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Do children interpret costs as signals of commitment to groups?

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Abstract

We explore whether younger children (4- and 5-year-olds) and older children (9- and 10-year-olds) expect a costly signaler (someone who engages in a costly action) to be a more committed group member than someone who engages in a comparatively less costly action. In Experiment 1 ($N=173$), older children and adults—but not younger children—expect a costly signaler wants to be in a group more than a control, and they give more positive evaluations of the costly signaler than the control. In Experiment 2 ($N=84$; ongoing), employing a different manipulation of cost both younger and older children infer that a costly signaler wants their goal more than the control, but they make different evaluations of the costly signaler depending on whether they exerted effort on behalf of a group versus an individual. Future research may be needed to rule out alternative explanations.

Keywords: costly signaling theory; naïve utility calculus; intergroup cognition

Introduction

Garnering a reputation as a reliable cooperator is crucial for living within groups, and so people are motivated to engage in costly actions that signal that they are committed groupmates (Gintis et al., 2001). People engage in taxing and even painful rituals, alter their diets, and donate large amounts of money to show commitment to groups (e.g., Sosis & Bressler, 2003). Indeed, these costly signals of commitment are effective—adults favor costly signalers as cooperative partners. For example, Christian adults in the United States view religious outgroup members (e.g., Muslims) who engage in costly signaling as more trustworthy than fellow Christians who do not (Hall et al., 2015).

Yet, it is unknown whether young children also expect costly signalers to be more committed, trustworthy groupmates. There are several reasons to believe that they do.

First, costly signaling is theorized to be an evolutionary universal (Zahavi, 1975). If costly signaling behavior is an evolutionary adaptation for maintaining allies, then even young children should attend to costly signals and make inferences based upon them. Second, a recently proposed framework in cognitive development, the “naïve utility calculus,” posits that young children assume agents seek to maximize benefits and minimize costs, and further that young children use this premise to make a variety of inferences about agents (see Jara-Ettinger et al., 2016 for a review). In other words, if a person engages in a costly action in pursuit of a goal, then children and adults alike will infer that the

person must ascribe high utility to the goal. In fact, even ten-month-old infants infer agents’ preferences based upon effort expended (Liu et al., 2017). Moreover, children make higher-order inferences and evaluations based on these calculations; for instance, two-year-olds infer that a less competent agent who refuses to help is nicer than a more competent agent who refuses to help (Jara-Ettinger, Tenenbaum, et al., 2015).

Third, children engage in behavior consistent with costly-signaling; six-year-olds, punish others who are unfair to them, even at a cost to themselves (McAuliffe et al., 2015). Further, by kindergarten, children are highly sensitive to their own reputations (see Silver & Shaw, 2018) which leads them to costly, generous displays; for example, five-year-olds give more in public than in private (Engelmann et al., 2018).

In the present research, we extend the naïve utility framework to the group context, hypothesizing that if children are employing a naïve utility framework when evaluating group members then they should construe costly actions on behalf of the group as evidence of commitment to the group. We also explore whether children use this as a signal of a member’s trustworthiness as a groupmate.

In two experiments, participants were introduced to a group and its initiation procedure, which required initiates to incur a cost. Then, participants were told about two new group initiates, one of whom incurs a greater cost during the procedure (i.e., the costly signaler). We then asked participants a series of forced-choice questions.

First, we asked participants which initiate they think wanted to be in the group more. If participants are sensitive to how much the procedure costs the participant, then they should infer that the costly signaler wanted to be in the group more than the other initiate. Second, we asked which initiate a current member of the group prefers and thinks is more trustworthy. If participants not only infer that the greater cost incurred suggests greater desire, but also that costs are a signal of commitment, then they should expect this third group member to prefer the costly signaler. Third, we asked which initiate participants prefer and think is more trustworthy in order to assess whether participants use cost as a “global” or “local” signal. That is, if participants are using costly signals to make “global” inferences about who is better to affiliate with, then they may prefer the costly signaler themselves and think of them as more trustworthy. Alternatively, if costly signals only matter within the context of the group (i.e., are a “local” signal), they may not display a preference themselves.

Finally, we were interested in how these inferential abilities develop across the life course. Given that infants are able to infer desire from costs incurred (Liu et al., 2017), we hypothesized that our youngest participants (4-5-yr-olds) would construe greater cost as greater desire and would infer that the costly signaler wanted to be in the group more than the control. However, it is also possible that younger children do not yet construe costs as signals of quality and trustworthiness and thus may not show these specific expectations.

