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by

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Egalitarian Envy: Cross-cultural Variation in the Development of Envy in Children *

Kirsten Häger[†] Bastiaan Oud[‡] Daniel Schunk[§]

October 25, 2012

Abstract

While envy has been studied extensively in adults, the question how envy develops during childhood has not received much attention. To address this gap, we report the results of an artefactual field experiment that investigates and compares the prevalence and development of destructive envy in children aged seven to ten. The experiment took place in the children's natural environment — their schools. We also checked for cultural variability of our results by conducting our

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study with German children and with children from a highly egalitarian society: the Eastern Penan of northern Borneo.

We found that envious behavior was prevalent already at a young age, even when it was costly. An egalitarian upbringing did not appear to mitigate this prevalence. Furthermore, we found strong evidence of cultural variability in the development of envy in children. For instance, in contrast with the German sample, gender was not associated with envy in the Penan sample and the age pattern of envy differed across our two groups. Together, this suggests that there does not appear to be a straightforward relationship between the development of envy and the natural development of the human mind with age, e.g. through better mentalizing ability. Rather, the acquisition pattern of envy is modulated by socio-cultural context. Further research is needed to identify what, then, drives the development of envy during childhood.

Key words: artefactual field experiment, children, envy, egalitarianism, Germany, Penan, Malaysia

JEL classification: C 91, C 99

1 Introduction

Many humans appear to care for their relative standing (see e.g. Solnick and Hemenway, 1998; Charness and Grosskopf, 2001). Envy is a particular aspect of this phenomenon and has fundamental influence on economic behavior. First, it is an example of the darker aspects of social preferences, which the empirical literature on social preferences has addressed to a far lesser extent than more pro-social aspects such as altruism.¹ Second, envy plays an important role in daily economic exchange situations. On the one hand, it can be seen as a positive force of economic growth and development, by generating the desire to catch up (e.g. Grolleau et al., 2006, and references therein). On the other hand, it can also have destructive potential where it causes the desire to reduce others' income (see Grolleau et al., 2006), sometimes even at one's own expense — in the words of Rawls (1972, p. 532):

“We envy persons whose situation is superior to ours [...] and we are willing to deprive them of their greater benefits even if it is necessary to give up something ourselves.”

In the present study we focus on this second form of envy, which leads to inefficient outcomes by virtue of decreasing aggregate income.

While a number of studies have investigated the phenomenon of envy in adults (e.g. Grolleau et al., 2006; Zizzo and Oswald, 2001; Zizzo, 2003), research on its development in children is still somewhat scarce. This is a surprising gap in the literature, as learning more about the acquisition of social preferences is both intellectually interesting and highly policy-relevant, e.g. in the design of educational institutions. In particular, if envious behavior has an acquired rather than innate component, then the question is when and how it is influenced by culture and other factors.

A notable first step has been taken by Fehr et al. (2008) who investigated inequality aversion in children aged 3–8. In their study they let children decide between two allocations in three different games. In their envy and their pro-social treatment the payoff remained constant for the deciding child while only the recipient's payoff differed in the two available options. One option delivered an equal payoff for both children while the other option delivered a higher (lower) payoff for the receiver in the envy (pro-social)

¹For studies on the “dark side” of human behavior see e.g. Zizzo and Oswald (2001) and Zizzo (2003) on money burning, as well as Abbink and Sadrieh (2009) and Abbink and Herrmann (2011) on joy of destruction. For studies on pro-social behavior such as altruism see e.g. Fehr and Fischbacher (2003); Andreoni (1990); Andreoni and Miller (2002); Andreoni and Vesterlund (2001); Harbaugh and Krause (2000).

treatment. Fehr et al. (2008) found that children aged 7–8 were more likely to choose the egalitarian option than younger children. Thus, they seemed to care more about their opponent’s outcome. Fehr et al. (2008) found that a substantial share of children was willing to make their opponent worse off than in the alternatively available option to increase their relative standing.

Fehr et al. (2011) extended this work by running the same three distribution games with children and teenagers aged 8–17 using monetary payoffs instead of sweets. They found that egalitarian choices played a less important role from the age of 12 on. They concluded that egalitarianism seemed to be most important for children at the age of 8 to 11 years and with increasing age the share of altruistic choices increased while the share of spiteful choices decreased.

Our study complements and extends this research in two important ways. First, we make envy *costly*.² This introduces a tradeoff between a child’s own *absolute* payoff and her *relative* standing. We believe this provides a number of epistemic advantages. Since it allows us to maintain inequality across both envious and non-envious choices, costliness allows us to better distinguish between effects of envy vs. inequality aversion. Furthermore, if envy is costly, the decision-maker must overcome a higher mental threshold. Costliness thus reduces the chance of a “false positive” in the attribution of envy to choices that favor one’s own relative standing. Can we still measure envy in this setting? If so, how does it develop with age? What other determinants can we find that impact the development of envy?

Second, we extend the literature by exploring to what extent the development of envy is robust to cultural variation. This is an open question since there is not much previous work comparing behavior of children from different countries, especially not on envy.³

²We are aware of three other studies which made envy costly, conducted by Bauer et al. (2011b), Bauer et al. (2011a), and Bügelmayer and Spieß (2011). All three extended the study by Fehr et al. (2008) with a costly envious choice. The first of these studies was conducted in the Czech Republic and related children’s choices to their parental background. The second was conducted with children aged 3–11, who had recently experienced war in Georgia, and with adults in Sierra Leone where a civil war took place about a decade ago. The third was conducted with German children and related spiteful (in our words “envious”) choices to cognitive skills. However, in these studies the participants’ option space included both envious *and* egalitarian options, whereas our study ruled the latter out.

³Exceptions of cross-cultural studies with children include Martinsson et al. (2011) who compared social preferences of children aged 10–13 in Austria and Sweden, Cárdenas et al. (2012) who compared competitive behavior of boys and girls in Sweden and Columbia, and Cárdenas et al. (2011) who studied cooperation of boys and girls in Sweden and Columbia.

More specifically, one part of our study was conducted in a culture which is very distinct from Western culture: the Penan of northern Borneo. This makes a comparison particularly interesting and allows us to shed first light on the question how culture influences envious behavior.

To summarize, our core questions are:

1. Does envious behavior continue to occur in children even when it is made costly?
2. How does envy develop with age in children aged 7 to 10?
3. Which factors other than age might have an influence on the acquisition of envy?
4. Is this development pattern robust to cultural variation?

To address these questions, we began by running a field experiment that tests for the existence of envy in a sample of $n_1 = 110$ primary school children aged 7–10 from a Western industrialized country, Germany. Based on this sample, we mapped out covariates of envy and an age path for its development. Second, we ran the same experiment in a group of $n_2 = 103$ children aged 7–10 raised in a highly egalitarian cultural background (Brosius, 1990), in relative isolation from Western culture: the Eastern Penan from the Baram region of Sarawak, Malaysia. To our knowledge, this is the first economic experiment conducted with children from this region.⁴ We again mapped out an age path and other covariates, and compared between groups to establish cultural variability.

Our data confirmed the prevalence of envious behavior even when it was costly, both in the German and the Penan sample. While average levels of envy were similar across the German vs. Penan participants, there were considerable differences for both the age path and influence of moderating variables (e.g. gender) — which suggests that the relationships between these factors and envy are *not* deeply ingrained human universals. More generally, our study hints at the dependence of the acquisition of social preferences on cultural context — which leads to many interesting follow-up questions.

The rest of this paper is organized as follows. Section 2 details our first experiment which was conducted in Germany. It addresses the question of whether envious behavior occurs in settings where it is costly, and if so, what

⁴We are aware of only one other economic study (Andersen et al., forthcoming) that compares two culturally very distinct groups of children in non-Western societies. However, this study focuses on a different topic: competitive behavior of boys and girls in matrilineal and patriarchal societies in Northeast India.

its age pattern and other correlates are. The design is explained, followed by a presentation of the results. Section 3 details and discusses the second part of our study, which we conducted with an egalitarian tribe in northern Borneo to investigate the intercultural variability of envy acquisition. Section 4 concludes and points out promising avenues for further research.

2 Costly envy among German children

In our first experiment, we analyzed the development of envy in a sample of German school children with the goals of (1) assessing whether envious behavior persists even in the face of costliness, and identifying (2) its age path and (3) other covariates.

