded puppet show event that introduced the two giraffes (see Movie-S8). A cookie was placed in front of each giraffe, and each giraffe, in turn, verbalized her interest for the cookie by saying "What a tasty cookie, how tasty!" (in Italian, "*Che buono il biscotto, che buono!*") and by doing a little 'dance' to express her joy. In the second familiarization trial, infants saw a 25-s event displaying again the two giraffes appearing from openings in the right and left sides of the apparatus (see Movie-S9). In front of each giraffe was a clear box containing a cookie. Each giraffe attempted but failed to open the box and then, in the absence of any helper, said "Ahhh! How difficult to open it! I cannot do it!" (in Italian, "*Ahhh! Che difficile aprirla! Non ci riesco!*").

Test events of Experiment 4 were identical to those of Experiment 3 with one main exception. Infants saw a 82-s recorded puppet show in which either each giraffe was helped after three requests for help (*fair test event*; Movie-S10) or one giraffe received help immediately after the first request whereas the other received help after five successive requests (*unfair test event*; Movie-S11). As in Experiment 3, half of the infants saw the delayed help first, and the other half saw the immediate help first.

Participants

Participants were 16 healthy full-term infants (9 male; mean age = 20 months, 20 days, age range = 18 months, 3 days – 23 months, 10 days) from Italian-speaking families. Two infants were excluded because they became overly fussy.

Apparatus and Procedure

The apparatus and procedure were identical to those used in Experiments 1-3, with the following exceptions. The first familiarization trial ended when infants (a) looked away for 2 consecutive seconds after having looked for at least 16 cumulative seconds (to allow infants to see the main part of one event loop) or (b) looked for a maximum of 40 cumulative seconds (corresponding to two event loops of 20 s). The second familiarization trial ended when infants either (a) looked away for 2 consecutive seconds after having looked for at least 22 cumulative seconds (to allow infants to see the main part of one event loop) or (b) looked for a maximum of 50 cumulative seconds (corresponding to two event loops of 25 s). Each test trial had a computer-controlled initial phase (or pre-trial) which lasted 82 s.

Results and Discussion

Infants looked longer at unfair events (M = 22.71, SD = 15.94) than at fair events (M = 11.91, SD = 7.16), $t(15) = 3.02$, $p = .009$, Cohen's $d = 0.87$. Looking times during the two test events in Experiment 4 were compared to those observed in Experiment 2 using an ANOVA with experiment as a between-subject factor and test event as a within-subject factor. We found only a significant Experiment × Event interaction, $F(1, 30) = 5.00$, $p = .033$, $\eta_p^2 = 0.14$, Cohen's $f = 0.41$. Infants looked longer at the biased than at the unbiased event in Experiment 4, but not in Experiment 2.

To assess the influence of *order of help type* in the unfair test events (i.e. immediate help first vs. delayed help first), we compared the looking times of the two test events of Experiment 4 using an ANOVA with order of help type as a between-subject factor and test event as a within-subject factor, and found that the Order of help type × Event interaction was not significant, $F(1, 14) = 0.73$, $p > .250$, $\eta_p^2 = 0.05$, Cohen's $f = 0.23$.

Finally, infants' manual choices did not reveal any significant preference (5 infants did not choose, 5 chose the fair agent and 6 chose the unfair agent).

In summary, these results strengthen those of Experiments 1 and 3, and rule out the hypothesis that the looking times pattern found in Experiments 1 and 3 was due to the fact that infants, having seen a balanced interaction between the beneficiaries and the helper in the familiarization trials, reacted to the novelty of the unbalanced interactions in the test trials.

General Discussion

The results of the present experiments suggest that infants expect an agent to act with impartiality when he provides help. Previous studies showed that infants look longer when an agent performs unfair rather than fair distributions, suggesting that they expect agents to perform fair distributions and they are surprised when they are shown violations of distributive fairness (Meristo et al., 2016; Meristo & Surian, 2013, 2014; Schmidt & Sommerville, 2011; Sloane et al., 2012; Ziv & Sommeville, 2017). Here we reported initial evidence suggesting that infants are also sensitive to violations of procedural fairness. The patterns of the looking times found in Experiments 1, 3 and 4 imply that infants did not care solely about the final outcomes of helping actions, but also attended to the process that brought about such outcomes. This sensitivity to procedural impartiality could be a foundational building block in the acquisition of mature norms concerning fairness (Bloom & Wynn, 2016).

