Give What You Get: Capuchin Monkeys (*Cebus apella*) and 4-Year-Old Children Pay

Forward Positive and Negative Outcomes to Conspecifics

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Abstract

The breadth of human generosity is unparalleled in the natural world, and much research has explored the mechanisms underlying and motivating human prosocial behavior. Recent work has focused on the spread of prosocial behavior within groups through paying-it-forward, a case of human prosociality in which a recipient of generosity pays a good deed *forward* to a third individual, rather than *back* to the original source of generosity. While research shows that human adults do indeed pay forward generosity, little is known about the origins of this behavior. Here, we show that both capuchin monkeys (*Cebus apella*) and 4-year-old children pay forward positive *and* negative outcomes in an identical testing paradigm. These results suggest that a cognitively simple mechanism present early in phylogeny and ontogeny leads to paying forward positive, as well as negative, outcomes.

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Humans frequently and willingly engage in costly behaviors that benefit others,

even when their actions are anonymous and when those helped are total strangers [1,2].

This proclivity for prosocial behavior is unparalleled in the natural world and is thus

thought to play a key role in large-scale cooperation unique to human society [3]. As a

result, much research has been devoted to understanding the social, cognitive, and

biological processes that encourage (and discourage) prosociality in adult humans [4–7].

Recently, researchers have begun to explore the spread of prosocial behavior within

populations [8,9]; specifically, several studies have examined when and why people pay

forward prosocial behavior [10,11]. This concept of "paying-it-forward" is simple:

Person A helps Person B and Person B, rather than paying this kindness *back* to Person

A, pays it *forward* to Person C, thus facilitating the spread of prosocial behavior beyond

the dyad to a larger group of individuals. While experimental research [9,12,13] and

real-life accounts [14] indicate that humans do pay forward positive outcomes, the

psychological underpinnings of such behavior remain unresolved. Traditional

explanations for paying forward positive outcomes tend to rely on socially and

cognitively complex mechanisms including gratitude [15–18], cultural and moral norms

[19,20], and processes requiring sophisticated perspective-taking abilities [21]. Taken

together, these social and cognitive constraints might suggest that paying forward

generosity is a uniquely human phenomenon.

However, a comprehensive review of the existing literature suggests that the tendency to pay-it-forward may instead be explained by more rudimentary behavioral strategies that are not, in fact, unique to human adults. Specifically, it is possible that people act on the basis of the maxim: "help anyone, if helped by someone" (hereafter, help-if-helped) [22]. Unlike more cognitively complex explanations for the propagation of prosocial behavior, this strategy does not require memory of the identities of interaction partners [26], sensitivity to one's own reputational status [27,28], the capacity to calculate the potential costs and benefits of prosocial behavior [29], or the use of self-control to inhibit initial selfish urges [30,31]; instead, the strategy simply requires that individuals do to others what was done to them. Both mathematical models [23,24] and laboratory simulations [12,13,25] have demonstrated that a simple rule like help-if-helped could lead to self-sustaining pay-it-forward systems. Moreover, experiments indicating that rats (*Rattus norvegicus*) pay forward helping behaviors [32] provide further evidence that complex and/or uniquely human social and cognitive capacities are not required for organisms to pay forward generosity. Indeed, these findings show that a help-if-helped strategy is not only sufficient to support the propagation of prosocial behavior within populations, but also that it likely predates more discriminating forms of cooperative behavior that rely upon the complex social and cognitive abilities found only in human adults.

Furthermore, the majority of existing studies investigating the psychology of paying-it-forward focus exclusively on the prosocial side of paying behavior forward—that is, on paying forward *positive* outcomes. However, laboratory simulations of pay-it-forward behavior suggest that negative outcomes are just as likely to be paid forward in

public goods games as positive ones [9], and experimental evidence suggests that—in

some situations—adults pay forward greed *more* than generosity [10]. These findings,

along with a long history of literature on displaced aggression [33], call into question the

proposed role of prosocial intentions, positive emotions and moral norms in paying

forward like outcomes. Instead, they suggest the existence of a strategy even more

simple than help-if-helped: they suggest that pay-it-forward behavior may be based on

the rudimentary rule of "give what you get" (hereafter, give-what-you-get).