All methods reported in both experiments were in accordance with procedures approved by our university's Institutional Review Board. In both experiments children and adults only participated once in a single experiment. The research questions, methods, planned sample size, exclusion criteria, and analyses were pre-registered using Open Science Framework's AsPredicted template ([Experiment 1, Children](#); [Experiment 1, Adults](#); [Experiment 2](#)). The power analysis, data, and code for both experiments are also available via [Open Science Framework](#).

Experiment 1

In our initial experiment, we introduced younger children (4-5-yr-olds), older children (9-10-yr-olds), and adults to a novel social group and two people who were joining that group. To join, each person must donate one of their own toys to the group. Each person was shown donating a single toy, but the number of toys each target owned varied: One target donated their one and only toy to the group (the costly signaler), whereas the other target donated one of their four toys to the group (the control). Importantly, in this method the price of joining the group was the same (donating a single toy), but its relative cost varied for the costly signaler versus the control.

Further, we thought this control would be an especially strong test of the power of costly signals because young children often display pro-wealth bias—preschoolers report liking the wealthy more and would rather be friends with the resource rich themselves (Horowitz et al., 2014; Shutts et al., 2016). This tendency would work against preferring the costly signaler since they had fewer resources.

Method

Participants All data for this study were collected between June and September of 2020. In total, $n=71$ younger children (four- and five-year-olds), $n=54$ older children (nine- and ten-year-olds), and $n=101$ adults participated, for a total of $N=226$. Following our pre-registered criteria for exclusion, we excluded 20 younger children, one older child, and 32 adults. After exclusions, $N=173$ participants remained. Broken down by age group, we collected $n=51$ younger children (26 female; $M_{\text{age}} = 5$ years 0 months, $SD = 6$ months), $n=53$ older children (26 female, 1 non-binary; $M_{\text{age}} = 10$ years 0 months, $SD = 6$ months), and $n=69$ adults (31 female; $M_{\text{age}} = 36.13$ years $SD = 10.27$ years).

Materials, design, & procedure All children participated in the experiment via an online video chatting platform and were directed through either a PowerPoint or a Qualtrics survey by a researcher who shared their screen, read aloud the story and questions, and recorded whichever response the child verbally chose. Adult participants were recruited via Cloud Research (Litman et al., 2017) and directed themselves through the experiment via a Qualtrics survey.

Participants were told about a school and a novel social group within the school, the Zarpies. They were told that, in order to join the group, initiates must donate a toy. It was stressed that joining the group was optional and that some children choose not to join a group. Participants were shown two new initiates to the Zarpies. The costly signaler initiate only owned one toy, and they donate their only toy in order to join the group. The control owned four toys and they donated one of their four toys to join the group. Participants were then told that, since both targets donated the required toy, they are now both members of the group. order of presentation was randomized across participants. Participants were asked seven forced-choice questions (see Table 1). Question 1 was always asked first, and Question 7 was always asked last. Question 7 was only asked of child participants, not adult participants. Questions 2-6 appeared in a random order.

Table 1: Questions asked in Experiment 1.

#	Type	Question
1	Direct	Who wanted to be a Zarpie more?
2	3 rd Party Like	In the middle is another Zarpie child. Who does she like more?
3	3 rd Party Trust	In the middle is another Zarpie child. Who does she trust more?
4	1 st Party Like	Who do you like more?
5	1 st Party Trust	Who do you trust more?
6	Control	Who do you think is better at school?
7	Hard	Was it harder for the child on the blue side (left) to join the Zarpies or was it harder for the child on the green side (right) to join the Zarpies?