In several previous studies it has been found that infants prefer helpers over hinderers (e.g., Hamlin, Wynn, & Bloom, 2007; Woo, Steckler, & Hamlin, 2013; for a review see Margoni & Surian, 2018), although this preference can be affected by the costs of choosing a helper (Tasimi & Wynn, 2016). An opposite bias has been found in Bonobos, suggesting that a preference for prosocial agents may have evolved in humans after the divergence from other apes (Krupenye & Hare, 2018). Infants also show a preference for fair over unfair distributors (Burns & Sommerville, 2014; Franchin et al., 2019; Geraci & Surian, 2011; Surian & Franchin, 2017b), but here we failed to find any preference for impartial over biased helpers. This may suggest that the ability to react to procedural fairness is acquired later and takes longer to affect children's preferences or socio-moral evaluations, compared to principles concerning distributive fairness.

Finding that infants hold expectations of procedural fairness but do not show any preference for procedurally fair agents in their manual choices suggests that, even if infants generate positive evaluations of the procedurally fair behaviors, such representations do not guide manual choices because they are not yet linked to the action system. This dissociation between knowledge revealed by the violation of the expectation paradigm and action system is well documented in several other studies on infant cognition, such as those on object knowledge (Spelke, 1998). Before settling for this conclusion, however, it would be fruitful to assess infants' and toddlers' preference for impartial agents using different dependent variables such as selective helping (e.g., Dunfield & Kuhlmeier, 2010; Surian & Franchin, 2017b).

This study provides evidence that infants' sense of fairness extends beyond the outcome of distributive actions and takes into account procedural constraints. As these positive findings are the first to support such a conclusion, they need to be strengthened by future studies. Moreover, some cautionary remarks are necessary to qualify our main conclusion. In a narrow sense, procedural justice is not just about how social actions are performed, but about how one should (in a deontic sense) form the decisions that underlie such actions. In this narrow sense, we did not test infants' reactions to violations of procedural impartiality, since infants were presented with puppets' actions and we had no control over whether and how they inferred the decision processes underlying such actions. Devising such a control would be a major challenge for future investigations on infants and non-human primates. Nevertheless, in our unfair events, by favoring one beneficiary over the other, the biased helper signaled the presence of a procedural bias in his

decision process. Partiality was not unambiguously a feature of the helper's decisions, but it was clearly a feature of the manner through which he provided help.

Some previous studies on infants' reactions to distributive actions have often included non-social control experiments that showed relocation of resources near inert objects rather than near animate recipients (e.g., Geraci & Surian, 2011; Meristo et al., 2016). These control studies were aimed at testing deflationary accounts based on the role of domain-general expectations or low-level perceptual features, such as symmetry in the actions of the distributive agent. Experiment 2 also went in that direction, but one way to further strengthen the present results would be to carry out a non-social follow-up study for procedurally fair and unfair scenarios.

These findings suggest that infants attended to partiality displayed in the behaviors that brought about the outcome. One outstanding remaining question is whether and how infants can extend this ability to the evaluation of distributive contexts. Would infants be able to judge the fairness of a distribution by relying on the procedure followed to bring it about rather than on the final distributive outcome? It is possible that the perceptual salience of the final outcomes in such distributive contexts may be stronger than in the present study, making it more difficult for infants to weigh outcomes as less important than procedures. Alternatively, the sensitivity to procedural fairness may be strong enough to trump expectations related to final outcomes. A further question to be investigated in future studies is whether the present results generalize to scenarios involving comforting rather than helping actions (Buon et al., 2014), and whether early abilities in representing fairness of actions and agents reliably predict later social abilities in preschoolers (Tan, Mikami, & Hamlin, 2018).

