



PAPER

The developmental roots of fairness: infants' reactions to equal and unequal distributions of resources

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Abstract

The problem of how to distribute available resources among members of a group is a central aspect of social life. Adults react negatively to inequitable distributions and several studies have reported negative reactions to inequity also in non-human primates and dogs. We report two experiments on infants' reactions to equal and unequal distributions. In two experiments, infants' looking times and manual choices provide, for the first time, converging evidence suggesting that infants aged 12 to 18 months (mean age 16 months) attend to the outcomes of distributive actions to evaluate agents' actions and to reason about agents' dispositions. The results provide support for recent theoretical proposals on the developmental roots of social evaluation skills and a sense of fairness.

Introduction

The problems concerning fairness of resources distribution are ubiquitous in everyday reasoning and are central topics for social sciences and theories of ethics (e.g. Kant, 1785/1964; Mill, 1861/1998; Sen, 2008). How do individuals acquire the ability to reason about these problems? Classic developmental theories (Piaget, 1932; Kohlberg, 1981) emphasized the effect of peer interaction, verbal competence and mathematical skills on how children and adolescents perform and evaluate distributive actions (e.g. Damon, 1975; Gunzburger, Wegner & Anooshian, 1977; Hook, 1978; Lane & Coon, 1972; Larsen & Kellogg, 1974; Lerner, 1974). Studies have repeatedly found that children below 5 years of age are mainly guided by self-interest, whereas older children tend to prefer egalitarian distributions (Arsenio & Gold, 2006; Fehr, Berhardt & Rockenbach, 2008; Carson & Banuazizi, 2008; Lane & Coon, 1972; McGillicuddy-De Lisi, Daly & Neal, 2006; Sigelman & Waitzman, 1991). It is only in late childhood that a systematic preference for proportional distributions linked to relative merit or need is reported (but see McCrink, Bloom & Santos, 2008, for evidence that even 5-year-olds can reason proportionally to evaluate donations).

There are several problems for classic theories on moral judgment and the empirical research stimulated by them. Explicit verbal reasoning is likely to confound moral competence and language skills and to reveal mostly post-hoc constructions that individuals generate

after an implicit and automatic evaluative process has been completed (Haidt, 2001). Also, while proportional reasoning is surely required when distributions must take into account relative effort, merit or need, its development does not explain the origins of the evaluative component of the process. School-aged children's verbal responses are useful to chart the development of explicit judgments, but they are of little use in investigating the origin of the sense of fairness and testing whether humans possess spontaneous evaluation skills that are applied to agents' distributive actions.

An alternative theoretical view, defended by the British empiricists, emphasized the role of spontaneous sentiments in the generation and development of moral judgments (Smith, 1759/1948; Hume, 1740/1978). To apply this view to distributive justice scenarios, one needs to imagine that spontaneous emotional reactions caused by the distress of an actual or potential victim may stimulate an aversion for unjust distributions. Hypotheses derived by moral sentimentalism have recently received considerable empirical support from behavioural (Haidt, 2001; Rozin, Lowery, Imada & Haidt, 1999), physiological (Blair, Mitchell & Blair, 2005) and neuroimaging studies (e.g. Greene, Sommerville, Nystrom, Darley & Cohen, 2001; Hsu, Anen & Quartz, 2008). Given that some empathic reactions emerge very early in development (Hoffman, 1991), this view would predict an early emergence of aversion to inequity in children.

A third theoretical view can be traced back to Rawls' theory of moral competence (Rawls, 1971). Works

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inspired by this view have suggested that adults (Hauser, 2006; Cushman, Young & Hauser, 2006) and preschool children (Pellizzoni, Siegal & Surian, 2010) evaluate actions' morality by relying on a set of tacit principles including the 'contact principle' (i.e. 'harm involving physical contact with a victim is worse than harm involving no physical contact') or the 'intention principle' (i.e. 'harm intended as a means to a goal is morally worse than equivalent harm foreseen as the side effect of a goal'). Preverbal infants display an ability to attribute positive values to helping actions and negative values to hindering actions (Hamlin, Wynn & Bloom, 2007; Kuhlmeier, Wynn & Bloom, 2003). No previous work, however, has investigated directly the hypothesis that a tacit principle may guide human intuitions about distributive actions and infants' detection of inequitable distributions.