Scoring & analysis If a participant selected the costly signaler their response was coded as 1, and if they selected the control their response was coded as 0. We fit generalized linear models to see if children's responses differ across the two child age groups (younger children = 4-5's, older children = 9-10's). Age was treated categorically and was contrast coded. Then, for each age group (younger children, older children, adults), we computed a Cochran's Q test to compare participants' responses across all test questions and

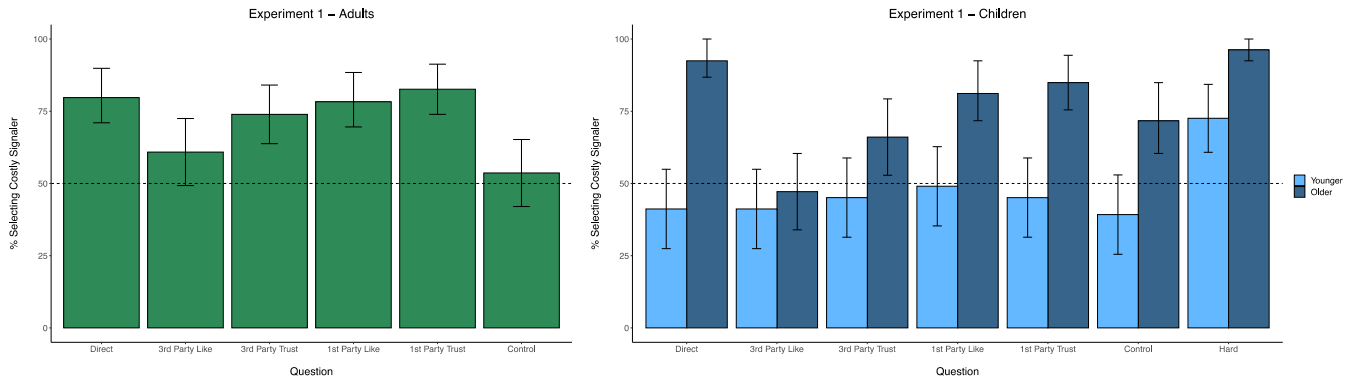


Figure 1: Percent of time that adults (left) and children (right) select the costly signaler for each question in Experiment 1. The dotted line indicates chance (50%), and error bars reflect 95% bootstrapped confidence intervals.

binomial tests to compare how often participants select the costly signaler to chance (50%) for each question.

Results

Age comparisons Younger children’s responses differed from older children’s responses for 6 of the 7 questions (p ’s < .03). The only question where younger and older children responded similarly was when asked who a fellow group member would prefer (the 3rd Party Like question; second set of bars from the left on the right panel of Figure 1).

Younger children Four- and five-year-olds’ rates of response differed by question type, $\chi^2(6) = 17.61, p < .007$. When asked who wanted to be in the group more, who a fellow group member would prefer, who a fellow group member would trust more, who they themselves would like and trust more, and who was better at school, they were equally likely to select the costly signaler and the control (binomial p ’s > .16). However, when asked who had a harder time joining the group, younger children selected the costly signaler 72.5% of the time (binomial $p < .001$). See Figure 1 (right, light blue bars).

Older children Nine- and ten-year-olds’ responses also differed by question, $\chi^2(6) = 54.45, p < .001$. When asked who wanted to be in the group more, who a fellow group member would trust more, who they themselves would like and trust, who was better at school, and who they thought had a harder time joining the group, they selected the costly signaler more often than chance (binomial p ’s < .028). However, when asked who a fellow group member would prefer, they selected both targets at similar rates (binomial $p = .784$). See Figure 1 (right, dark blue bars).

Adults Rates of response among adults also differed by question, $\chi^2(5) = 34.18, p < .001$. Adults were more likely (binomial p ’s < .001) to select the costly signaler for all questions except when asked who a fellow group member would prefer (binomial $p < .091$) and when asked who was better at school (binomial $p = .63$). See Figure 1 (left).

Discussion

In addition to directly inferring that the costly signaler wanted to be in the group more, older children and adults appear to be taking costly action as a “global” signal, rather than a “local” signal. They prefer and trust the costly signaler themselves, in addition to expecting that a group member will trust the costly signaler more than the control.

However, contrary to predictions, four- and five-year-olds made no specific inferences based on the relative cost paid by an actor, though they acknowledge that it was harder for the costly signaler to join the group. This suggests that younger children recognize the relative cost difference between the two children’s actions (insofar as saying something is harder is an indicator of understanding that the cost was greater) but that they do not yet infer that incurring a greater cost might mean the target wanted to be in the group more.

Alternatively, perhaps younger children’s responses were influenced by their tendency to be biased towards wealthy people or, as in this case, people with more resources. As mentioned, we viewed the wealthy actor as a strong test against the costly signaler. Perhaps for younger children this was too strong of a test because having wealth is sending just as strong a signal as incurring costs.