The present results dovetail with previous findings showing that preschoolers (e.g., Cushman, Sheketoff, Wharton, & Carey, 2013; Margoni & Surian, 2016, 2017), as well as preverbal infants (Hamlin, 2013; Woo et al., 2017), attend to the helpers' intentions, rather than simply to the final outcome of their actions. The fact that our results were found in the absence of any distribution involving concrete resources also suggests that infants did not rely on principles concerning distributive fairness. In future studies, it would be very interesting to test whether infants' ability to attend to agents' intentions can be displayed not only when they are shown helping and hindering agents, but also when they are looking at fair and unfair distributors.

Explaining how humans acquire and fine-tune their aversion to unfairness requires a better understanding of how infants conceptualize fairness and of the processing mechanisms underlying

responses to fair and unfair actions (Richardson, Mulvey, & Killen, 2012). To pursue these goals, it would be important to assess the role played by empathic feelings towards individuals that are victimized by unfair decisions (Bloom, 2017; Nichols, 2010) and the contribution of processes that require teleological and mental state understanding (Meristo & Surian, 2013; Shaw et al., 2013; Sodian, Licata, Kristen-Antonow, Paulus, Killen, & Woodward, 2016). Another important venue for future work would be to spell out different possible notions of procedural fairness and investigate how such notions may relate to other aspects of children's representations of bad and good agents. For example, extending previous relevant studies (e.g., Surian, Ueno, Itakura, & Meristo, 2018), it would be important to assess whether infants do not expect hindering agents to use fair procedures. Another fruitful goal would be to investigate whether and how infants' expectations of procedural fairness are linked to other aspects of their social cognition, such as their understanding of ingroup-outgroup and dominance relations (e.g., Jin & Baillargen, 2017; Stavans & Baillargeon, 2019; Thomsen, Frankenhuis, Ingold-Smith, & Carey, 2011; Ting, He, & Baillargeon, 2019). For example, would they hold different fairness expectations depending on whether a distributor is represented as a dominant or a subordinate individual, or would they generate different inferences about dominant individuals on the basis of the type of power they display (Margoni, Baillargeon, & Surian, 2018; Thomas & Sarnecka, 2019)? Finally, if humans' reactions to unfair actions are, at least in part, a biological adaptation, we also need to identify the relevant evolutionary pressures (Alexander, 1987; Baumard, André, Sperber, 2013; Darwin, 1871/1982; Joyce, 2006; Sheskin, Chevallier, Lambert, & Baumard, 2014).

Shedding new light on the early emergence of reactions to procedural and distributive unfairness gives us some clues on the acquisition mechanisms and the factors constraining the learning processes. Finding such reactions in the second year of life prompts a re-evaluation of the role played by interactions with peers in ontogeny (Macnamara, 1991; Piaget, 1932/1965; Tomasello, 2016). This will help to further evaluate competing theories on the origins of human judgment and moral cognition.

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.

References

Alexander, R. D. (1987). *The biology of moral systems*. New York: Aldine de Gruyter.

Baillargeon, R., Scott, R. M., He, Z., Sloane, S., Setoh, P., Jin, K., Wu, D., & Bian, L. (2015). Psychological and sociomoral reasoning in infancy. In M. Mikulincer, P. R. Shaver (Eds.), E. Borgida, & J. A. Bargh (Assoc. Eds.), *APA handbook of personality and social psychology: Vol. 1. Attitudes and social cognition* (pp. 79-150). Washington, DC: American Psychological Association.

Baumard, N., André, J., & Sperber, D. (2013). A mutualistic approach to morality: The evolution of fairness by partner choice. *Behavioral & Brain Sciences, 36*, 59–78. https://doi.org/10.1017/S0140525X11002202

Bian, L., Sloane, S., & Baillargeon, R. (2018). Infants expect ingroup support to override fairness when resources are limited. *Proceedings of the National Academy of Sciences, 115*, 2705-2710. https://doi.org/10.1073/pnas.1719445115

Bloom, P. (2017). *Against empathy: The case for rational compassion*. New York: Harper.

Bloom, P., & Wynn, K. (2016). What develops in moral development? In D. Barner, A. S. Baron, (Eds.), *Core knowledge and conceptual change*. New York: Oxford University Press.