　　　　Taken as a whole, this set of findings hints that existing research—which

typically divides paying-it-forward into separate positive and negative phenomena—may

be neglecting a more parsimonious explanation for the propagation of behavior in

general. While some accounts of paying it forward favor cognitively and morally rich

accounts of human kindness [34,35], empirical evidence suggests that these behaviors

may instead be rooted in a general tendency to reciprocate both positive and negative

behaviors in kind [9]. If this simple explanation holds true, we would expect to see

behaviors consistent with a give-what-you-get mechanism present early in human

development, and possibly even in non-human primates.

　　　　The current study tests this possibility by examining pay-it-forward tendencies in

4-year-old children and capuchin monkeys (*Cebus apella*). While there is evidence that

capuchin monkeys [36–38] and young children [39–42] consistently take advantage of

no-cost opportunities to act prosocially toward conspecifics, both groups lack certain

capacities key to current explanations of paying-it-forward in human adults. Specifically,

capuchin monkeys largely fail at tasks that rely on perspective-taking abilities [43–47],

self-awareness [48,49], and the ability to evaluate and reflect upon their own knowledge

states [50,51] – all cognitive capacities assumed necessary for the experience of gratitude [52–54] and implicated in current explanations for paying forward generosity. Similarly, before the age of five, children have difficulty in evaluating the perspectives and knowledge states of others in a consistent manner [55–58] and in evaluating and reflecting upon their *own* thoughts and knowledge states [59]. Unlike capuchin monkeys, however, young children have likely been exposed to social and moral norms advocating paying forward generosity in some form or another. Testing these populations using an identical paradigm allows us to identify the minimal cognitive abilities required to pay-it-forward and illuminates the role uniquely human social and moral norms play in the propagation of paying forward generosity.

Participants in the current study took part in a chain of non-anonymous donation games in which individuals first received a positive or negative outcome from a member of their social group, and then had the chance to distribute a positive or negative outcome to a different member of this social group. We used only "no-cost" options, in which participants making donation decisions received the same outcome regardless of the outcome they chose to deliver to a group member. The use of a "no-cost," (or non-zero-sum) paradigm reduces the role of self-interested motivations, accounts for between-species differences in self-control and/or reputational concerns, and minimizes cognitive demands imposed by trade-off related calculations. Controlling for these factors allowed us to explore the minimal social and cognitive factors underlying pay-it-forward strategies, thus making it possible to identify the most parsimonious explanation for the donation behaviors observed in monkeys and children.

Materials and Methods

Ethics Statement

This study was carried out in strict accordance with the recommendations in the Guide for Care and Use of Laboratory Animals of the National Institutes of Health. The protocol for non-human primates was approved by the Institutional Animal Care and Use Committee at Yale University (Protocol Number: #2008-10678). The treatment of human participants in studies described in this paper was in accordance with the ethical standards of the American Psychological Association. Participants' parents provided written informed consent and all procedures were approved by the Human Research Protection Program at Yale University.

Participants

Monkey participants were 4 brown capuchins (*Cebus apella*) ranging in age from 5-15 years at the conclusion of the study (1 male [NN], 3 females [HG, HR, JM]; $M_{age}=$ 134.86 months; $SD=$ 55.05). Our capuchin participants were members of the Yale Comparative Cognition Laboratory colony where they were socially housed in a large indoor enclosure equipped with natural branches and toys. Capuchins were fed monkey chow prior to testing and had access to water ad libitum. All participants had previous experience with reward distribution tasks involving conspecifics [e.g. 36] and were familiar with one another prior to testing. To control for the effects of previous experience and developmental differences in social cognitive abilities, only mature adult monkeys who had previously demonstrated an understanding of the apparatus (Unpublished data) were involved in the current study. Although these strict selection criteria limited the number of monkeys we were able to include in the study, our final

sample size is nonetheless comparable to those in other studies of social cognition in

brown capuchin monkeys [38,60–62].