Further, contrary to our predictions, older children and adults only expect a fellow group member to trust the costly signaler more than the control, but do not expect the group member to also prefer the costly signaler. This may suggest that children and adults are making an even more specific inference than we anticipated—people may infer that others construe costly signals as indicators of trustworthiness, but people may think preference is better predicted by other features. In fact, some participants may have expected the groupmate to have a pro-wealth bias and thus reported that the groupmate would prefer the target with the greater relative wealth (i.e., the target with more toys).

In Experiment 2, we seek to replicate our initial findings, with a different non-resource-based manipulation of cost. Following much past work (e.g., Jara-Ettinger, Gweon, et al., 2015; Liu et al., 2017), we used physical cost. This should eliminate the pro-wealth confounds highlighted above while

also using a manipulation of cost directly relevant to the group’s goals, which could make the costly signaler’s actions more salient. If we continue to find that young children do not infer that the costly signaler wanted to be in the group more this suggests that the naïve utility framework is not as early emerging in the group context. Further, it suggests that children may learn over the course of development that costly signalers are more committed groupmates.

Experiment 2

We again introduced children to a costly signaler and a control and asked them to make inferences about others’ evaluations as well as their own. However, we made two key changes. First, we employed a physical cost (having to pick up trash at recess) rather than a resource-based cost. This cost was directly relevant to the group’s goals (in that the group really cared about keeping the school playground clean). Second, children were assigned to one of two versions: Targets shown are either committing costly actions in order to join a group (Group condition) or in order to make a teacher happy (Individual condition). The individual condition allows us to confirm that our cost manipulation replicates prior work on the naïve utility calculus. Younger children in the Group condition may once again not infer that a costly actor is a more committed groupmate than a target who expends less effort, while younger children in the Individual condition should infer that a costly actor was more desirous of making their teacher happy. If so, we can reasonably conclude that it is not until later in development that children construe costs made on behalf of groups as a signal of a desire to commit to that group, even though they infer desires from costs in non-group contexts.

Method

Participants Data collection for this experiment is ongoing, and reported here are the data from participants who have completed participation as of January 31, 2022. All data will be collected prior to July 2022. We pre-registered that we would collect $n=50$ participants per age group (Younger vs. Older children) per condition (Individual vs. Group condition), for a total of $N=200$. So far, $N=89$ children have completed the experiment. Following our pre-registered criteria for exclusion, we excluded five children from analysis, so $N=84$ participants remain. Broken down by age group, we have collected $n=47$ younger children (four- and five-year-olds; 20 female; $M_{\text{age}} = 4$ years 10 months, $SD = 7$ months) and $n=37$ older children (nine- and ten-year-olds; 15 female; $M_{\text{age}} = 10$ years 0 months, $SD = 8$ months). $N=25$ younger children have participated in the Group condition and $n=22$ in the Individual condition, while $n=19$ older children have participated in the Group condition and $n=18$ in the Individual condition ($n=44$ total in the Group condition; $n=40$ total in the Individual condition).

Materials, design, & procedure Except for the following, the procedure was as described in Experiment 1. Children

were randomly assigned to the Group or Individual condition. In the Group condition participants were told about a novel social group, the Zarpies. They were then told that the Zarpies really care about keeping the school playground clean and that, in order to join the group, new initiates must spend a recess period picking up trash off the playground. In the Individual condition, participants were told about a teacher at the school, Ms. Zarpie. They were told that Ms. Zarpie really cares about keeping the school playground clean and that no one has to but that it makes Ms. Zarpie really happy when children spend their recess period picking up trash.

Participants were then shown two targets who decide to spend their recess picking up trash off the playground, either to join the Zarpies (Group condition) or to make Ms. Zarpie happy (Individual condition). In both conditions, one of the targets picks up four bags of trash (the costly signaler) while the other picks up only one bag of trash (the control). Whether the costly signaler or the control was introduced first was randomly determined across participants. In the Group condition, participants were then told that, since both targets picked up trash off the playground during their recess period, they are now both members of the group. In the Individual condition, they were told that Ms. Zarpie is happy and thanks both of the targets. Participants were then asked seven forced-choice questions (see Table 2). The questions were largely similar to Experiment 1, except that we modified the wording and the control question: To ensure that children are not simply picking the costly signaler for any possible question asked, we chose an irrelevant control question. Question 1 was always be asked first, and Question 7 was always be asked last. Questions 2-6 appeared in a random order.