Olson and Spelke (2008) have recently found that, when helping another agent to distribute some resources, 3.5-year-old children, like adults, take into account (1) the degree of relation existing between the donor and the recipients ('principle of close relations'), (2) whether the potential recipients had given resources to the donor in the past ('principle of direct reciprocity'; see also Dunfield & Kuhlmeier, 2010), and (3) whether the recipients had previously shown generous behaviour toward third parties ('principle of indirect reciprocity'). Children's sensitivity to these principles was clearly shown in contexts where the donor did not have enough resources to allocate an equal amount to each potential recipient. By contrast, when the number of resources was equal to the number of recipients, children consistently showed a tendency to divide the resources equally among all the recipients, with little regard for the principles of close relations or reciprocity. This bias could have been due to a spontaneous tendency or to a rule that was explicitly taught by parents and that mandates performing a one-to-one mapping between available resources and potential recipients.

Negative reactions to inequity in human adults are universal (e.g. Fehr & Rockenbach, 2003; Kahneman, Knetsch & Thaler, 1986) and several studies have also found them in some non-human species such as brown capuchin monkeys (Brosnan & de Waal, 2003; see also Lakshminarayanan & Santos, 2008), chimpanzees (Brosnan, Schiff & de Waal, 2005) and dogs (Range, Horn, Viranyi & Huber, 2008). Capuchin monkeys and chimpanzees react negatively to inequity in reward allocations; for example, they are likely to throw a reward back to the experimenter when two animals participate in a 'give-and-take' game with the experimenter and they are given unequal rewards on trials in which they perform equally. Moreover, male chimpanzees show such negative reactions not only when they are the victims of unequal allocation of rewards (e.g. they received a piece of carrot while their partners received grape, which chimpanzees universally prefer to carrots), but also when their partner is the victim of the experimenter's inequity

in that their reward was *more* attractive than the one given to their partner (Brosnan, Talbot, Ahlgren, Lambeth & Shapiro, 2010). This evidence supports the claim that some species may have evolved an ability to detect inequity that does not depend on explicit teaching, peer interaction or verbal reasoning (Darwin, 1871/2004).

The present experiments were aimed at assessing whether infants can take into account the outcome of distributive actions in encoding and reasoning about agents' actions. In Experiment 1, infants first saw four animation events in which one agent (i.e. a schematic bear or a lion) performed equal distributions towards two recipients (i.e. a cow and a donkey) and another agent performed unequal distributions while a bystander (a chicken) observed all the distributive actions. In the test phase, infants saw the bystander approaching either the egalitarian distributor or the other agent while we recorded both infants' anticipatory looks and their looking times at the final outcomes. Finally, infants were given the chance to choose manually one of the two distributors. Manual choices should reveal a preference or dispositions towards the two distributing agents, whereas anticipatory looks and looking times were used to assess whether infants could attribute their dispositions to other agents and use such attributions to anticipate or interpret their behaviours.

Experiment 1

Method

Subjects

Participants ($N = 36$) were divided in two age groups: 16 10-month-olds (nine females; mean age = 10 months 23 days, range = 7 months 2 days through 12 months 18 days) and 20 16-month-olds (13 females; mean age = 16 months 0 days, range = 12 months 24 days through 18 months 27 days). To our knowledge, no infant had participated in previous experiments. One participant in the younger group was excluded because he did not follow the familiarization events.