2.1 The Sample

We collected the decisions from 135 participants in our envy game as well as decisions from 143 participants in a control treatment in January 2008 and November 2009.⁵ Our participants were students from three German public primary schools in Duisburg (henceforth DS and DU) and Koblenz-Gondorf (henceforth KG) aged 6–12.⁶ We conducted our experiment in a total of 34 school classes for both treatments ranging from grades 1 to 4 with one experimental session run per class.⁷ We tried to divide the treatments as equally as possible between all school years and locations. Henceforth our data analysis for the envy game will include the decision of 110 children aged 7–10.⁸

⁵As we cannot say anything about the reasons for non-envious choices we conducted a second treatment testing for altruism. Since the main focus of our paper is on envy, these results are reported in the appendix.

⁶Duisburg is a city in western Germany with nearly 500,000 citizens. Koblenz-Gondorf is a rural town in southwestern Germany with approximately 3,500 inhabitants.

⁷For our data analysis one class had to be excluded, because the information we received about the children on gender and age did not match with the respective children and their identification number. A second class was dropped during the data analysis due to the fact that none of the children tested were in the age range of interest to our study as explained below.

⁸We chose an age range from 7–10 for a number of reasons: First, we have very few observations outside of this range, since this is the typical age range for school children in grades 1–4 in our German sample. This age range also has the largest overlap between our German and Penan samples, making it most suitable for comparison. Second, we were not fully confident that children outside of the normal age range for a class are comparable in development and comprehension of the experimental setup. The chief reason for older children to be present is failure to graduate to the next grade. In total, the age restriction led to the exclusion of the following numbers in the envy (altruism) treatment: five(one)

2.2 Experimental set-up and procedure

The experiment proceeded class by class. The respective class' teacher assigned a random identification number to each child. The identification numbers were not publicly announced, so only the teachers and the experimenter knew which students the numbers referred to. These numbers were then randomly matched into pairs of two. Within each pair, one child was assigned the role of *decider* and the other the (passive) role of *recipient*. After the experimenter had introduced herself to the class, she re-located into a separate empty room or hallway. The teacher then sent the deciders to the experimenter one by one. Once the decider had arrived, the experimenter explained the task to her.⁹ The participating child was asked to choose between two possible allocations of sweets between herself and her anonymous counterpart.¹⁰ As indicated earlier, the decider did *not* know with whom she was matched. This was particularly stressed when explaining the task. Table 1 illustrates the available options.

Option	Decider	Recipient
A (“envious”)	5	3
B (“non-envious”)	6	8

Table 1: Payoff scheme envy game

As indicated in the table, the decider could either take five sweets for herself and send three sweets to the other child (option A) or take six sweets for herself and send eight sweets to the recipient (option B).¹¹ The payoff combinations were chosen so that they forced the decider to choose between obtaining a higher relative payoff or a higher absolute payoff:

- In option B (6/8) both children received more sweets than in option A, but the recipient received *even more* than the decider.
- In option A (5/3) the decider had one sweet less than in option B, but the other child had *even less* than this. Thus, this choice made

children above the age of 10, and 20(12) below the age of 7. Thus, the data analysis for our control treatment is based on a sample of 130 participants.

⁹Although we use only the female form here for brevity, our participants included both boys and girls in Germany as well as in Malaysia.

¹⁰We used a chewy gelatinous German brand of sweets called gummy bears.

¹¹We deliberately kept the numbers small to be sure that children at this age would be able to distinguish between the numbers.

the decider worse off than option B in *absolute* terms, but better off in *relative* terms.

We call a choice of 5/3 “envious”, since here the decider picks the option that optimizes *relative* standing, at the absolute expense of one sweet of her own.¹²

To make the two allocation options as salient as possible, the sweets were placed onto napkins on a table in a way that facilitated visually capturing the amounts. In addition, we placed little pieces of paper with a number indicating the amount of sweets next to each payoff. Thus, the child did not face an abstract choice, but had the options directly in front of her. Figure 1 illustrates the layout of the table.

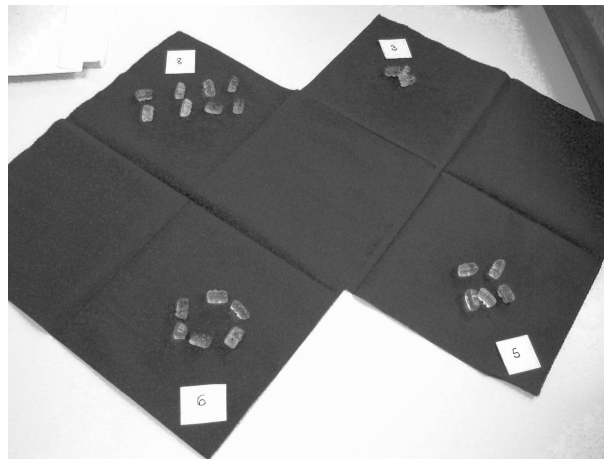


Figure 1: Experimental set-up Germany

As can be seen in the figure, the two halves (left/right) of the table corresponded to options A and B. We randomized which half corresponded to which choice option.¹³ The decider’s payoffs were placed on the side of the table facing the child; whereas the payoffs for the recipient were on the

¹²Note that there are multiple possible reasons for choosing the *non-envious* option (6/8) like profit maximization, efficiency, or altruism. As this envy experiment does not permit us to distinguish between the motives for the non-envious choice, we have also conducted a control treatment with a distribution task which tests for altruism to investigate possible reasons for the non-envious choice further which we report in appendix A. For the question of identifying envy, however, it does not matter much which particular motive drives the choice of B as long as it is in fact a *competing* motive.

¹³We tested whether the side (left or right) on which the envious option was placed mattered and found no such side effect (two-sample test for proportions, $p = 0.775$).

experimenter's side. Thus the child chose either the left or the right half of the table, and received, from that half of the table, the set of sweets closer to her.

Once the decider had made her decision, the experimenter put this child's payoff into an envelope and gave it to her. Then the experimenter placed the payoff for the recipient into a second envelope and assured the decider that the receiver was going to receive the envelope at the end of the experiment.

Next, the experimenter interviewed the child to find out about the reason for the choice, but also to get additional information on other background details that might potentially affect envy, such as participation in team sports and the number of siblings.¹⁴ Importantly, when asked for the reasons for their choice, no child claimed to have compared their payoffs to children outside the immediate context of the two-person distribution task, such as the other deciders in the same class. They reported to have compared their payoff only to that of their anonymous receiver, i.e. their designated reference group in this experiment.

After the interview, the child returned to her classroom, whereupon the next decider was sent to the experimenter. Children were asked not to talk to each other until the experiment was completed.

After the experiment was completed, the experimenter returned to the classroom and handed the envelopes to the teacher in the classroom in front of the children. The teacher then distributed envelopes to the corresponding children. Neither the children nor the teacher were informed who had sent which envelope.¹⁵

In order to avoid reciprocal thinking, in which children might think that their choice could influence somebody else's choice, the receivers remained passive throughout the experiment. They had no choice to make and did not themselves become deciders at any point of the experiment.¹⁶

¹⁴Please refer to appendix C.2 for the detailed list of questions asked.

¹⁵In case of an uneven number of students, or if time constraints prevented that all children of a class could participate in the experiment, the remaining children nevertheless received an envelope with sweets for ethical reasons. As a result, anonymity was even augmented, because the deciding children were even less likely to know who had received their envelope. It is possible that one or two decisions might have been observed by a teacher.

¹⁶Furthermore, each decider participated only in either the envy treatment or the additional control treatment on altruism (see appendix A), but never in both, to avoid that choices in one treatment might influence choices in the other treatment.

2.3 Results

The reported results are based on the full sample of children aged 7–10.¹⁷ We pool the data from all locations. This is permissible as there are no significant differences between the distributions of the decisions in the three locations at the 5%-level, except that boys in DS and DU and girls in DS and KG differ in behavior (two-sample test of proportion, stratified by gender, see table 2).

	p-values	
	envy treatment	
	female	male
DS/DU	0.668	0.001
DS/KG	0.037	0.078
DU/KG	0.072	0.168

Table 2: Two-sample test of proportion for different locations in envy treatment, separately for gender

Overall, we find that despite the costs associated with envy, a considerable fraction of children (31.8%) took the envious choice. Disaggregating this finding by age, we see that across all age groups a non-negligible fraction of children took the envious choice (see figure 2).