Table 2: Questions asked in Experiment 2. For some questions, parts of the wording varied based upon condition. The Group condition wording is shown first and the Individual condition wording is shown second.

#	Type	Question
1	Direct	Who really wanted to be a Zarpie/wanted to make Ms. Zarpie happy?
2	3 rd Party Like	In the middle is another Zarpie child/another child from this school. Who does she like more?
3	3 rd Party Trust	In the middle is another Zarpie child/another child from this school. Who does she trust more?
4	1 st Party Like	Who do you like more?
5	1 st Party Trust	Who do you trust more?
6	Control	Who saw more flowers when they were walking to school today?
7	Hard	Who had a harder time joining the Zarpies/making Ms. Zarpie happy?

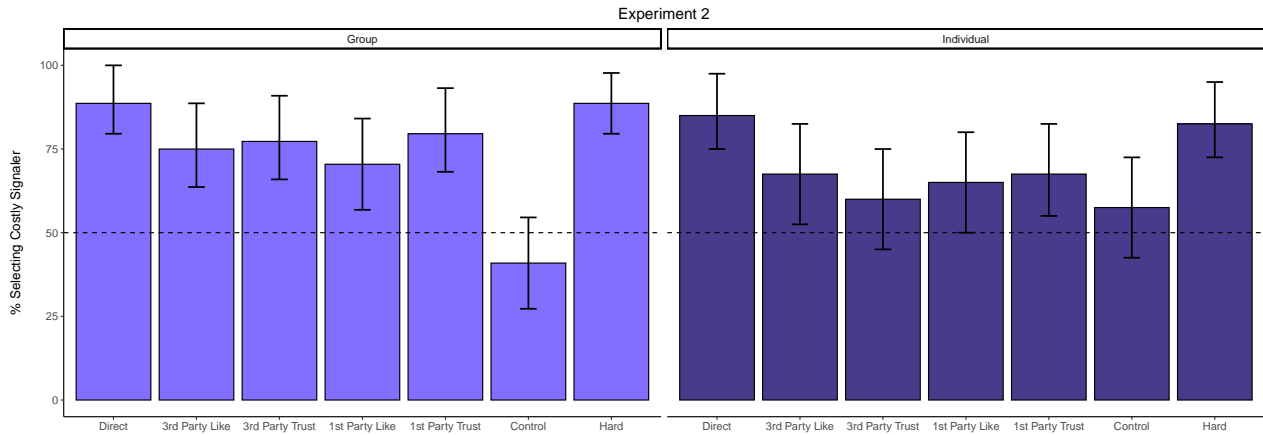


Figure 2: Percent of time that children in the Group condition (left panel, $n=44$) and children in the Individual condition (right panel, $n=40$) select the costly signaler for each question in Experiment 2. The dotted line indicates chance (50%), and error bars reflect 95% bootstrapped confidence intervals.

Scoring & analysis Scoring was as described in Experiment 1. We conducted Chi squared tests to compare results between conditions (Group vs. Individual). Then we completed a Cochran's Q test to compare participants' responses across questions, and binomial tests to compare to chance (50%). We used generalized linear models to see if responses differed with age (age treated categorically: younger children = 4-5's, older children = 9-10's) and by condition for each question, but at present—since we have not collected the full sample—we do not have sufficient power to detect age differences, and so focus on the overall results here.

Preliminary Results

Overall rates of selecting the costly signaler did not differ between conditions, $\chi^2(6)=2.37$, $p=.883$. This means what, while we currently do see differences between participants' pattern of response for individual questions in the Group and Individual conditions, they are not reliably different from one another. We still report the results for each condition separately below.

Group When asked about two targets who incur costs in order to join a group, children's rates of selecting the costly signaler differed by question asked, $\chi^2(6)=37.95$, $p<.001$. For all questions except the control question (who saw more flowers when walking to school today; binomial $p=.30$), children are more likely to select the costly signaler than chance (binomial p 's $<.01$). See Figure 2, left panel.