Apparatus

The experiment was conducted in a quiet room of day nurseries in Rovereto (Italy). A Tobii 1750 eye tracker was used to collect data on gaze direction and looking times. The eye tracker was integrated into a 17-inch monitor and the stimuli were presented on this monitor via a computer running the Tobii's Clearview AVI presentation program. Each infant was seated on an educator's lap, 50 cm from the monitor while the experimenter was behind a white curtain and controlled the stimuli presentation using a laptop computer. Two cameras were also used to record the testing sessions; one was placed behind the monitor to record infants' faces

and the other was placed behind the infant to record the animations.

Stimuli and procedure

The testing session started with a 5-point calibration procedure in which a picture of an infant toy (either a rattle or a puppet) appeared on the screen accompanied by attractive sounds. To pass the calibration phase infants had to fixate successfully at least three points.

Familiarization trials. Each infant was presented with six familiarization trials (four in the first familiarization phase and two in the second), one test trial involving animation stimuli and one test trial on a manual choice task. An attractive sound was also used at the beginning of each trial. The four trials in the first familiarization phase were aimed at providing infants with information about the fairness or unfairness of the two distributors. On each of the first four familiarization trials, infants were shown four animals and two multicoloured disks on a green lawn. One of the animals (a chicken) always

played the role of the ‘observer’. Another animal (a lion or a bear) played the role of ‘distributor’ of the two disks, while the other two (a donkey and a cow) played the role of ‘receivers’. All familiarization trials started by showing the distributor in the centre of the screen close to the two multicoloured disks. Next, the chicken entered, brought the two disks closer to the distributor and rested at the bottom of the screen, looking at the distributor which was fully visible both to him and to the child. Then the receivers entered the scene, one by one, moved towards the centre and then moved back, resting one on each side of the screen. From this point, familiarization trials differed depending on the type of distributive action displayed. In familiarization trials with *equal distributions* (E), the distributor gave one disk to each receiver (see Figure 1). In the familiarization trials with *unequal distributions* (U) the distributor gave both disks to one of the two receivers (Figure 1). About half of the infants saw the same agent performing two equal distributions and then they saw the other distributor performing two unequal distributions (Order 1: EEUU). The other half of the participants saw the event types in reverse order