Result 1. *Even if envy is costly, envious behavior occurs at non-negligible levels.*

In particular, we observe a significant gender effect (Probit regression; dummy female: $P > |z| = 0.018$, coefficient = -0.828 , $df/dx = -0.279$) with boys opting for the envious choice A (5/3) more frequently than girls. The fraction of boys and girls who chose option A in treatment 1 was 39.1% and 21.7%, respectively.¹⁸

¹⁷To show that all results also fully hold if we exclude children with reasons biasing their choices, we report them in the appendix. The limited sample excludes those who did not understand the game, claimed to be on a diet, were not hungry, did not like gummy bears, or stated they were not allowed to eat candy. For the results of the tests with this limited sample, see appendix B.1.

¹⁸We assessed whether there are different preferences for sweets between boys and girls by asking the children which gender usually wants more candies. 13.0% of the children that gave an answer to this question in this treatment stated that girls want more, 38.9% said that boys want more candies. But the largest fraction of 48.1% argued that boys and girls want as many candies. Thus it does not seem that different preferences are driving the effect. Note that we do not have this information about children attending school in DS and DU in the session of 2008.

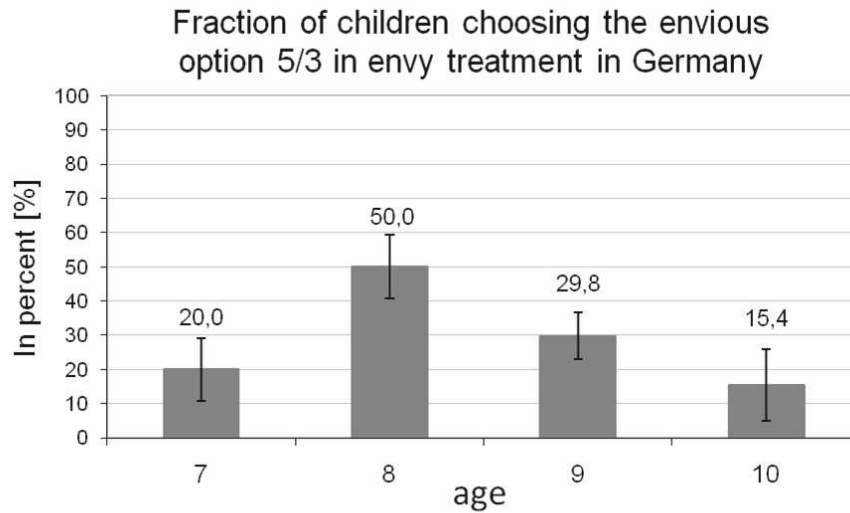


Figure 2: Fraction of children taking envious choice 5/3 in envy treatment. Whiskers indicate standard errors.

Result 2. *In the German sample, boys took the envious choice significantly more often than girls.*

This finding about more envious behavior among boys than among girls is in line with studies by Gneezy and Rustichini (2004) and Houser and Schunk (2009) who investigated competition among school children as well as with findings by Gneezy et al. (2003) who investigated adults. These studies suggest that boys consider it more important than girls to be relatively better off, and that in a competitive environment boys perform better than girls. In line with this, Sutter and Rützler (2010) found that Austrian boys aged 3–7 were more likely than Austrian girls of the same age to enter into a running competition and Austrian boys aged 8–18 were more likely than Austrian girls of the same age to enter into a math competition. However, not all studies on gender differences in competitiveness have found a gender effect. Specifically, in contrast to Gneezy and Rustichini (2004)’s Israeli study, Dreber et al. (2011) found no such gender effect when they conducted a running competition in Sweden. Thus, there might be a cultural aspect to gender differences.

Our results complement this literature and are consistent with the hypothesis that relative standing matters more to boys than to girls. It would

therefore be interesting to further investigate to what extent envy is a driving force behind the gender performance gap in competitive settings.

There are many reasons to expect that the presence of siblings might affect social preferences, and the question of sibling influence sparks large interest in the literature. For instance, Fehr et al. (2008) found that children without siblings were more willing to share than children with siblings, even if it was costly, and that the youngest child of a family was less willing to share than children with younger siblings. Lampi and Nordblom (2010) conducted a survey study to analyze the effect of birth order and being an only child on concern about one's relative position. They found that only children, people with many siblings, as well as people who have been compared to their siblings by their parents during childhood cared the most about their relative position.

In our study we found that the more siblings a child had, the more likely it was to opt for the envious choice 5/3 (Probit regression; number of siblings: $P > |z| = 0.101$, coefficient=0.195, $df/dx = 0.070$; see table 3), thus caring for her relative position, although this result was not statistically significant.

Since team sports also expose children to group-level considerations, it appears important to ask whether participation in a team sport impacts envious behavior. Learning how to cooperate or help each other during sport activities may have an influence on social decisions outside the gym. We found that children who practiced a team sport in their spare time were less likely to opt for the envious choice A (5/3) than children who did not practice sport or who practiced an individual sport, but this result was again not statistically significant at conventional levels (Probit regression; dummy team sport: $P > |z| = 0.106$, coefficient=-0.513, $df/dx = -0.172$).

In addition to the data mentioned above we obtained three school grades from the teachers: a grade for mathematics, a grade for working behavior, and a grade for social behavior. We use the grade for mathematics as a proxy for cognitive abilities, and the grades for working and social behavior as an indicator for social preferences.¹⁹ The regression (see table 3) reveals that

¹⁹Children in the first and second school year do not receive school grades. From class 3 on, they receive grades for all subjects, as well as so called "Kopfnoten" in the fields of social and working behavior at the time of the study and in the regions where our study was conducted (one grade for each of the fields in KG; in DU and DS social behavior and working behavior were each split up into three separate grades in 2008 and working behavior was split up into two separate grades in 2009; we only received an average grade for both fields). The so called "Kopfnoten" have been eliminated by legislation in DS and DU after conducting our study. Grades in mathematics range from 1 (best grade) to 6 (worst grade). Grades for social and working behavior range from 1 (best) to 4 (worst). The grades are often given as integers, but we received grades which were sometimes increased or decreased by 0.3 to show a tendency or given as a degree between two integer

Probit regression on envious choice 5/3		
Independent variable	Coefficient	dF/dx
Dummy 8 years	1.168*** (0.421)	0.436*** (0.147)
Dummy 9 years	0.214 (0.403)	0.077 (0.146)
Dummy 10 years	-0.277 (0.639)	-0.094 (0.203)
Dummy female	-0.828** (0.350)	-0.279** (0.106)
Grade math	0.115 (0.198)	0.041 (0.071)
Grade social behavior	-0.074 (0.348)	-0.027 (0.125)
Grade working behavior	0.193 (0.341)	0.069 (0.122)
Dummy team sport	-0.513* (0.318)	-0.172* (0.100)
Number of siblings	0.195* (0.119)	0.070* (0.042)
Constant	-0.720* (0.407)	

Observations: 98; $PseudoR^2 = 0.163$
Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, * $p < 0.11$
Omitted age category is 7 years.

Table 3: Probit regression on taking the envious choice 5/3 in envy treatment.

grades did not have any predictive power for the actual choices of the children, despite the fact that the grade for social behavior is meant to indicate how nicely the child behaves at school towards other children and teachers.

As indicated earlier, we asked children about the reasons for their choice. Two student assistants who were blind as to the purpose of the study later classified the children's answers into twelve categories: No answer given, profit maximization, envy, altruism, efficiency, not allowed to eat candies, misunderstood the game, on a diet, not hungry, does not like candies, other, and excuse.²⁰

Out of the 35 children who took the envious choice, 23% claimed that the choice was due to envy, 9 (26%) found an excuse for their behavior, but the largest fraction of children (37%) did not give an answer.²¹

It turns out that the fractions of children who (1) did not give a reason for their choice or (2) used what was obviously an excuse to justify their choice were both substantially higher for the group that made the envious choice (37% vs. 29%, and 26% vs. 0%, respectively). Is this because envy is a cultural taboo that people are simply not comfortable admitting to? Consistent with this candidate explanation, children choosing the envious option often took a longer time to find a response, blushed, or looked down rather than towards the experimenter when asked for an explanation. In their study with students Grolleau et al. (2006) found that participants less often stated destructive envy which destroys another person's income if they were asked about their *own* feelings than if they were asked what *another* person would feel in this situation. This is also consistent with there being social desirability motivations for not admitting envious motivations.