  We also tested 31 four-year-old children (10 males, 21 females; M_{age}= 54.68

months; SD= 3.45) recruited from preschools in the greater New England area.

Participants were tested in mixed gender groups comprised of children from the same

classroom; as a result, all children were familiar with one another prior to testing. Care

was taken to ensure that children never received from, or gave to, members of their own

family. Group size was constrained by the number of consenting participants per class,

with groups ranging in size from 3-7 individuals.

General Methods

  Testing was performed using identical novel apparatuses for the monkeys (Figure

1) and the children (Figure 2) that allowed participants to choose between two distinct

distributions. Each distribution provided an allocation for an Actor (the participant

manipulating the apparatus), and an allocation for a Recipient (a second participant who

merely received whatever he/she was given). The apparatus was situated between the

Actor and the Recipient such that the two participants were able to see one another and

the distribution options over the top of the apparatus. In order to equate the non-verbal

methods as closely as possible across the two populations, children were asked not to

speak to one another or signal their preferences in any way. The Actor was always the

participant seated on the side of the apparatus with two identical levers. By pulling the

lever on her left, the Actor could distribute the leftmost allocations to herself and the

Recipient; by pulling the lever on her right, the Actor could distribute the rightmost

allocations to herself and the Recipient. Allocations were simultaneously delivered via a

chute to both participants immediately following the Actor's choice, and the two

remaining allocations were removed from the apparatus by the experimenter.

Using this apparatus, monkeys and children participated in a series of overlapping

donation games, such that each participant in a chain first received from, and then gave to

different conspecific members of their social groups. Test sessions began when an initial

Actor distributed an outcome to a conspecific Recipient. After both participants had

collected their respective allocations, the Recipient moved to the opposite side of the

apparatus to assume the role of Actor and the previous Actor left the testing area. At this

point, a third conspecific—ignorant to the outcome of the previous interaction—entered

the testing area to assume the role of Recipient, and the new Actor was asked to choose

between the same distribution options presented to the previous Actor. This process

continued until all participants had received from, and subsequently given to, a

conspecific group member, with the initial Actor serving as the recipient for the final

participant. Data from the initial Actor was excluded from analysis. Efforts were made

to ensure that testing and data collection procedures were identical between species

whenever possible (however, see the Supporting Materials (S1) for between-species

methodological differences).

Allocations were placed inside of clear, round, plastic containers that allowed for

easy distribution via the apparatus. The placement of the distribution options

(positive/negative) into the apparatus was counterbalanced to control for the possible role

of side biases in participant's donation choices (see S1 for more details). For each test

trial, Actors had the option to deliver one of two outcomes to the Recipient: a positive

outcome that delivered a high-value allocation to both herself and the recipient, or a

negative outcome that delivered a high-value allocation to herself and a low-value allocation to the Recipient. A positive outcome for monkeys consisted of a grape for both the Actor and the Recipient; a negative outcome consisted of a grape for the Actor and a piece of spinach for the Recipient. A positive outcome for children consisted of 4 small, star-shaped stickers for both the Actor and Recipient; a negative outcome consisted of 4 small, star-shaped stickers for the Actor and 1 small, star-shaped sticker for the Recipient. Actors always received the high-value reward, regardless of what they chose to distribute to Receivers; thus, there was no cost to generosity and no benefit from greed—participants' distributions to conspecifics revealed the tendency to pay forward outcomes, divorced from potential selfish motives present in zero-sum distribution tasks. In addition, using the same value reward across both options for the Actors removed any confounds related to differences in or distractions from their own outcome.