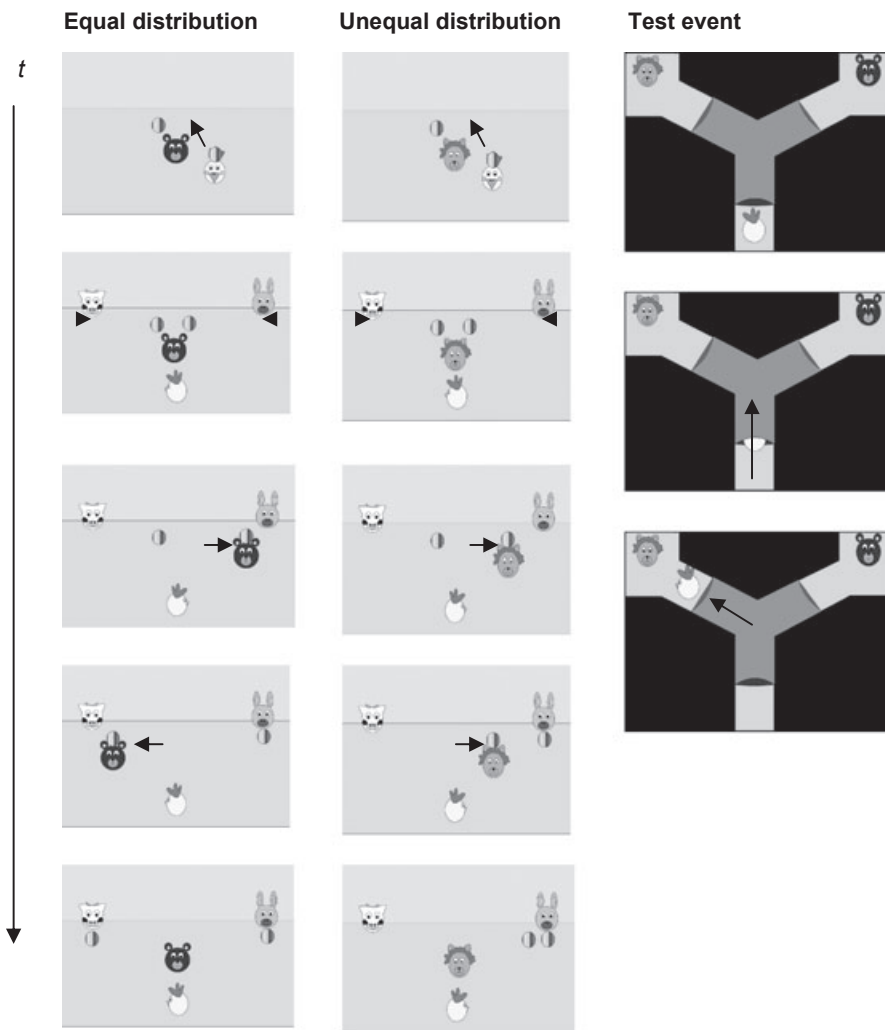


Figure 1 Illustration of the familiarization and test events used in Experiment 1.

(Order 2: UUEE). About half of the infants in each age group saw the lion performing equal distributions and the bear performing unequal distributions, and the rest of the participants saw the lion performing unequal distributions and the bear performing equal distributions. In the unequal distribution trials, for approximately half of the participants in each age group the 'lucky recipient of all resources' was the cow and for the other half it was the donkey (for more details on counterbalancing conditions, see Tables 1 and 2 in the Supplementary Materials).

In the second familiarization phase, infants were shown twice the following event: the chicken entered into a Y-shaped tunnel from a bottom entrance and came out from one of the two upper exits. In each age group about half of the subjects saw the agent going out first from the left exit and then from the right exit and other half of the subjects saw the two exits in the reverse order. These two trials were aimed at familiarizing the infants with the tunnel and the possibility of passing through it. Familiarization trials ended when the infants looked away for more than 2 consecutive seconds, as determined by one of the experimenters, or 60 s elapsed. The duration of the animation events shown in each familiarization trial was 65 s.

In the test phase, infants were presented with two test trials, one using a final animation event (Figure 1) and the other one using a manual choice task. The animation test event started with the observer at the bottom of the monitor, one of the two distributors near one of the two upper exits of the tunnel and the other distributor near the other exit. For half of the infants the fair distributor was on the right side and for the other half it was on the left side of the monitor. There was no clear obstacle or barrier in the scenario that prevented the chicken from seeing where the two distributors were at time of the test trial. The chicken entered into the tunnel and, after 3.5 sec it came out to approach either the fair or the unfair distributor. The presence of the tunnel allowed us to record anticipatory gazes towards one of the two upper exits. Half of the infants saw the observer approaching the fair distributor and the other half saw the observer approaching the unfair distributor. Test trials ended when the infants looked away for more than 2 consecutive seconds or 60 s had elapsed.

After seeing the animation test event, all infants were given a manual choice task. Infants were shown two 10 cm × 13 cm pictures of the two distributors mounted on foam board. The pictures were placed in front of the infants using a 32 cm × 28 cm yellow tray. Infants were encouraged to choose one when asked, 'Which one do you want? Pick it up.' The purpose of this task was to assess infants' preference for fair or unfair distributors. In each age group, about half of the participants saw the fair distributor on the left and the unfair distributor on the right, and the others saw the fair distributor on the right and the unfair one on the left.

Results and discussion

Looking times at the end of four trials in the first familiarization phase and at test trials, first looks on test trials and responses on the manual choice task were coded independently by one experimenter and by an independent judge who was blind to the fairness of the distributors. The inter-judge reliability for looking times was very high (Pearson's $r = .99$ for each familiarization trial and for test trials). The analyses reported below were carried out on the looking times coded by the experimenter. In the responses on the manual choice task the agreement between the two judges was perfect.