There remains the question what considerations drove the 75 children that took the *non*-envious option B. Most of these children (41%) claimed altru-

levels (for example a grade of "2-3" would correspond to a 2.5). Unfortunately, we did not receive grades for all children of the second session. Some teachers only provided us with an estimation of the children's performance (above average, average, below average), some teachers did not provide any grades, especially for the children that did not yet officially get school grades (classes 1 and 2). For this reason, we transformed the school grades we received to estimations (grade 1.0-2.3: above average (1); grades 2.4-3.3: average (0); grades 3.4-6.0: below average (-1)) and used these estimations of the children's performance for our analysis (math: mean: 0.33, sd: 0.76; social behavior: mean: 0.73, sd: 0.50; working behavior: mean: 0.62, sd: 0.57 for participants of the envy and the control treatment on altruism). The missing grades are also the reason why the number of observations in the regressions is smaller than our actual number of observations in both treatments.

²⁰In case of disagreement of the two assistants about a category, the answer in question was discussed with the experimenter until an unanimous category was found. For the frequency and proportion of answers, see table 12 in appendix B.1.

²¹As explained above, excuses were identified as such by two student assistants.

istic reasons: They wanted the other child to receive more candies (see table 12 in appendix B.1). To check the validity of these claims, we additionally ran a control treatment on altruism (reported in more detail in appendix A). It appears that these claims are in fact credible, as in our control treatment many children were even willing to give up one sweet to make the other child receive five more. This is line with other studies, e.g. Fehr et al. (2008) found in their sharing game that a fraction of children was willing to give up one unit of candy to send it to an unknown child. The fraction of children willing to share if it was costly increased with age in their in-group treatment (which is more comparable to our study), but decreased in the out-group treatment. Benenson et al. (2007) conducted a study where children aged four to nine played a dictator game using stickers as incentives. They found that children of all age groups were willing to donate a fraction of their stickers and that the amount of stickers given away was increasing with age although results of a pilot study showed that children of all age groups valued the stickers highly. Further, children with a high socioeconomic status gave away more stickers than children with a low socioeconomic status although all of the children confirmed that they liked the stickers when asked by the experimenter.

In our German sample only 3 out of 75 children opting for 6/8 cited efficiency reasons. This makes us believe that efficiency is not a salient motivation, since aggregated payoff appears not to exert much motivational force.

We summarize the findings of our envy treatment in Germany by concluding that indeed a substantial fraction of children (31.8%) was willing to give up own payoff to make an anonymous counterpart worse off. This behavior peaked at the age of 8 years with 50.0% of the children opting for the envious alternative. While gender, siblings, and practicing a team sport had some influence on envious behavior, we found no evidence that school grades matter.

3 Cultural variability of envy

Having demonstrated that envy is prevalent in our Western sample even when it is costly, we proceeded to investigate the degree to which the development of envy is culturally variable. We thus conducted our study with children of the *Eastern Penan*, one of the indigenous populations of Sarawak in Malaysia. Since the Penan are known to have strongly egalitarian sharing norms, this procedure would maximize our chances of picking up such an effect; moreover, to our knowledge, no previous economic research has been conducted with this ethnic group.

While the Penan were traditionally nomadic hunter-gatherers in the trop-

ical rainforests of Borneo, the vast majority have transitioned to sedentism in recent decades. Nearly all of them now live in small settlements for at least the larger part of the year, and have begun to take up agriculture, although small numbers of Penan continue to live nomadically (Brosius, 1999; Sercombe, 2008). Recent estimates put the present Penan population at approximately 16,000 (SUHAKAM, 2007) out of an overall Sarawak population of approximately 2.2 million.

Equal food sharing is one of the most important social norms in Penan culture and a core element of Penan self-perception and identity. For instance, meat obtained in hunting is divided up equally among *all* members of the camp, even including people who are not immediate family members and who were not part of the hunting party (e.g. Speth, 1990). Even very small hunting kill, such as a squirrel hunted by blowpipe, is divided up equally — e.g. into six little piles of meat that fit on the palm of the hunter’s hand, for distribution to the six households in the group (Peter Brosius, personal communication). Sharing extends beyond just hunting kill — e.g. to sago (the main carbohydrate staple food), other edible produce gathered in the forest (mushrooms etc.), and in some instances even indivisible non-edible commodities bought from outside (e.g. cassette players). This pervasive social norm is emphasized in child raising and instilled in children from a very early age on (e.g. toddlers instructed to carry meat shares to neighbors). We hypothesized that this ought also to resonate in primary school children’s behavior, and hence would increase our chance of picking up cultural variability.

3.1 The Penan Sample

A total of 145 Penan children aged 4–12 participated in our study in four locations: two government-run primary schools (grades 1–6) in Long Kevok and Long Luteng, and two pre-schools in Long Latei and Long Belok, run by an NGO (The Borneo Project). These locations were selected because they are attended almost exclusively by Penan children (> 95% of our sample). The experiment was conducted in July 2009 with official permission obtained from the headmasters of the participating schools and The Borneo Project for the pre-schools. 103 of the participants were in the age range of 7–10 and will be included in our data analysis.²² Schools are run and centrally staffed

²²10 of the initially 145 Penan participants were younger than 7 years old and 32 were older than 10 years old. They were excluded from the data analysis to match the German sample as previously explained. We did not get information on age for 45 out of 103 Penan children (43.7%). To impute the missing information on age for those 45 children, we used a hotdeck procedure which conditions on children’s height, gender, and the grade

by the Sarawak State Government, and follow the standard governmental curriculum. To our knowledge, none of the teachers were ethnically Penan, and although a portion of them had acquired mastery of the Penan language, the language of instruction at school was Malay. Penan culture and language is not part of the official curriculum. The schools are boarding schools out of walking range from home for most children, so that the vast majority of students live in the school dormitories rather than with their families during the school year.

In the pre-schools, the language of instruction is Penan, and the curriculum covers basic literacy skills such as the alphabet and the numbers from one to ten in Penan, Malay, and English. The aim of this is to prepare Penan students for the government schools. Teachers at the pre-schools were locally sourced and ethnically Penan.

All four locations are situated in remote secondary jungle areas. The only access is by boat or a ten-hour four-wheel drive from the coastal city of Miri, along mud roads used for logging. Neither the roads nor the small settlements are, to our knowledge, marked on any publicly available street maps, so we documented their locations using GPS recordings.²³

3.2 Experimental set-up and procedure in Malaysia

The experimental set-up in Malaysia mirrors the set-up of the study in Germany as closely as possible given the local circumstances. Participants played dictator games with the same 6/8 vs. 5/3 payoff structure as in the German envy treatment. Children were told that their task was to divide up some sweets between themselves and an anonymous second child from the same school. As in Germany, each child could either take five sweets for herself and send three sweets to another child or she could take six sweets for herself and send eight sweets to another child (see table 1). The sweets for the second child were to be put in an envelope, and the researcher would give them to a random child from the same school later on.

The participating child was assured that the researcher would not reveal the identity of the decider to the receiving child or anybody else. Children were told that they could not take the sweets out of the room but had to eat them inside before leaving. This was done both to ensure that anonymity remained credible and to ensure that children could not share the sweets with others after leaving the room (thus modifying the payoff structure in an uncontrolled way). Payoffs were then explained, and the child was asked

that they were in.

²³The maps are available upon request from the authors in Google Earth KML or Garmin GPX formats.