Results

Actors' distributions were strongly related to previously received outcomes, for both monkeys (n=4 participants, 22 trials, Fisher's exact, p=.03) and children (n=48 children, 48 trials, Fisher's exact, p=.009). Monkeys paid forward negative outcomes 75% of the time and positive outcomes 80% of the time; children paid forward negative outcomes 72% of the time and positive outcomes 70% of the time. The rates at which positive versus negative outcomes were paid forward did not significantly differ in monkeys (X^2(1, N=17)=.06, p=.81) or children (X^2(1, N=34)=.12, p=.73). Similarly, the rates at which children versus monkeys paid forward positive (X^2(1, N= 33)=.38, p=.54) and negative (X^2(1, N=37)=.04, p=.85) outcomes were not statistically different across species. See Figure 3 for all results.

We also performed a series of logistic regressions in order to confirm that the giving behavior of both children and monkeys truly reflected a tendency to pay forward both positive and negative behavior in kind. If this was the case, then previously received outcomes should predict giving behavior even when controlling for all other possible variables (e.g., identity of initial Actor, identity of Recipient). A regression on monkey giving behavior (positive, negative) using the predictors of *initial Actor identity*, *focal participant identity*, *final Receiver identity*, and *received outcome* (positive, negative) revealed that only *received outcome* affected giving behavior, Wald's $X^2(1) =$ 7.34, $p < .01$; all other predictors $p > .45$. A regression on children's giving behavior (positive, negative) using the predictors of *initial Actor gender*, *focal participant gender*, *final Receiver gender*, and *received outcome* (positive, negative) revealed that only *received outcome* affected giving behavior, Wald's $X^2(1) = 7.34$, $p < .01$; all other predictors $p > .16$. Taken together, these analyses confirm that the giving behavior of both children and monkeys can be attributed to previously received outcomes—that is, they paid both positive and negative behavior forward in kind. See Tables S1 and S2 in the Supporting Materials for trial-by-trial data.

Discussion

Our results suggest that the propagation of both positive and negative behavior within social groups may stem from a mechanism that is both cognitively simple and evolutionarily old. Our finding that monkeys and 4-year-old children paid forward positive outcomes to conspecifics is line with previous behavioral findings in rats [32], and confirms that the act of paying forward positive events does not require complex emotions [15], human-specific norms [20], or sophisticated perspective-taking abilities

[21]. Our results also indicate that both populations paid forward positive *and* negative

outcomes, demonstrating that paying forward behavior is not limited to prosocial

interactions. Instead, our findings suggest that paying forward behavior in monkeys and

children is best explained by a simple give-what-you-get mechanism--one that may be the

foundation upon which more complex cooperative behaviors are built in adult humans.

Overall, our findings are consistent with a contingency-based give-what-you-get

strategy, a form of generalized reciprocity in which like begets like, regardless of the

specific recipient or the valence of the outcome [23]. Giving what you get is less

cognitively complex than other forms of reciprocity, and so is a likely explanation for

group-level cooperation in non-human animals [63,64]. Importantly, because

contingency-based strategies like give-what-you-get are not sensitive to recipient identity,

individuals employing them need not differentiate between paying outcomes *forward* and

paying outcomes *back*; they are simply motivated to reciprocate outcomes *in kind*. As a

result, this explanation implies that the pattern of behavior of monkeys and children in

the current study may not necessarily be specific to paying-it-forward, but rather a

reflection of a motivation to reciprocate outcomes in general. If this were the case, we

would expect similar patterns of giving whether the recipient was the same or different

than the individual from whom an allocation was received; that is, we would expect

minimal differences between paying behavior forward and paying behavior back.

However, if the mechanism underlying our results is specific to paying-it-forward, we

would expect different patterns of giving when individuals have the opportunity to pay

outcomes *back* to the initial actor. While the current data do not allow us to make this

distinction, future research could examine the extent to which common and distinct mechanisms underlie these two related behaviors.

In our results, monkeys and children appear to pay forward like outcomes at equally high rates, despite evidence suggesting predispositions toward prosociality in other contexts [39–43]. The current data do not include baseline levels of giving, but a follow-up study comparing general rates of positive/negative outcome distribution with rates after participants receive a positive/negative outcome themselves would offer insight into the relative strength of the drive to pay forward positive vs. negative outcomes. Nonetheless, our findings show a clear pattern of behavior in which giving in both monkeys and children is influenced by the valence of received outcomes; these data suggest that a "give what you get" strategy drives the tendency to pay forward both positive and negative outcomes.