Brosnan, S. F., & de Waal, F. B. (2014). Evolution of responses to (un)fairness. *Science, 346,* 1251776. https://doi.org/10.1126/science.1251776

Buon, M., Jacob, P., Margules, S., Brunet, I., Dutat, M., Cabrol, D., & Dupoux, E. (2014). Friend or foe? Early social evaluation of human interactions. *PLoS One, 9,* e88612. https://doi.org/10.1371/journal.pone.0088612

Burns, M. P., & Sommerville, J. A. (2014). I pick you: The impact of fairness and race on infants' selection of social partners. *Frontiers in Psychology, 5*, 93. http://dx.doi.org/10.3389/fpsyg.2014.00093

Carpenter, M., Nagell, K., Tomasello, M., Butterworth, G., & Moore, C. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development*, *63*, No. 255. https://doi.org/10.2307/1166214

Cushman, F., Sheketoff, R., Wharton, S., & Carey, S. (2013). The development of intent-based moral judgment. *Cognition*, *127*, 6-21. https://doi.org/10.1016/j.cognition.2012.11.008

Darwin, C. (1871/1982). *The descent of men, and selection in relation to sex*. Princeton, NJ: Princeton University Press.

Deák, G. O., Flom, R. A., & Pick, A. D. (2000). Effects of gesture and target on 12-and 18-month-olds' joint visual attention to objects in front of or behind them. *Developmental Psychology*, *36*, 511-523. https://doi.org/10.1037//0012-1649.36.4.511

DesChamps, T. D., Eason, A. E., & Sommerville, J. A. (2015). Infants associate praise and admonishment with fair and unfair individuals. *Infancy, 21*, 478-504. http://dx.doi.org/10.1111/infa.12117

Deutsch, M. (1975). Equity, equality and need: What determines which value will be used as the basis of distributive justice? *Journal of Social Issues, 31*, 137-149. https://doi.org/10.1111/j.1540-4560.1975.tb01000.x

Dunfield, K. A., & Kuhlmeier, V. A. (2010). Intention-mediated selective helping in infancy. *Psychological Science, 21*, 523–527. http://dx.doi.org/10.1177/0956797610364119

Fehr, E., Bernhard, H., & Rockenbach, B. (2008). Egalitarianism in young children. *Nature, 454*, 1079–1083. https://doi.org/10.1038/nature07155

Franchin, L., Savazzi, F., Neira-Gutierrez, I. C., & Surian, L. (2019). Toddlers map the word 'good' to helping agents, but not to fair distributors. *Journal of Child Language, 46,* 98-110. https://doi.org/10.1017/S0305000918000351

Geraci, A., & Surian, L. (2011). The developmental roots of fairness: infants' reactions to equal and unequal distributions of resources. *Developmental Science, 14,* 1012-1020. https://doi.org/10.1111/j.1467-7687.2011.01048.x

Gold, L. J., Darley, J. M., Hilton, J. L., & Zanna, M. P. (1984). Children's perceptions of procedural justice. *Child Devevelopment, 55,* 1752-1759. https://doi.org/10.2307/1129922

Greenberg, J. (1986). Determinants of perceived fairness of performance evaluations. *Journal of Applied Psychology*, *71*, 340-342. https://doi.org/10.1037//0021-9010.71.2.340

Grocke, P., Rossano, F., & Tomasello, M. (2015). Procedural justice in children: Preschoolers accept unequal resource distributions if the procedure provides equal opportunities. *Journal of Experimental Child Psychology, 140,* 197-210. https://doi.org/10.1016/j.jecp.2015.07.008

Grosse, G., Moll, H., & Tomasello, M. (2010). 21-Month-olds understand the cooperative logic of requests. *Journal of Pragmatics*, *42*, 3377-3383. https://doi.org/10.1016/j.pragma.2010.05.005

Hamlin, J. K. (2013). Failed attempts to help and harm: Intention versus outcome in preverbal infants' social evaluations. *Cognition, 128,* 451-474. https://doi.org/10.1016/j.cognition.2013.04.004