Familiarization trials

Infants' looking times at the event outcomes of trials in the first familiarization phase were analyzed in a 2 (age group) × 2 (distribution type) analysis of variance with distribution type as a within-subject variable. The beginning of the outcome started when the distributor had finished its allocation of resources. Given that there were two homogeneous trials for each distribution type, the mean of these two trials was entered in the analysis. This analysis revealed only a significant main effect for age group, showing that the older infants looked significantly longer than the younger infants, $F(1, 34) = 4.63$, $p = .04$, $\eta_p^2 = .120$, $p_{\text{rep}} = .892$. However, in both age groups, infants did not look significantly longer at the outcome of equal or unequal distributions (10-month-olds: $M_s = 12.7$ s and 13.9 s; 16-month-olds: $M_s = 18.0$ s and 19.8 s, respectively).

Test trials

To assess infants' expectations about the observer's search actions we used gaze replay files exported using the Tobii Clearview program showing infants' eye motions and fixation points. From these gaze replay files, we coded the first look infants made, after the 'observer' entered into the tunnel, towards one of the two 9 cm × 12 cm Areas of Interest (AoIs) surrounding the two distributors and the two upper exits of the tunnel. The objects in each AoI occupied about one-third of the AoI's areas and the total viewing area on the monitor measured 41.1 × 38.6 cm.

Eleven out of 16 10-month-olds and eight out of 20 16-month-olds looked first at the AoI that included the fair distributor, $p = .210$, $p_{\text{rep}} = .716$ and $p = .503$, $p_{\text{rep}} = .500$, two-choice binomial test, two-tailed, respectively. Neither age group showed a significant bias for one of the two AoIs, suggesting that they did not anticipate that the agent would go towards the fair or the unfair distributor.

We also coded the *total looking time* at the outcomes of the test trials, starting from the moment the bystander came out of the tunnel. Infants' total looking times on the test trial in each age group were analyzed in two

separate 2 (distributor identity: lion or bear) \times 2 (test event type: approach the fair vs. the unfair distributor) analyses of variance (ANOVA). The only significant effect we found was a significant effect for event type in the older age group, $F(1, 16) = 5.04$, $p < .04$, $\eta_p^2 = .24$. The looking times of one subject in the younger group were not included due to experimenter error. Ten-month-olds did not look reliably longer at test trials showing the observer approaching the unfair distributor compared to the trials showing an approach toward the fair distributor ($M_s = 20.87$ s and 16.77 s, respectively), $t(14) = .69$, $p = .501$, $p_{\text{rep}} = .499$. By contrast, 16-month-olds looked significantly longer at test trials showing the agent approaching the fair distributor than at test trials showing the agent approaching the unfair distributor ($M_s = 25.36$ s and 11.53 s, respectively), $t(18) = 2.37$, $p = .029$, $p_{\text{rep}} = .910$ (see Figure 2).

In each age group, the identity of the distributor (bear vs. lion) did not have a significant main effect on infants' looking time and it did not interact with the event type variable (all $ps > .14$). Similar ANOVAs were also run to assess the possible effect of the identity of the receiver (cow vs. donkey) in the unequal distributions familiarization trials. These analyses also found no significant main effect for the receiver identity factor nor for a significant interaction of such factor with the event type factor (all $ps > .20$).

Infants in the older age group looked longer at events showing the chicken going toward the fair rather than the unfair distributor. This result is in line with the looking time patterns reported by Kuhlmeier *et al.* (2003) in their study on infants' attribution of behavioural dispositions towards helping and hindering agents. As in the present study, infants in that study looked reliably longer at test events showing an approach towards the agent that manifested a positive disposition (the 'helper') than at events showing an approach towards the agent that