A second (and not mutually exclusive) possibility consistent with our results is that pay-it-forward tendencies are driven by basic affective processes, ones that may be precursors to the more sophisticated emotions observed in adult humans [10]. Whereas affect (i.e. positive and negative feelings) occur automatically [65,66] and across species [e.g., 56], gratitude is considered a secondary emotion requiring additional cognitive resources to interpret initial basic affective responses [15,68,69]. Capuchin monkeys do not possess the suite of cognitive abilities associated with explanations relying on complex emotions like gratitude, and thus these emotions cannot drive pay forward behaviors as some have hypothesized [15–18]. However, both children and capuchins possess basic affective processes that may drive paying forward of both positive and negative outcomes. Indeed, affect has been shown to motivate future behavior in adult

humans [10,25,70–73] as well other primate species [74–76]; further research may

determine the role of affective factors in pay-it-forward behaviors in capuchin monkeys

and children.

        While the form of paying-it-forward we observed in capuchin monkeys and

young children does not require secondary emotions, perspective-taking abilities, or

uniquely human social or moral norms, these factors are likely important in adult

humans. Our results therefore hint that the mechanism underlying pay-it-forward

behavior in children and monkeys serves as a framework around which more

sophisticated social, emotional, and moral decision-making systems are built in adult

humans. For example, while adult humans—like monkeys and children—surely

experience basic affective responses after experiencing a positive or negative outcome,

they may be uniquely be able to draw upon a more sophisticated suite of cognitive

abilities with which to reflect upon their experiences and determine their future actions.

Whereas monkeys and children in our study consistently paid forward negative outcomes

despite the no-cost nature of the task, the general tendency to pay forward negative

outcomes in adults may be overshadowed by more cognitively sophisticated processes

such as cost/benefit analyses [29] or concerns about maintaining one's positive reputation

within the group [77–79][1]. Likewise, it is probable that paying forward generosity in

human adults is not merely due to general positive affect, but is instead the result of

further cost/benefit analyses, secondary emotions like gratitude [15], adherence to

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[1] Relatedly, research shows that human adults often act in strikingly self-interested ways
when cost/benefit analyses tip in their favor and the likelihood of negative reputational
repercussions is low [81,82], suggesting that increased cognitive sophistication doesn't
necessitate increased prosociality, but rather facilitates flexible decision-making
processes.

cultural or religious norms [19], and/or means to attain the warm glow that comes as the result of being the cause of another's good fortune [80]. In the end, though, all of these more cognitively complex factors may merely be building on—or modifying—the simple strategies evident in the behavior of organisms such as capuchin monkeys and human children.

Our results indicate that the propagation of prosocial behavior within groups is not rooted in prosocial motives alone, but instead emerges via a simple mechanism, shared across phylogeny and ontogeny, that encourages paying forward both positive and negative behaviors in kind. Our results suggest that even the most heartwarming acts of paying forward generosity likely have their roots in a simple mechanism that is not limited to prosocial tendencies. While emotions like gratitude and uniquely human norms likely play a role in the extraordinary cases of paying forward generosity that make newspaper headlines, our data suggest paying-it-forward may propagate and persist within social groups, even in the absence of these factors. Although a fascination with the propagation of kindness—and a tendency to explain these behaviors in moralistic terms—may be uniquely human, the mechanism underlying this behavior is likely not.

Figures

Figure 1. Testing apparatus used for monkeys. Monkey Actors pulled one of the two levers to choose an outcome to distribute to the Receiver situated on the other side of the apparatus.