Hamlin, J. K., Wynn, K., & Bloom, P. (2007). Social evaluation by preverbal infants. *Nature*, *450*, 557-559. https://doi.org/10.1203/pdr.0b013e318168c6e5

Helweg-Larsen, M., & LoMonaco, B. L. (2008). Queuing among U2 fans: Reactions to social norm violations. *Journal of Applied Social Psychology*, *38*, 2378-2393. https://doi.org/10.1111/j.1559-1816.2008.00396.x

Jin, K. S., & Baillargeon, R. (2017). Infants possess an abstract expectation of ingroup support. *Proceedings of the National Academy of Sciences*, *114*, 8199-8204. https://doi.org/10.1073/pnas.1706286114

Joyce, R. (2006). *The evolution of morality.* Cambridge: MIT Press.

Krupenye, C. & Hare, B. (2018). Bonobos prefer individuals that hinder others over those that help. *Current Biology, 28*, 1-7. https://doi.org/10.1016/j.cub.2017.11.061

LoBue, V., Nishida, T., Chiong, C., DeLoache, J. S., & Haidt, J. (2011). When getting something good is bad: Even three-year-olds react to inequality. *Social Development, 20*, 154-170. http://dx.doi.org/10.1111/j.1467-9507.2009.00560.x

McAuliffe, K., Blake, P. R., Steinbeis, N., & Warneken, F. (2017). The developmental foundations of human fairness. *Nature Human Behaviour*, *1*, 0042. https://doi.org/10.1038/s41562-016-0042

MacCoun, R. J. (2005). Voice, control, and belonging: The double-edged sword of procedural fairness. *Annual Review of Law and Social Science*, *1*, 171-201. https://doi.org/10.1146/annurev.lawsocsci.1.041604.115958

Macnamara, J. (1991). The development of moral reasoning and the foundations of geometry. *Journal for the Theory of Social Behaviour*, *21*, 125-150. https://doi.org/10.1111/j.1468-5914.1991.tb00517.x

Margoni, F., Baillargeon, R., & Surian, L. (2018). Infants distinguish between leaders and bullies. *Proceedings of the National Academy of Sciences, 115,* E8835-E8843. https://doi.org/10.1073/pnas.1801677115

Margoni, F., & Surian, L. (2016). Explaining the U-shaped development of intent-based moral judgments. *Frontiers in psychology, 7,* 219. https://doi.org/10.3389/fpsyg.2016.00219

Margoni, F., & Surian, L. (2017). Children's intention-based moral judgments of helping agents. *Cognitive Development, 41,* 46-64. https://doi.org/10.1016/j.cogdev.2016.12.001

Margoni, F., & Surian, L. (2018). Infants' evaluation of prosocial and antisocial agents: A meta-analysis. *Developmental Psychology, 54,* 1445-1455. https://doi.org/10.1037/dev0000538

McCrink, K., Bloom, P., & Santos, L. R. (2010). Children's and adults' judgments of equitable resource distributions. *Developmental Science, 13*, 37-45. http://dx.doi.org/10.1111/j.1467-7687.2009.00859.x

Meristo, M., Strid, K., & Surian, L. (2016). Preverbal infants' ability to encode the outcome of distributive actions. *Infancy, 21,* 353-372. https://doi.org/10.1111/infa.12124

Meristo, M., & Surian, L. (2013). Do infants detect indirect reciprocity? *Cognition, 129,* 102-113. https://doi.org/10.1016/j.cognition.2013.06.006

Meristo, M., & Surian, L. (2014). Infants distinguish antisocial actions directed towards fair and unfair agents. *PLoS ONE, 9,* e110553. http://dx.doi.org/10.1371/journal.pone.0110553

Moore, C. (2009). Fairness in children's resource allocation depends on the recipient. *Psychological Science, 20,* 944-948. https://doi.org/10.1111/j.1467-9280.2009.02378.x

Ng, R., Heyman, G. D., & Barner, D. (2011). Collaboration promotes proportional reasoning about resource distribution in young children. *Developmental Psychology, 47*, 1230-1238. http://dx.doi.org/10.1037/a0024923

Nichols, S. (2002). Norms with feelings: toward a psychological account of moral judgment. *Cognition, 84,* 221-236. https://doi.org/10.1016/s0010-0277(02)00048-3

Nichols, S. (2010). Emotions, norms, and the genealogy of fairness. *Politics, Philosophy & Economics, 9*, 275-296. http://dx.doi.org/10.1177/1470594X09345478

Piaget, J. (1932/1965). *The moral development of the child*. New York: Free Press.