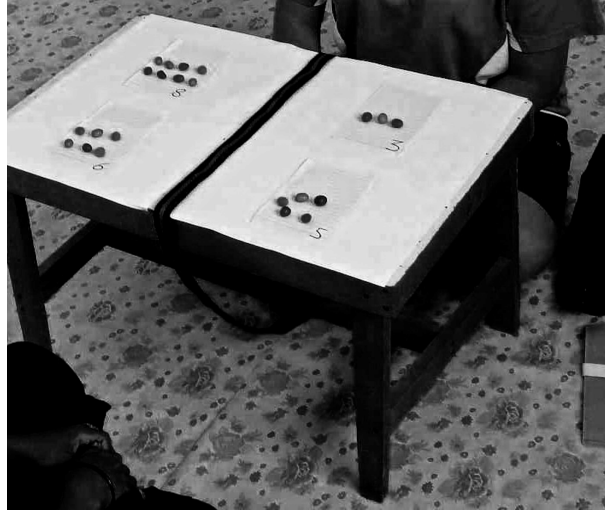


Figure 3: Experimental set-up Malaysia

whether she had any questions. If not, we tested comprehension of the payoff structure by asking (in random order) questions about all four payoffs, i.e. “If you choose this side, how many sweets do you get? How many sweets does the other child get?”. Once we were sure the child had understood the payoffs, the child was asked to make her choice. Finally, she was asked a number of additional questions (age, class level, number of siblings, motivation for the choice, etc.).

At each school location, we obtained a small room to conduct the experiment. Windows were masked with paper to ensure it was not possible to look into the room from the outside to ensure privacy.

In order not to interfere with the regular class schedule, we conducted our experiment in the afternoons, after classes had been completed, and continued to test until just before dinner. In order to avoid satiation effects, we made sure not to test immediately after meals, keeping an approximate 2-hour time distance to lunch.

For payoffs, we used *Nips*, which are a Malaysian brand of peanuts covered in a colored sugary coating, similar to M&Ms. In order to be able to interpret the $5/3$ choice as envy, it is important to check for monotonicity of preferences for the payoffs (i.e. more sweets are better). Otherwise, the child may choose option $5/3$ in order to avoid having to eat more. In addition, the child needed to believe that her anonymous counterpart also has monotonic preferences for the sweets — otherwise there may be a pro-social motive of sparing the other child the disutility of eating so many sweets. To ensure this, we introduced

a number of additional control questions (see appendix D.3 for a full list of questions). In the vast majority of cases (92.1%) monotonicity was not a problem.

Participants were recruited by asking teachers to send us children of different age groups. Children were told to enter the room one by one, and instructed not to tell any of the other children what the experiment was about or what they had decided during the game. Before a participant entered, the sweets were arranged on two halves of a table (see figure 3), as in the German sample.²⁴

All interaction with the participating children was done exclusively by a translator fluent in Penan. The translator sat on one side of the table and the child on the other. The researcher sat a little further back, observed and took notes. The translator's interaction with the child was based on a set of written instructions, which were translated from the English original to Penan and Malay (for use with possible non-Penan participants). In order to verify the accuracy of the translation, an independent second translator who had not seen the original English version of our instructions back-translated the Penan version of the instructions to English (see appendix D.3).

3.3 Results for the Penan sample

In all presented results we pool the data from the four locations (two primary schools in Long Kevok and Long Luteng, and two pre-schools in Long Latei and Long Belok).²⁵

Figure 4 shows the fraction of children who chose the envious option A (5/3), by age. Although the envious choice was costly for the deciding child, a considerable fraction of children (39.8%) took this option. Thus, the overall fraction of children choosing 5/3 was similar in both countries (39.8% and 31.8% among Penan and German children, respectively; unpaired t-test: $p = 0.226$). The distribution of envious choices in the different age groups was, however, different in both countries (see table 4).

²⁴Again, we randomized the location of the two payoff combinations (left/right) and the color composition of the sweets. The location of the payoffs (left/right side of the table) did not matter for the decision of the children (two-sample test of proportions; $p = 0.719$).

²⁵The distributions of deciders' decisions did not differ significantly between locations at the 10%-level (two-sample test of proportion; the behavior of children attending pre-school in Long Latei could not be compared to behavior in other locations because we have only one observation in this location for the respective age group). To show that all results also fully hold if we exclude children who violate monotonicity assumptions we report them in the appendix. For more details and the results of the tests with the limited sample see appendix B.2.

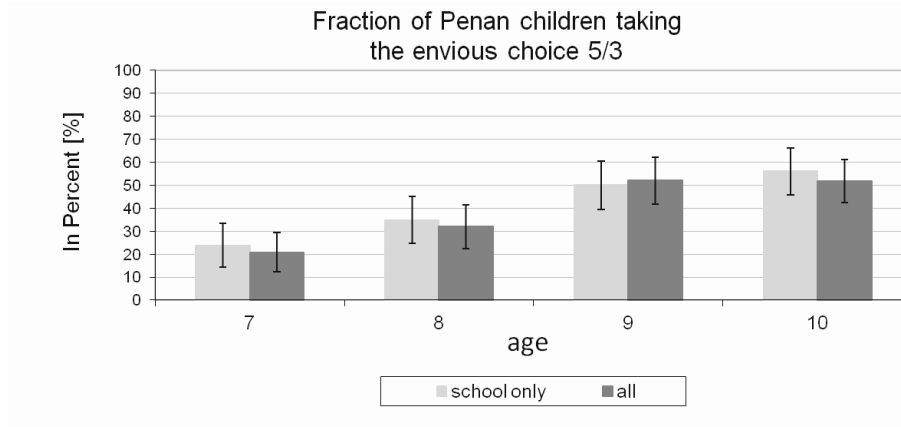


Figure 4: Fraction of Penan children taking envious choice 5/3. Whiskers indicate standard errors.

Location	7	8	9	10	All
Penan	20.8	32.0	52.0	51.7	39.8
Germany	20.0	50.0	29.8*	15.4**	31.8

Fraction of children choosing 5/3 in %

T-test separately for each age group; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4: Fraction choosing 5/3 among Penan and German children.

In a study about envy in adults Zizzo and Oswald (2001) found that about 2/3 of the participants were willing to pay to reduce somebody else's outcome. Their decision to burn others' payoff was not sensitive to the price of doing so. However, the amount of burning varied with the price, i.e. how much outcome of another person one could destroy with one unit of one's own outcome.²⁶ Our results from both the German and the Penan samples suggest that such a willingness to pay for reducing somebody else's outcome appears to be already present in children, even across two vastly different cultures. We summarize this finding in

Result 3. *A strong egalitarian cultural background does not reduce children's tendency to choose the envious option.*

While overall average levels of envy appear similar in the German and the Penan sample, we did find variability in how it develops with age and how it relates to other correlates such as gender.

As the regression results (see table 5) show, there was an increase of envious choices with age in our Penan sample. The fraction of children choosing the envious option increased from age 7 to age 9 and remained at about the same level for children aged 10, although not all age dummies are significantly different from the dummy for 7-year-olds. This contrasts with our findings of our German sample, where we found a peak of envious behavior at the age of 8 years, followed by a considerable decrease for older children. We summarize this finding in

Result 4. *The development of envy within the age span from 7 to 10 years differs between Penan and German children.*

This result complements findings by Fehr et al. (2008) who conducted distribution games with Swiss children. In their envy game,²⁷ young children took the envious choice in almost half of the cases, whereas older children took the outcome in which the other child received more much less frequently. Note, however, that this is not directly comparable to our setup, since in their game, the envious choice equated payoffs, i.e. it was simultaneously egalitarian, whereas in our design, inequality cannot be avoided.²⁸ Fehr et al. (2011)

²⁶Note that in Zizzo and Oswald (2001)'s design — unlike in our design — subjects had to take into consideration that their own payoff might be reduced by others, too. Zizzo (2003) eliminated this possibility in his study, but still found substantial money burning.

²⁷As indicated in the introduction, in Fehr et al. (2008), the envious choice was costless to the participants — i.e. they did not have to sacrifice a part of their own payoff in order to reduce the other player's income.

²⁸Note also that the sample in Fehr et al. (2008) was on average younger than our sample.

Probit regression on envious choice 5/3		
Independent variable	Coefficient	dF/dx
Dummy age=8	0.264 (0.439)	0.101 (0.171)
Dummy age=9	0.789* (0.411)	0.304* (0.154)
Dummy age=10	0.862** (0.392)	0.330** (0.144)
Dummy female	0.353 (0.293)	0.133 (0.110)
Dummy pre-school	-0.705 (0.456)	-0.230 (0.121)
Number of siblings	0.099* (0.061)	0.037* (0.023)
Constant	-1.325*** (0.414)	

Observations: 101; $PseudoR^2 = 0.116$
 Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, * $p < 0.11$
 Omitted age category is 7 years.