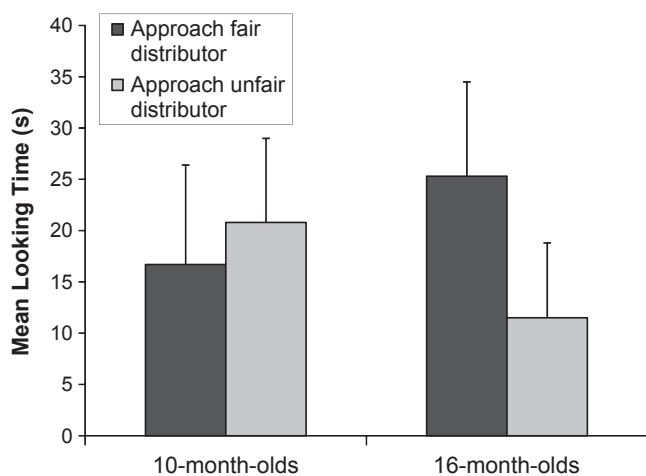


Figure 2 Mean looking times (with standard error bars) to the test movies showing an approach to agents that had previously performed equal distributions of resources ('fair distributors') or unequal distributions ('unfair distributors').

showed a negative disposition (the 'hinderer'). In both studies infants looked longer at events that appear to be a natural continuation of the events observed during the familiarization phase.

The results of the manual choice task provide converging evidence on infants' ability to evaluate distributive actions. Separate preliminary tests on each age group showed that the fair distributor's identity (lion vs. bear), the side of the fair distributor (left vs. right), the identity and fairness of the distributor that was approached by the chicken in the visual test event did not affect infants' responses on the manual choice task (Fisher exact probability test, all $ps > .8$). Three 16-month-olds were excluded because they did not choose any distributor. Nine of the 16 10-month-olds and 14 of the 17 16-month-olds chose the fair distributor, $p = .803$, $p_{\text{rep}} = .273$, and $p = .012$, $p_{\text{rep}} = .945$, two-choice binomial test, two-tailed, respectively. In sum, the older group, but not the younger group, showed a significant tendency to pick up the fair rather than the unfair distributor.

One may suspect a possible confounding effect of perceptual exposure on infants' performance in the manual choice test. Specifically, in the manual task children may have had a tendency to pick up the agent they have looked at longer in the previous visual task. To test this possibility, we examined whether infants who picked up the fair agent in the manual choice task did indeed show longer looks at fair distributors than unfair distributors and those who picked up the unfair one showed the opposite pattern of looking times. In the older age group, children who chose the fair distributor in the manual task looked longer at the equal distributor (22.9 s) compared to the unequal distributor (12.3 s) in the visual test; but this pattern was also found in those who picked up the unfair distributor (32.4 s and 12.8 s, respectively). In the younger age group, children who chose the equal distributor looked longer at the unequal distributor (23.4 s) than at the equal distributor (13.2 s) in the visual test, while those who picked up the unfair distributor showed the reverse pattern (18.3 s and 22.7s, respectively). However, a 2 (manual choice) \times 2 (test event type) ANOVA showed that such interaction was not significant, $F(1, 12) = 1.45$, $p > .21$, $\eta_p^2 = .11$. So, although the small numerosity of the samples indicates some caution in drawing any conclusion, the available data provide no hint of an effect of amount of perceptual exposure to fair and unfair agents in the visual test trials on infants' performance in the manual choice task.

In sum, 16-month-olds' looking times and manual choices suggest that they were sensitive to the outcomes of the distributive actions. The results of Experiment 1 suggest that by 16 months infants (1) evaluated the agents on the basis of their distributive actions, (2) preferred the distributor that performed a fair distribution of resources and (3) reasoned about the approach performed by an agent towards a fair or an unfair distributor of resources by assuming that the agent

would prefer the fair one. However, the null results in anticipatory gazes suggest that infants show no evidence of the ability to generate an expectation about the future actions of the 'observer' (i.e. the chicken) in the test trials. Therefore, looking times at the final test outcomes, showing a preference for events in which the observer approached the fair distributor, appear to be the result of a judgment that such events were the most intelligible continuation of the animation scenarios.