Qiu, X., Yu, J., Li, T., Cheng, N., & Zhu, L. (2017). Children's inequity aversion in procedural justice context: a comparison of advantageous and disadvantageous inequity. *Frontiers in Psycholology, 8,* 1855. https://doi.org/10.3389/fpsyg.2017.01855

Rawls, J. (1971). *A theory of justice.* Cambridge, MA: Harvard University Press.

Richardson, C. B., Mulvey, K. L., & Killen, M. (2012). Extending social domain theory with a process-based account of moral judgments. *Human Development, 55*, 4-25. https://doi.org/10.1159/000335362

Schmidt, M. F. H., & Sommerville, J. A. (2011). Fairness expectations and altruistic sharing in 15-month-old human infants. *PLoS ONE, 6,* e23223. https://doi.org/10.1371/journal.pone.0023223

Shaw, A., & Olson, K. (2014). Fairness as partiality aversion: the development of procedural justice. *Journal of Experimental Child Psychology, 119,* 40-53. https://doi.org/10.1016/j.jecp.2013.10.007

Shaw, A., Montinari, N., Piovesan, M., Olson, K., Gino, F., & Norton, M. I. (2013). Children develop a veil of fairness. *Journal of Experimental Psychology General, 143*, 363-375. https://doi.org/10.1037/a0031247

Sheskin, M., Chevallier, C., Lambert, S., & Baumard, S. (2014). Life-history theory explains childhood moral development. *Trends in Cognitive Science, 18,* 613-615. https://doi.org/10.1016/j.tics.2014.08.004

Siegal, M. (1982). *Fairness in children: A social-cognitive approach to the study of moral development.* New York: Academic Press.

Sloane, S., Baillargeon, R., & Premack, D. (2012). Do infants have a sense of fairness? *Psychological Science, 23*, 196-204. https://doi.org/10.1177/0956797611422072

Sodian, B., Licata, M., Kristen-Antonow, S., Paulus, M., Killen, M., & Woodward, A. (2016). Understanding of goals, beliefs, and desires predicts morally relevant theory of mind: A longitudinal investigation. *Child Development*, *87*, 1221-1232. https://doi.org/10.1111/cdev.12533

Sommerville, J. A. (2018). Infants' understanding of distributive fairness as a test case for identifying the extents and limits of infants' sociomoral cognition and behavior. *Child Development Perspectives*, *12*, 141-145. https://doi.org/10.1111/cdep.12283

Sommerville, J. A., Schmidt, M. F. H., Yun, J., & Burns, M. (2013). The development of fairness expectations and prosocial development in the second year of life. *Infancy, 18*, 40-66. http://dx.doi.org/10.1111/j.1532-7078.2012.00129.x

Spelke, E. S. (1998). Nativism, empiricism, and the origins of knowledge. *Infant Behavior and Development*, *21*, 181-200. https://doi.org/10.1016/s0163-6383(98)90002-9

Stavans, M., & Baillargeon, R. (2019). Infants expect leaders to right wrongs. *Proceedings of the National Academy of Sciences, 116,* 16292-16301. https://doi.org/10.1073/pnas.1820091116

Surian, L., & Franchin, L. (2017a). Infants reason about deserving agents: A test with distributive actions. *Cognitive Development, 44*, 49-56. http://dx.doi.org/10.1016/j.cogdev.2017.08.009

Surian, L., & Franchin, L. (2017b). Toddlers selectively help fair agents. *Frontiers in Psychology, 8,* 944. https://doi.org/10.3389/fpsyg.2017.00944