Figure 2. Testing apparatus used for children. Actors pulled one of the two levers to choose an outcome to distribute to the Receiver situated on the other side of the apparatus.
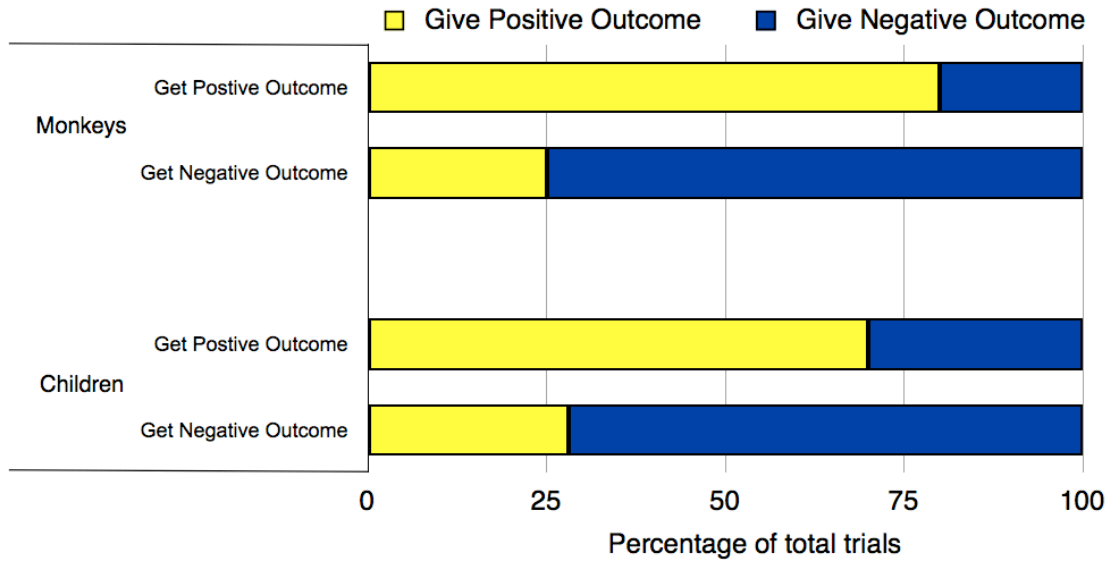
Figure 3. Percentage of total trials in which monkeys and children paid forward positive

and negative outcomes after receiving positive and negative outcomes.

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S1. Supplemental Methods

Monkeys. All monkey participants had extensive experience with the testing apparatus from a previous study. Similar to the testing protocol used for children, monkeys were tested in chains of participants, such that individuals first received from, and then gave to, a familiar conspecific. Unlike the children who were randomly assigned a position in the testing chain, monkeys were tested in predetermined groups of three with the first and last monkey in the chain (AG) being a trained Stooge. The Stooge was trained to pull only the left lever of the apparatus, thus allowing experimenters the flexibility to arrange allocations in the apparatus such that it appeared AG was willingly delivering positive or negative outcomes. The use of a Stooge maximized data collection within a limited sample size by allowing experimenters to control the outcome distributed on the first trial within each chain. AG was chosen to be the Stooge monkey because he had previous experience with the apparatus and was also the lowest ranking monkey in the group, thus controlling for any influence relative rank may have played on the initial or final distribution in each testing chain.

The order in which monkeys were placed within testing chains was determined prior to the commencement of testing and was dictated by the need to control for several social factors. First, precautions were taken to minimize the possibility of task-specific long-term reciprocation by ensuring that a given monkey never served as an Actor for another monkey from whom they had previously received an allocation over the course of testing. However, due to the small number of monkeys in our colony and the nature of the testing paradigm, we were not able to control for direction of the interactions with the

Stooge monkey. While participants both received from, and gave to, the Stooge monkey

over the course of the study, they never did so within the same day and there were often

several days between test sessions for each participant. Second, efforts were made to

control for inter-dyad relationship quality by ensuring that each monkey received from,

and gave to, at least 2 different monkeys over the course of testing. Additionally, no

matrilineal dyads were tested together, meaning female participants never gave to, or

received from, their offspring. Finally, monkeys only participated in one test session per

day (and, thus only received and gave one distribution per day), with an average of $8.35 \pm$

2.3 days between test sessions for each participant in an effort to minimize the possibility

for carry-over effects between test sessions. As a result of these criteria, some monkeys

participated in more test sessions than others; specifically, subject NN participated in 7

test sessions, subject JM participated in 6 test sessions, subject HG participated in 5 test

sessions, and subject HR participated in 4 test sessions. See Table S1 for a detailed table

illustrating all monkey testing chains and individual outcomes.