Individual When asked about two targets who incur costs in order to make their teacher happy, children's rates of selecting the costly signaler differed by question asked, $\chi^2(6)=13.84$, $p=.032$. When asked who wanted to make Ms. Zarpie happy, children were more likely to select the costly signaler (88.64%; binomial $p<.001$). This was also the case when asked who a classmate would prefer (75%, binomial $p=.001$), who the participant trusted more (67.50%, binomial

$p=.039$), and who had a harder time making Ms. Zarpie happy (88.64%, binomial $p<.001$). When asked who they themselves prefer, participants were marginally more likely to select the costly signaler (65%, binomial $p=.081$). When asked who a fellow groupmate trusted and when asked the control question, children responded at chance (binomial p 's $>.268$). See Figure 2, right panel.

Discussion

The results suggest that, overall, children use costs incurred as a signal that the actor who incurred more cost is more committed to their cause. That is, children in both the Group and Individual conditions report that the costly signaler had greater desire to complete their goal. Further, in a group context, children overall are robustly using costly signals as a "global" signal—they prefer and trust costly signalers more even though they are not a part of the group. However, in the individual context, it remains unclear whether children use this information to shape their own social preferences, or to infer that others in the costly signaler's social sphere would use this information to shape their preferences. The effects for the preference and trustworthiness questions appear weaker in the Individual condition than in the Group condition. However, we remain cautious about interpreting the data prior to collecting the full sample.

So far, it appears that children in Experiment 2 are most likely to select the costly signaler for the question gauging who desired their goal more (the Direct question) and the question regarding who had a harder time achieving their goal (the Harder question). This was also the case for older children in Experiment 1. Since we were most interested in whether children inferred targets' desires from the costs they incurred, we always asked the Direct question first. We viewed the Harder question as a comprehension check and thus always asked it last. It is possible that always asking these questions in this particular order affected children's responses; future work will randomize question order.

General Discussion

Across two experiments, we extend the naïve utility framework to a group context, showing that children use costs as signals of commitment to groups. That is, they infer that a person who paid a higher cost had a greater desire to be in the group. Moreover, we show that children also make “global” inferences and evaluations based upon this calculation of desire: They expect a fellow group member to prefer and trust a costly signaler over a control, and they also prefer and trust a costly signaler more than a control.

As data collection is ongoing, it remains unclear whether our youngest participants use costs to make this inference as readily as older children do. In Experiment 1, four- and five-year-olds did not infer greater commitment when the cost was resource-based. There are two interesting possibilities for the results of Experiment 2. One possibility is that children *will not* infer that a person who commits a greater cost wanted to be in the group more in the Group condition, but *will* infer that a person who commits a greater cost wanted their goal more in the Individual condition. If this is the case, it would suggest that only later on in development do children make inferences about third parties based upon costly signals in a group context. A second possibility is that younger children will reliably infer greater desire in the Group condition of Experiment 2, and perhaps will also make higher-order evaluations of their own and others’ preferences. If this is the case, then it suggests that as early as preschool children pick up on costly signals of commitment to groups, but their understanding of what specific kinds of costs convey commitment is still developing. Additional work is needed to determine what kinds of costs children use to infer desires.

Future work should also explore how the nature of the costs incurred affects children’s and adults’ inferences. For example, in both our experiments, the cost incurred (donating a toy; picking up trash) directly benefits the group. But costly signals need not be beneficial to the group per se—fasting for a religious holiday, for example, provides no direct benefit to one’s religious group yet still sends a strong signal of commitment. At what age do children employ less tangible costly signals as indicators of commitment?

Finally, future experiments may also be needed to rule out possible confounds. First, participants may favor costly signalers in their answers simply because they would prefer anyone who exerts more effort in any context, not because they expect costly signalers to be more committed groupmates or social partners. A future experiment could include a control condition where one target engages in more effort than another to achieve an entirely non-social goal. Second, in the above experiments we ask participants to report who they trust more and who a fellow groupmate trusts more, but it is unclear how children are interpreting the question. To our knowledge, no published work has asked young children who they trust more in a given situation. Our intention was to gauge who participants thought was more reliable as a social partner, but they could instead be reporting who they think is more knowledgeable and thus more likely to give accurate information when asked (e.g., Koenig et al.,

2004). Future work could employ more specifically worded questions. For example, “Who is better at keeping their promises?” may be a better question for assessing who children think is a more reliable social partner.

Allying oneself with committed groupmates is crucial for survival, and humans rely on costly signals as markers of commitment. By extending this to a group context we present the naïve utility calculus as a potential proximate mechanism through which we fulfill this ultimate evolutionary need.

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