Surian, L., Ueno, M., Itakura, S., & Meristo, M. (2018). Do infants attribute moral traits? Fourteen-month-olds' expectations of fairness are affected by agents' antisocial actions. *Frontiers in Psychology, 9,* 1649. https://doi.org/10.3389/fpsyg.2018.01649

Tan, E., Mikami, A. Y., & Hamlin, J. K. (2018). Do infant sociomoral evaluation and action studies predict preschool social and behavioral adjustment? *Journal of Experimental Child Psychology, 176,* 39-54. https://doi.org/10.1016/j.jecp.2018.07.003

Tasimi, A., & Wynn, K. (2016). Costly rejection of wrongdoers by infants and children. *Cognition, 151,* 76-79. https://doi.org/10.1016/j.cognition.2016.03.004

Thibaut, J., & Walker, L. (1975). *Procedural Justice: A psychological analysis*. Hillsdale, NJ: Erlbaum.

Thibaut, J., & Walker, L. (1978). A theory of procedure. *California Law Review, 66*, 541-566. https://doi.org/10.2307/3480099

Thomas, A. J., & Sarnecka, B. W. (2019). Infants choose those who defer in conflicts. *Current Biology, 29,* 2183-2189. https://doi.org/10.1016/j.cub.2019.05.054

Thomsen, L., Frankenhuis, W.E., Ingold-Smith, M., & Carey, S. (2011). Big and mighty: Preverbal infants mentally represent social dominance. *Science, 331*, 477–480. https://doi.org/10.1126/science.1199198

Ting, F., He, Z., & Baillargeon, R. (2019). Toddlers and infants expect individuals to refrain from helping an ingroup victim's aggressor. *Proceedings of the National Academy of Sciences, 116,* 6025-6034. https://doi.org/10.1073/pnas.1817849116

Tomasello, M. (2008). *The origins of human communication*. Cambridge, MA: MIT Press.

Tomasello, M. (2016). *A natural history of human morality.* Cambridge, MA: Harvard University Press.

Tyler, T. R. (2000). Social justice: Outcome and procedure. *International Journal of Psychology, 35*, 117-125. https://doi.org/10.1080/002075900399411

Tyler, T. R., & Blader, S. (2000). *Cooperation in groups.* Philadelphia, PA: Psychology Press.

Wang, Y., & Henderson, A. M. E. (2018). Just rewards: 17-month-old infants expect agents to take resources according to the principles of distributive justice. *Journal of Experimental Child Psychology, 172,* 25-40. https://doi.org/10.1016/j.jecp.2018.02.008

Warneken, F., Lohse, K., Melis, A., & Tomasello, M. (2011). Young children share the spoils after collaboration. *Psychological Science, 22*, 267-273. http://dx.doi.org/10.1177/0956797610395392

Woo, B. M., Steckler, C. M., & Hamlin, J. K. (2017). Social evaluation of intentional, truly accidental, and negligently accidental helpers and harmers by 10-month-old infants. *Cognition, 168,* 154-163. https://doi.org/10.1016/j.cognition.2017.06.029

Ziv, T. & Sommerville, J. A. (2017). Developmental differences in infants' fairness expectations from 6 to 15 months of age. *Child Development, 88*, 1930-1951. https://doi.org/10.1111/cdev.12674

Figure captions

Figure 1. Examples of events shown in Experiments 1 and 2. In the familiarization trials of Experiment 1, the giraffes asked in turn for help by saying "Can you help me?" to an elephant (or a lion, in a different familiarization trial). In the test trials infants saw a fair and an unfair event. In the fair test event, the central puppet (either the elephant or the lion) helped both giraffes after they had each asked for help twice. In the unfair test event, the central puppet helped the first giraffe immediately and helped the second giraffe only after she asked for help three times. In the familiarization trials of Experiment 2, the giraffes attracted in turn the attention of the central character by saying "How nice! How nice!". In the test trials, the central puppet moved towards the giraffes' boxes and leaned down to them after the giraffes had each spoken twice (balanced test event) or, alternatively, he moved towards the first giraffe immediately and moved towards the second giraffe only after she had spoken three times (unbalanced test event).