Monkeys were tested in enclosures that were spatially and visually distant from

the rest of the social group. Each monkey was tested in his/her own enclosure (71 cm^3),

with the apparatus situated between the two enclosures such that both monkeys could see

the allocation distributions and one another over the top of it. Testing began when the

Stooge monkey "chose" to deliver either a positive or a negative outcome to the first

participant (Subject 1). After collecting their respective food allocations, the Stooge left

the testing area and Subject 1 moved into his testing enclosure to assume the role of

Actor. A third monkey (Subject 2)—unaware of the outcome of the previous

interaction—then entered the enclosure vacated by Subject 1 and assumed the role of

Recipient. Subject 1 was then given the option to deliver a positive or negative outcome to Subject 2. After collecting their respective food allocations, Subject 1 left the testing area, Subject 2 moved into her testing enclosure to assume the role of Actor, and the Stooge—unaware of the outcome of the previous interaction—reentered the testing area to assume the role of Recipient for Subject 2. After Subject 2 delivered a positive or negative outcome to the Stooge monkey, the test session was complete and all monkeys were reunited with the social group. With the exception of the Stooge monkey, all monkeys were first a Recipient and then an Actor, creating a chain of allocations where each monkey received *from* and gave *to* different monkeys from their social group.

The first distribution of each testing chain was counterbalanced such that half of the testing chains began with AG distributing a positive outcome and half of them began with a negative outcome; the order in which positive/negative distributions were presented on the first trial was randomized. Finally, the placement of the distribution options (positive/negative) in the apparatus for all Actors was counterbalanced such that each option was presented on the left side of the box 50% of the time and the right side of the box 50% of the time.

Children. Prior to the commencement of testing, children were brought into the testing area from their classrooms as a group to receive training on the operation of the apparatus and an explanation of the testing procedure. A previous study [Leimgruber, Shaw, Santos & Olson, 2012] showed that children found the operation of the apparatus to be quite intuitive, and the present study proved no different. The training procedure consisted of a demonstration of the mechanics of the apparatus using colored bouncy

balls (i.e. "If you pull the lever on the left you will get what is here [point] and you will deliver what is here [point] to whomever is across the table from you."), followed by a series of hypothetical questions regarding the outcomes (i.e. "If I pull this lever, what color ball will I get? Which lever do I pull to deliver a red ball to the person sitting on the other side of the table?"). Once it was confirmed that children understood the apparatus, they were told that they would have a chance to use the apparatus to distribute stickers to themselves and their classmates.

Children were given the opportunity to ask clarifying questions as a group before the experimenters randomly selected two children to remain in the testing area with Experimenter 1. The remainder of each group was taken out of visual and audio contact by Experimenter 2 who kept the children waiting to participate occupied with a distracting task (e.g. reading a book, doing a puzzle, playing with blocks). Tasks were dependent on readily available school materials and were intended to discourage discussion of the experiment between participants. One of the two participants remaining in the testing area was randomly designated the Actor and the other was designated the role of Recipient. The Actor was then given the choice between distributing a positive or negative outcome to the Recipient, and the Recipient received whatever she was given. Once the Actor had made her distribution decision and both children had collected their allocations, this initial Actor left the testing area to join the other children and the original Recipient assumed the new role of Actor. A third child, unaware of what had happened on the previous trial, entered the room to assume the role of the new Recipient and the procedure described above was repeated. This chain of events continued until all children had the opportunity to first receive from, and then give to, a classmate. Similar

to the procedure used with monkeys, the original Actor served as a Recipient for the last

child in the chain. See Table S2 for detailed table illustrating testing chains and

individual outcomes for children. Once all children had participated in the study, they

returned to their classroom as a group. With the exception of the first Actor, all children

assumed the role of Recipient first and Actor second, thus creating a chain of allocations

where each child received *from* and gave *to* different peers from their social group.