Table 5: Probit regression on taking the envious choice 5/3

found the opposite age trend, i.e. a decrease of envious choices, in their study with older children and teenagers. The absolute level for the youngest participants were higher than for Fehr et al. (2008)'s oldest participants who were of the same age. A possible explanation could be that monetary incentives may interact with age differently than sweets. Taking these two studies together, envious (and simultaneously egalitarian) choices peak at the age of 8/9 years which is similar to the result we see in our German sample. Bauer et al. (2011b) conducted a study with children aged 4–12 in the Czech Republic with a costly and a costless envy task. They found no significant age effect. It is noteworthy, however, that about 30% of their subjects chose the envious option in their costly envy task. This is similar to the average level we found in the neighboring country of Germany. The fact that these results from Western societies are qualitatively different from the findings in the Penan sample may be taken as an indication that the development pattern of envious behavior is not universal to mankind, but rather depends on external factors like the culture or environment the children grow up in.

If age-related maturation is not the driving force behind the envy trend in the Penan sample, then the question is what may be causing it. Possibilities include the influence of a more competitive environment at school (with grading, building a new hierarchy among the children etc.), and the fact that children are away from the cultural influence of their parents due to this being boarding schools. Once the children enter boarding school, they are typically several hours' to days' journey (on foot) away from their families, because a single school will serve multiple communities. Thus, the majority of children live in the school's dormitories during the school year. In addition, schools follow the standard governmental curriculum, which means that the topics are not specifically adapted to Penan culture, the language of instruction is Malay, rather than Penan, and teachers are typically from other ethnic groups than Penan. In sum, life at a boarding school represents an exposure to a cultural and social environment that differs from the traditional Penan experience at home. The degree of this influence ought to intensify with the duration of exposure.

This may or may not play a role for the development of envious behavior. One way to test this would be to compare Penan children of the same age who attend school to Penan children who do not. Obviously, implementing this faces practical difficulties, as the second group is comparatively small in our sample — and is likely to be systematically different on a number of other dimensions, due to the absence of random assignment to either schooling or non-schooling groups.

We nevertheless compared Penan children from 7 to 10 years attending boarding school to Penan children of the same age group attending pre-

school²⁹ and thus living with their parents.³⁰ We saw that children attending boarding school were more likely to take the envious option with increasing age. While comparisons of the absolute numbers seem to indicate that the children at pre-school of all age groups tended to take the non-envious choice more frequently, except for the one observation in pre-schools at the age of 9, this difference is not significant in a two-sample test of proportions (see table 16 in appendix B.2) — perhaps due to the small number of observations in pre-schools. This carries through to our regression (see table 5), where the coefficient for the pre-school dummy goes into the expected direction, but is not significant (Probit regression; dummy pre-school: $P > |z| = 0.122$, coefficient = -0.705 , $df/dx = -0.230$). Thus, our data, by itself, unfortunately do not permit any conclusions concerning the extent to which the contact with the boarding school system (as opposed to the cultural influence of the parents) may be driving the age trend. This seems like an interesting question for further research.

Result 5. *The association between gender and envy in children is not a human universal.*

Support for this result is obtained if we consider that the fraction of Penan girls and boys choosing the envious option 5/3 was 44.7% and 35.7%, respectively, but this difference is not statistically significant (Probit regression; dummy female: $P > |z| = 0.227$, coefficient = 0.353 , $df/dx = 0.133$). This contrasts with the results of our German sample, where boys took the envious option significantly more frequently than girls (39.1% and 21.7%, respectively; unpaired t-test: $p = 0.055$). Although Penan and German boys showed about the same level of envious behavior (35.7% and 39.1%, respectively; unpaired t-test: $p = 0.708$), Penan girls opted for the envious choice significantly more often than German girls (44.7% versus 21.7%, respectively; unpaired t-test: $p = 0.019$). As with the role of age in envy development, the role that gender plays appears not to be universal. While other studies, including the German sample of this experiment, have found that boys tend to care more about being relatively better off, and that in a competitive environment boys perform better than girls (see Gneezy and Rustichini, 2004;

²⁹Pre-schools are located at the children's home villages — so here, they are under the daily influence of their relatives. Moreover, the language of instruction at these schools is also Penan.

³⁰In part, children at this age who attend pre-school instead of regular schools are children who were expelled from boarding school and sent to pre-school because they missed more boarding school days than permissible. Some of this, we were told, is the result of parents taking their children along with them on extended hunting trips into the deep jungle during the school year. This can lead to the children missing more than the maximum permitted number of days at school.

Houser and Schunk, 2009), these studies were based on Western participants and may not extend to other cultural spheres.

Regarding the effect of siblings, we do not find a significant association with choice in the Penan sample. But as in the German sample, Penan with more siblings were slightly but insignificantly more likely to opt for the envious choice. This is consistent with Fehr et al.'s (2008) result that single children share more than children who have siblings. The fact that the effect of the number of siblings in the Penan sample is smaller than in the German sample might be due to the considerably higher number of siblings in the Penan sample (mean=4.00 for Penan siblings compared to mean=1.56 in the German sample for both treatments and mean=1.46 in the envy treatment in Germany): The difference between having 4 vs. 5 siblings may not be as pronounced as having one vs. no siblings at all. Furthermore, the reported numbers of siblings may not be as accurate as in the German sample, as the word sibling (“pade”) is used somewhat more liberally in Penan, and is sometimes extended also to include cousins (Peter Brosius, personal communication).

Taken together, our data make a strong case that the development of envy is not a purely age-related phenomenon. The acquisition pattern appears to be modulated by socio-cultural context rather than there being a universal human development trajectory.

4 Discussion and Conclusion

We conducted an incentivized artefactual field experiment to investigate and compare the prevalence and development of destructive envy in Penan and German children aged seven to ten. There are three aspects that distinguish our study from previous work. First, we made envy costly. Second, in our design, the envious choice did not simultaneously abolish inequality. These first two features were designed to enhance the reliability of identifying truly envious choices. Third, we checked for cultural variability of our results by also conducting the study with children from a highly egalitarian non-Western society: the Eastern Penan of northern Borneo.

To identify envy, we played a distribution game with children in which they had to decide for one of two allocations of sweets between themselves and another anonymous receiving child. One of the options available signified a willingness to sacrifice a part of one's own pay in order to make the other child even worse off. We label this the envious choice. We found that a considerable fraction of children in the German sample was willing to give up payoff in order to be relatively better off than their unknown partner, even

though this was costly to the decider. An array of background information obtained about the children allowed us to shed light on the question which environmental factors are associated with the behavior of children.

To maximize our chance for picking up cultural variability, we conducted the same experiment with a group of children of the Eastern Penan. We expected that these would display a larger tendency to pick the non-envious choice, due to the prevalence of food sharing norms. Contrary to this hypothesis, we found that even among children from this context, a considerable fraction made envious choices. This indicates that a strongly egalitarian upbringing does not necessarily mitigate envy.

More generally, assuming that the cultural differences that we detected are not genetically determined, our findings suggest that the development pattern of envious behavior is influenced by the environment, rather than being a human universal. For instance, gender appears to matter in a way that is modulated by cultural context: Boys displayed more envious choice behavior than girls only in the German sample, and Penan girls made significantly more envious choices than German girls. Furthermore, we found differing age patterns in the development of envy across the two cultural groups.

Looking forward, a promising avenue of research seems to be to conduct a larger array of intercultural comparisons in children to better understand which dimensions contribute how much. Since our goal was to investigate whether there is any variability at all, we picked the Penan as a group with maximal contrast, but a more fine-grained approach may help better pin down the observed behavioral differences to particular dimensions.

It would further be interesting to extend the scope by investigating the development pattern of a larger range of social preferences in children. Such investigations have the potential to offer insight into the origins of human social behavior and may have interesting policy implications. For example, such studies may be informative for the optimal design of the educational environment.

Clearly, the establishment of cultural variability in envy development can only be a starting point for the more extensive agenda of better understanding the way in which social preferences are acquired and how this is modulated by the outside world. What can we do to build pro-social attributes like trustworthiness in children, and diminish the roles played by *schadenfreude* and envy? How do levels of envy and other social preferences in childhood influence envy in adolescence and adulthood?