*Figure 2***.** Box plots of looking times at the test events in Experiments 1-4. An asterisk denotes a significant difference between the events within an experiment, $p \leq .009$.

Supplementary information

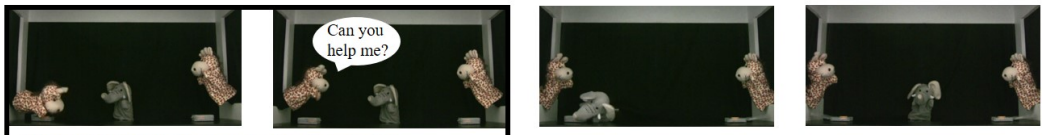
Examples of familiarization and test video (Movies S1-S11) used in all experiments can be seen on this site:

https://osf.io/4yrpa/?view_only=8d1db031b4304601966fe38635f4eafa

Experiment 1

Familiarization Event

Test Event



Fair Trials: 2 requests for help
Unfair Trials: 1 request for help

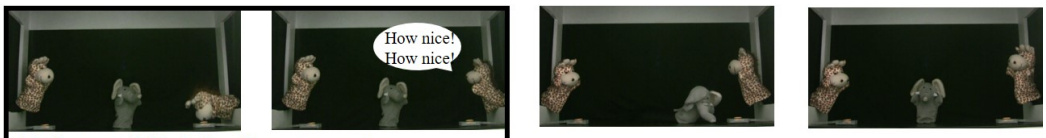
Fair Trials: 2 requests for help
Unfair Trials: 3 requests for help

Experiment 2

Familiarization Event

Test Event

Balanced Trials: 2 comments
Unbalanced Trials: 1 comment



Balanced Trials: 2 comments
Unbalanced Trials: 3 comments

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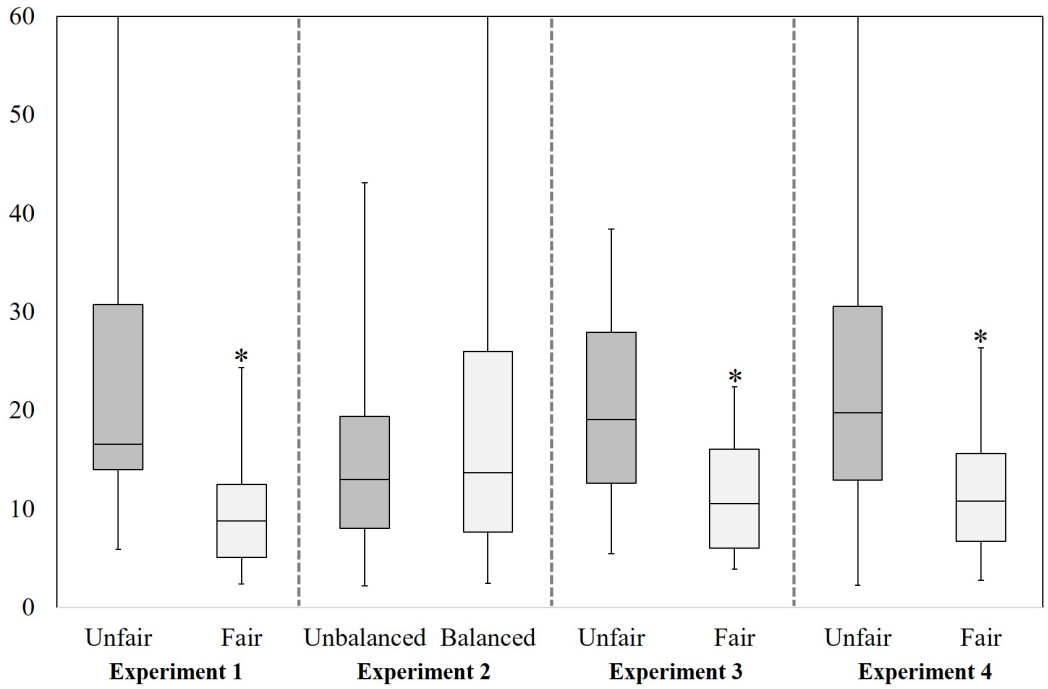

desc_12939_f2.jpg