The placement of the distribution options (positive/negative) into the apparatus

was varied within test sessions, such that the lever associated with positive/negative

outcomes alternated between participants. As a result, a participant who received a

positive outcome via the lever on the north-facing side of the apparatus would have to

pull the lever on the south-facing side of the apparatus to deliver a positive outcome to a

third conspecific.

Data Collection. All monkey test sessions were videotaped and experimenters recorded

choice data was recorded live during testing; choice data was later confirmed from video

by a second coder. Children's test sessions were not videotaped and choice data was

recorded live during testing. The authors would like to note that a subset of the monkey

testing videos (n=6) are no longer available due to a technical error that occurred while

transferring data.

Table S1. Positive/Negative outcome distribution patterns within testing chains for

monkeys. Each row represents a discrete test session; monkeys only participated in one

test session per day.

Stooge	Give →	Subject 1	Give →	Subject 2	Give →	*Stooge*
Auric	**Positive**	**Jill**	**Positive**	**Honey**	**Positive**	Auric
Auric	**Negative**	**Jill**	**Negative**	**Honey**	**Negative**	Auric
Auric	**Negative**	**Nick Nack**	**Negative**	**Holly**	**Negative**	Auric
Auric	**Positive**	**Nick Nack**	**Positive**	**Holly**	**Positive**	Auric
Auric	**Negative**	**Nick Nack**	**Negative**	Holly	Positive	Auric
Auric	**Negative**	**Honey**	**Negative**	**Nick Nack**	**Negative**	Auric
Auric	**Positive**	**Honey**	**Positive**	**Nick Nack**	**Positive**	Auric
Auric	**Negative**	**Nick Nack**	**Negative**	**Jill**	**Negative**	Auric
Auric	**Positive**	**Nick Nack**	**Positive**	Jill	Negative	Auric
Auric	Positive	Jill	Negative	Holly	Positive	Auric
Auric	Negative	Jill	**Positive**	**Holly**	**Positive**	Auric

Trials in which monkeys 'gave what they got' are bolded. Trials in which monkeys paid

forward negative outcomes are highlighted in blue; trials in which monkeys paid forward

positive outcomes are highlighted in yellow.

Table S2. Positive/Negative outcome distribution patterns within testing chains for children. Each row represents a single testing chain; variance in chain length is due to variance in the number of consenting children per classroom.

Initial Actor	Give →	Subject 1	Give →	Subject 2	Give →	Subject 3	Give →	Subject 4	Give →	Subject 5	Give →	Subject 6	Give →	Subject 7
Male	Negative	Male	Positive	Female	Postive	Female	Positive	Female	Positive	Male				
Male	Negative	Female	Negative	Female	Negative	Female	Positive	Female	Positive	Male				
Female	Negative	Female	Negative	Female	Negative	Female	Negative	Female	Negative	Female				
Female	Negative	Male	Negative	Female	Negative	Male	Negative	Female						
Male	Negative	Female	Negative	Male	Negative	Male	Positive	Female	Positive	Male				
Male	Negative	Female	Negative	Male	Negative	Female	Negative	Female	Negative	Male				
Male	Negative	Female	Negative	Male	Positive	Male	Positive	Female	Negative	Male				
Female	Positive	Male	Negative	Female	Positive	Female	Positive	Male	Negative	Female				
Male	Positive	Male	Positive	Female	Positive	Male	Negative	Female	Negative	Male	Negative	Female	Positive	Male
Female	Positive	Male	Positive	Female	Negative	Female								
Female	Positive	Male	Positive	Male	Positive	Female								
Female	Positive	Male	Positive	Male	Positive	Female								
Male	Positive	Female	Positive	Female	Positive	Male	Negative	Male	Positive	Female	Negative	Male		

Trials in which children (males = M; females = F) 'gave what they got' are bolded.

Trials in which children paid forward negative outcomes are highlighted in blue; trials in which children paid forward positive outcomes are highlighted in yellow.