This list of questions could easily be extended and demonstrates both how little is currently known about the acquisition of social preferences in childhood, and how large the potential of future work in this field may be —

we thus conclude with the hope that it inspires further research.

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A Control treatment on altruism

A.1 Design of control treatment

The control treatment on altruism was conducted in the same way as the envy treatment in Germany except that the payoffs were six sweets for the decider and three sweets for the receiver and five sweets for the decider and eight sweets for the receiver in option A and B, respectively (see table 6).³¹

	Option	Decider	Recipient
Envy Treatment	A	5	3
	B	6	8
Altruism Treatment	A	6	3
	B	5	8

Table 6: Payoff scheme for treatments on envy and altruism

This treatment serves to distinguish between profit maximization and altruism. We tested whether children were willing to give up one unit of payoff in order to let another child benefit from five more units. There are two plausible reasons for opting for B (5/8); one is altruism, and the other one is efficiency concerns. A reason for choosing option A (6/3) is profit maximization. As we will show, a considerable fraction of children did not behave selfishly and chose option B (5/8) although this meant giving up one unit of payoff for herself.

When giving reasons for their choice, no child compared herself to children outside the game, for example other deciders, they only compared their payoff to the one of the corresponding receiver.

A.2 Results Control Treatment

Here we present the results of the control treatment which tests whether already children behave altruistically even if it is costly for them.³² Figure 5 shows the fraction of children choosing option B (5/8) separately for the different age groups.

We observed an age effect: The older the children the more likely they took the altruistic option. The increase is statistically significant in 9- and

³¹Note that only the payoffs of the decider have been changed for the control treatment. All other parameters remain the same as in the envy treatment.

³²Note that in all following results the data from the three location is pooled as there are no significant differences at the 5%-level between the different locations (see table 8).

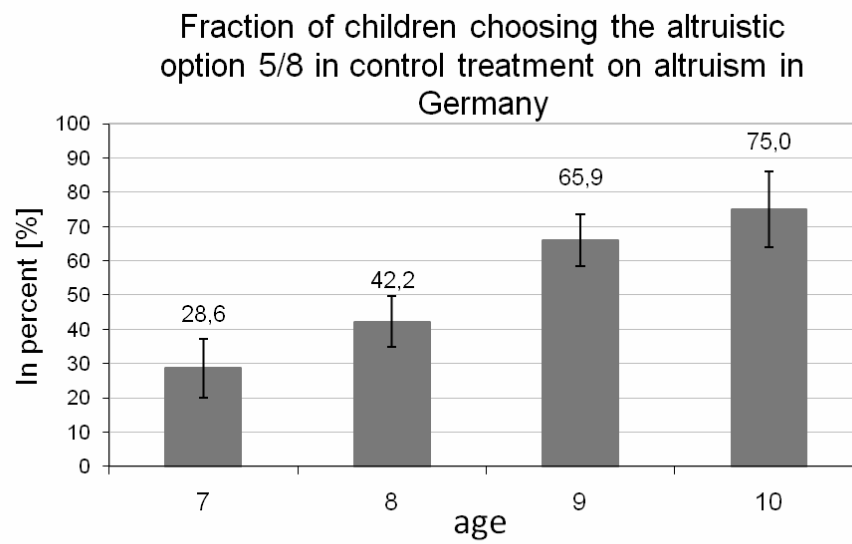


Figure 5: Fraction of children taking altruistic choice 5/8 in control treatment.
Whiskers indicate standard errors.

10-year-olds compared to 7-year-olds, but not for 8-year-olds (see table 7). While 28.6% of the children at the age of 7 took the altruistic choice the fraction of children doing this increased monotonically with age. 75.0% of the children at the age of 10 were willing to give up one sweet to make the receiving child better off.

Result 6. *The older German children were the more likely they took the altruistic choice.*

Our results fit the results of Fehr et al. (2008) who found an increase of altruistic choices with increasing age in the in-group variant (with children from the same school/Kindergarten) of their sharing game where children had to give up one unit of candy to make the other child equally well off. Note that children in our study were older than those in Fehr et al. (2008). In line with findings of the study by Benenson et al. (2007), our children behaved more and more altruistically with increasing age. Fehr et al. (2011), however, conducted a study similar to Fehr et al. (2008) with children and teenagers aged 8–17 and found that only about 10% of the children and teenagers were willing to share if it was costly for them. Note that they used money as an incentive for their subjects whereas we as well as Fehr et al. (2008) used candies as incentives which might have an influence on the willingness to give up own payoff.

Again, we have asked children about the reasons for their choice (see table 13 in appendix B.1). More than half (53%) of the 64 children choosing the non-altruistic option A (6/3) did not give a reason for their choice while only 36% out of the children taking the altruistic choice did not give a reason. The reason the most often argued (45%) for choice B (5/8) was that deciders wanted to be nice to the receiver (altruism), which is credible, because they even had to give up one unit of payoff to do so. This shows that many children at that age already know which behavior would have been the "kind" one. Only three out of the 66 children taking option B (5/8) claimed efficiency reasons. This supports our impression of the envy treatment that efficiency reasoning seems not to be present in children of that age.

As in the treatment on envy interacting with others while practicing a team sport had an impact on the behavior of children in the treatment on altruism: Children who practiced a team sport in their spare time were more likely to take the altruistic choice (Probit regression; dummy team sport: $P > |z| = 0.042$, coefficient= 0.581, $df/dx = 0.224$). Gender and the school grade on social behavior, however, did not have a significant influence on choices in the treatment on altruism.

Probit regression on altruistic choice 5/8		
Independent variable	Coefficient	dF/dx
Dummy 8 years	0.419 (0.401)	0.163 (0.151)
Dummy 9 years	0.913** (0.380)	0.344** (0.131)
Dummy 10 years	1.265*** (0.475)	0.414*** (0.112)
Dummy female	0.142 (0.297)	0.056 (0.118)
Grade math	0.134 (0.206)	0.053 (0.082)
Grade social behavior	0.256 (0.357)	0.102 (0.142)
Grade working behavior	-0.399 (0.330)	-0.158 (0.131)
Dummy team sport	0.581** (0.286)	0.224 (0.106)
Number of siblings	0.117 (0.095)	0.047 (0.038)
Constant	-1.002** (0.408)	

Observations: 103; $PseudoR^2 = 0.129$
 Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
 Omitted age category is 7 years.

Table 7: Probit regression on taking the altruistic choice 5/8 in control treatment on altruism

B Complementing tables

B.1 Tables for German sample

	p-values	
	control treatment	
	female	male
DS/DU	0.737	0.717
DS/KG	0.143	0.773
DU/KG	0.247	0.555

Table 8: Two-sample test of proportion for different locations in control treatment on altruism, separately for gender

	p-values			
	envy treatment		control treatment	
	female	male	female	male
DS/DU	0.853	0.001	0.862	0.647
DS/KG	0.037	0.101	0.228	0.768
DU/KG	0.053	0.118	0.295	0.473

Table 9: Two-sample test of proportion for different locations in both German treatments, separately for gender, without subjects stating reasons 5, 7, 8, and 9 and without subjects who did not understand the game

Probit regression on envious choice 5/3		
Independent variable	Coefficient	dF/dx
Dummy 8 years	1.132*** (0.428)	0.423*** (0.151)
Dummy 9 years	0.114 (0.408)	0.041 (0.147)
Dummy 10 years	-0.252 (0.652)	-0.086 (0.209)
Dummy female	-0.678* (0.373)	-0.231* (0.118)
Grade math	0.149 (0.207)	0.053 (0.074)
Grade social behavior	-0.206 (0.387)	-0.074 (0.138)
Grade working behavior	0.357 (0.389)	0.128 (0.138)
Dummy team sport	-0.373 (0.342)	-0.127 (0.110)
Number of siblings	0.149 (0.141)	0.054 (0.050)
Constant	-0.729* (0.419)	

Observations: 93; $PseudoR^2 = 0.151$
 Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
 Omitted age category is 7 years.