Another possibility is that infants may have simply responded to perceptual aspects that differed in the two distributive actions, such as the symmetry of fair distributions and the asymmetry of unfair ones. To assess the hypothesis that the preferences found in Experiment 1 were due to perceptual factors unrelated to the equality of the distributions, such as a preference for distributions ending in one-to-one mapping between resources and salient locations, we carried out a second experiment.

Experiment 2

Method

Subjects

Participants were 15 infants (seven females; mean age = 15 months and 18 days; range = 12 months 24 days through 18 months 15 days). Given the lack of significant results in the younger infants of Experiment 1, in the present experiment we did not test younger infants. No infant had participated in previous experiments.

Procedure

The procedure was similar to the one followed in Experiment 1. The main difference concerned the event stimuli since on both familiarization and test trials the animal recipients present in Experiment 1 were replaced with two inanimate objects (a bottle and a coffee pot) that were present on the stage from the beginning of each familiarization trial. These artefacts never interacted or moved. Given the lack of any agent-like morphological or dynamic cue, it is very unlikely that infants could categorize these objects as agents (e.g. Surian & Caldi, 2010). As in Experiment 1, the identity of the fair distributor and of the receiver in the unfair distribution trials was counterbalanced across subjects in each age group.

Results

Looking times at the end of each trial, first looks on test trials and responses on the manual choice task were coded independently by one experimenter and by another judge who was blind to the fairness of the distributors. For looking times, the inter-judge reliability

was very high (Pearson's $r = .99$ on both familiarization and test trials). The inter-judge disagreement was found on the coding of the first saccades.

Familiarization trials

Looking times at the outcomes of balanced and unbalanced distributions ($M_s = 18.9$ s and 15.6 s, respectively) did not reveal a significant preference for one of the two events, $t(14) = 1.47$, $p = .162$, $p_{\text{rep}} = .757$.

Test trials

On test trials, infants did not show an effect of agent fairness on anticipatory looks (five out of 15 infants first gazed at the fair distributor AoI, $p = .301$, $p_{\text{rep}} = .644$, two-choice binomial test, two-tailed) nor did they look significantly longer at one of the two types of outcomes (observer approaching the balanced or unbalanced distributor: $M_s = 31.67$ s and 23.75 s, respectively), $t(13) = .81$, $p = .432$, $p_{\text{rep}} = .548$. On the manual choice task, the distributor identity and the side of distributor location did not have any significant effect on infants' responses. Five of the 15 infants chose the balanced distributor, $p = .301$, $p_{\text{rep}} = .644$, two-choice binomial test, two-tailed. The patterns of manual choices in Experiments 1 and 2 were significantly different, $\chi^2(1, N = 32) = 6.04$, $p = .010$, $p_{\text{rep}} = .940$.

Overall, these results rule out the hypothesis that the response patterns found in Experiment 1 were due to low-level features such as the symmetry of equal distributions, or to a preference for distributions ending in one-to-one mapping between resources and salient locations.

General discussion

Infants aged 12 to 18 months showed a sensitivity to the fairness of distributive actions both when they observed the final outcome of test events and when they chose manually between distributors that performed equal and unequal distributions. The effect of agent fairness on their manual choices indicates that infants were sensitive to the different outcomes of the distributive actions performed by the two agents. Moreover, they looked longer at the outcomes of test events showing an agent approaching the fair distributor, as opposed to events showing the agent approaching the unfair distributor. This suggests that they preferred to look at outcomes that completed the scenarios more coherently. Previous studies showed that infants' early social evaluations take into account whether an agent helped or hindered another agent's attempts to reach a goal and these successes have been interpreted as revealing some aspects of the innate foundations of human morality (Hamlin *et al.*, 2007; Kuhlmeier *et al.*, 2003; Wynn, 2008). The present

results suggest that infants can also evaluate agents by taking into account their fairness in distributive actions.

Mature reasoning about distributive justice includes principles of equity that require computing relative need or merit as well as considerations about the efficiency of different possible distributions (Hsu *et al.*, 2008). To avoid making events too long and possibly too difficult to process and remember for our subjects, in the present study we decided to use event stimuli that did not provide any information on recipients' relative merit or need. Since relative need and merit are cues that elementary school children use systematically to evaluate distributive actions (e.g. McGillicuddy-De Lisi *et al.*, 2006; Sigelman & Waitzman, 1991), it would be very important for future studies using nonverbal tasks to assess whether infants can also use such cues to evaluate a specific distribution of resources. This type of investigation will help to clarify whether infants are limited to a very simple egalitarian rule ('everybody should receive the same'), or they can also rely on more complex equity principles that link the evaluation process to relevant information concerning the relative merit and needs of possible recipients.

An equity principle that takes into account relative merit may be present in adult non-human primates. For example, chimpanzees show negative reactions to unequal outcomes when different rewards (a highly valued grape compared to a less desirable piece of carrot) are given by the experimenter in response to similar task performance (Brosnan *et al.*, 2010). Crucially these reactions did not emerge when rewards were given for free (as was the case for the events used in the present study). These results could be due to the fact that chimpanzees were used to unequal allocation of 'free' rewards, or they could suggest that chimpanzees are sensitive to relative effort. The fact that infants responded to the inequitable allocations of free rewards is likely to result from various procedural differences across studies involving human and non-human subjects, but is also suggestive of cross-species differences.

We doubt that the present results are due to infants' ability to use information on distributive actions to assess agents' popularity rather than their fairness. One may propose that by seeing an agent that distributes resources to two recipients rather than one, infants may have inferred that the former is more popular than the latter and this may have affected their manual preferences and looking times. While this is a possibility that needs to be tested in further studies, at present there is no evidence to suggest that infants rely on distributive actions to assess the popularity of the distributors. Therefore we think it is more in line with previous results on social evaluations concerning positive and negative action outcomes to propose that infants' sensitivity to the outcomes of distributive

actions reveals their emerging understanding of the principle of fairness.

In contemporary theories of moral competence, the role played by emotions, empathy and tacit principles is a hotly debated question. The spontaneous emergence of a sense of fairness in infants is compatible and could be predicted both by theories that emphasize the role of empathic reactions in moral intuitions (Haidt, 2001) and by theories that emphasize the role of innate domain-specific tacit principles (Cushman *et al.*, 2006; Hauser, 2006; Rawls, 1971). In the latter case, the current proposals simply need to enrich the set of principles proposed so far with an 'equality' or 'fairness principle' that applies to agents' distributive actions. As for the former, numerous works have demonstrated that emotional reactions play an important role in moral intuitions. Thus, one could also propose that the aversion to inequitable distributions is guided by empathic reactions related to the pain produced in the victims of such unfair distributions (Hoffman, 1991; Smith, 1759/1948). We believe that this proposal faces a serious problem. For example, an empathic reaction simply driven by the perception of the victim's pain, by itself, falls short of distinguishing between a person that is suffering because of an unjust violation of her rights and a person that is suffering because of causes unrelated to ethical violations, such as an unlucky course of events (Nichols, 2008).

In relation to this problem, Leslie, Mallon and DiCorcia (2006) have shown that preschoolers do make such a distinction and that children with autism, a disorder that is associated with severe and persistent deficits in empathy and mindreading skills (e.g. Surian & Leslie, 1999), do not fail tasks assessing basic moral reasoning (see also Blair, 1996). These results on children with autism suggest that, contrary to what one would predict from moral sentimentalism, the early expression of moral intuitions in young children does not depend on intact empathic and mindreading skills. Thus, early negative evaluations of unequal distributions may not rely on infants' ability to empathize with the victims of such distributions, their understanding of agents' goals (e.g. Gergely & Csibra, 2003), or their rudimentary ability to reason about agents' representational mental states (e.g. Luo & Baillargeon, 2010; Surian, Caldi & Sperber, 2007), but rather on intuitions based on a tacit principle of fairness.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Table S1. Participants in Experiment 1 as a function of age counterbalancing conditions.

Table S2. Participants in Experiment 2 as a function of counterbalancing conditions.

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