Table 10: Probit regression on taking the envious choice 5/3 in envy treatment (without reasons 5, 7, 8, and 9 and without children that did not understand the task)

Probit regression on altruistic choice 5/8		
Independent variable	Coefficient	dF/dx
Dummy 8 years	0.429 (0.401)	0.168 (0.153)
Dummy 9 years	0.877** (0.394)	0.332** (0.137)
Dummy 10 years	1.188** (0.484)	0.405** (0.125)
Dummy female	-0.034 (0.307)	-0.014 (0.122)
Grade math	0.156 (0.217)	0.062 (0.086)
Grade social behavior	0.398 (0.385)	0.159 (0.153)
Grade working behavior	-0.434 (0.344)	-0.173 (0.137)
Dummy team sport	0.456 (0.303)	0.179 (0.115)
Number of siblings	0.133 (0.099)	0.053 (0.039)
Constant	-0.960** (0.418)	

Observations: 95; $PseudoR^2 = 0.122$
 Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
 Omitted age category is 7 years.

Table 11: Probit regression on taking the altruistic choice 5/8 in control treatment on altruism (without reasons 5, 7, 8, and 9 and without children that did not understand the task)

Reason	5/3			6/8		
	girls	boys	all	girls	boys	all
No answer given	5 (50%)	8 (32%)	13 (37%)	11 (31%)	11 (28%)	22 (29%)
Profit maximization	0	0	0	5 (14%)	6 (15%)	11 (15%)
Envy	4 (40%)	4 (16%)	8 (23%)	0	0	0
Altruism	0	0	0	15 (42%)	16 (41%)	31 (41%)
Efficiency	0	0	0	1 (3%)	2 (5%)	3 (4%)
No candy allowed	0	0	0	1 (3%)	0	1 (1%)
Misunderstood game	0	2 (8%)	2 (6%)	1 (3%)	1 (3%)	2 (3%)
On diet	0	0	0	0	0	0
Not hungry	0	0	0	0	0	0
Doesn't like candy	0	0	0	0	0	0
Other	0	3 (12%)	3 (9%)	2 (6%)	3 (8%)	5 (7%)
Excuse	1 (10%)	8 (32%)	9 (26%)	0	0	0
Σ	10	25	35	36	39	75

Table 12: Reasons for choice given by subjects, envy treatment

Reason	5/8			6/3		
	girls	boys	all	girls	boys	all
No answer given	9 (26%)	15 (48%)	24 (36%)	22 (63%)	12 (41%)	34 (53%)
Profit maximization	0	0	0	5 (14%)	7 (24%)	12 (19%)
Envy	0	0	0	0	4 (14%)	4 (6%)
Altruism	19 (54%)	11 (35%)	30 (45%)	0	0	0
Efficiency	2 (6%)	1 (3%)	3 (5%)	0	0	0
No candy allowed	0	1 (3%)	1 (2%)	0	0	0
Misunderstood game	1 (3%)	0	1 (2%)	0	2 (7%)	2 (3%)
On diet	0	1 (3%)	1 (2%)	0	0	0
Not hungry	1 (3%)	0	1 (2%)	0	0	0
Doesn't like candy	1 (3%)	2 (6%)	3 (5%)	0	0	0
Other	2 (6%)	0	2 (3%)	5 (14%)	2 (7%)	7 (11%)
Excuse	0	0	0	3 (9%)	2 (7%)	5 (8%)
Σ	35	31	66	35	29	64

Table 13: Reasons for choice given by subjects, control treatment on altruism

B.2 Tables for Penan sample

	p-values			
	Long Kevok	Long Latei	Long Belok	Long Latenk
Long Kevok	-			
Long Latei	0.419	-		
Long Belok	0.323	insuf. obs.	-	
Long Latenk	0.769	insuf. obs.	0.235	-

Table 14: Two-sample test of proportion for different locations

	p-values			
	Long Kevok	Long Latei	Long Belok	Long Latenk
Long Kevok	-			
Long Latei	0.473	-		
Long Belok	0.489	insuf. obs.	-	
Long Latenk	0.557	insuf. obs.	0.290	-

Table 15: Two-sample test of proportion for different locations (without children who do not like candies or who think that the receiver does not like the candies)

Envious decision 5/3			
Age	Pre-school	School	Two-sample test of proportions (p-value)
7	0% (0/3)	24% (5/21)	0.342
8	0% (0/2)	35% (8/23)	0.312
9	100% (1/1)	50% (12/24)	0.327
10	25% (1/4)	56% (14/25)	0.249

Table 16: Fraction of children choosing the envious option 5/3 in pre-schools and schools

Probit regression on envious choice 5/3		
Independent variable	Coefficient	dF/dx
Dummy age=8	0.213 (0.449)	0.080 (0.170)
Dummy age=9	0.706* (0.428)	0.270* (0.163)
Dummy age=10	0.846** (0.392)	0.319** (0.145)
Dummy female	0.293 (0.307)	0.108 (0.113)
Dummy pre-school	-0.653 (0.461)	-0.206 (0.120)
Number of siblings	0.089 (0.061)	0.033 (0.022)
Constant	-1.277*** (0.413)	

Observations: 95; $PseudoR^2 = 0.104$
 Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
 Omitted age category is 7 years.

Table 17: Probit regression on Penan children taking the envious choice 5/3 (without children who do not like candies or who think that the receiver does not like the candies)

C Experiment in Germany

C.1 Experimental Set-up in Germany

Experimental protocol of the proceeding

- Teachers of the classes participating in the study receive a letter in which they are informed about the study. They are also asked to distribute letters in which the parents are informed about the study. Parents have the possibility to exclude their children from the study.
- Teachers of the participating classes prepare a list for each class. On these lists we find no names, but a randomly assigned number for each child in order to ensure complete anonymity. In addition, teachers provide us with data about the gender, the age at the day of the experiment, school grades in math, social- and working behavior, as well as sometimes the degree of education of the parents classified as below average, average, or above average.³³
- The children of one class are randomly matched in pairs by drawing lots without knowing with whom they are paired. The first child gets the role of the decider, the second child gets the role of the receiver.
- The class pursues its normal teaching procedure, often as individual work. The deciders go one by one in random order to the experimenter who is located in a separate empty room with her experimental set-up. When one child returns to the class, the next one is sent to the experimenter.
- The experimenter sits at a table. To make it easy for the child to capture the different options, each of the two options (5/3 vs. 6/8 and 6/3 vs. 5/8 for treatment on envy and control treatment on altruism, respectively) is arranged on a napkin with the payoff for the proposing child at the side of the table where the child sits and the payoff for the recipient at the side of the table where the experimenter sits. The sweets are placed in a way to make it easy to immediately see the different amount. In addition, we placed a little piece of paper with a number indicating the amount of sweets next to each payoff (see figure 1).
- The experimenter explains the game to the child and asks for a choice, underlining the fact that she does not know with whom she is matched.

³³Unfortunately, only few teachers filled out this column. For this reason we did not include this information in our data analysis.

- After the child's decision, the sweets are placed into envelopes. The decider's envelope is directly handed out to her and the child is assured that the other child will receive the other envelope after the experiment is completed in her class.
- Then a couple of questions follow (see appendix C.2).
- While placing the sweets into the envelopes, the experimenter casually asks the decider about the reasons for her choice.
- After all deciders of one class have played the game, the experimenter goes into the class room and hands the envelopes for the receivers to the teachers. The teacher hands out the envelopes to the corresponding children. If there was an uneven number of children in one class or if not all children of a class could participate in the experiment due to time constraints, the remaining children received for ethical reasons nevertheless an envelope with sweets.

C.2 Translation of instructions

Protocol of the interaction/interview with each decider during the experiment³⁴

Experimenter (E): Hallo! Sit down. Your task is to split up gummy bears. You can take some for yourself and send some to another child. The other child is in your class, but you don't know which one of them it will be, because this will be randomly drawn. You can either take 5 (6) gummy bears for yourself and send 3 to the other child or you can take 6 (5) for yourself and send 8 to the other child.

[If you choose this side (E. pointing at one side of the table), who will then get how many gummy bears?

Child (C): I would get ... and the other child would get ...

E: Correct. (Or repeating this question with re-explanation of the game until the child understands it although this rarely happened.)]³⁵

What do you want to do?

C: I take ... for myself and send ... to the other child.

E: What do you think, who wants usually more candies? Boys, girls, or do both want as much as possible (*these three options in random order*)?

C: ...

E: How many brothers and sisters do you have?

C: ...

E: What do you want to be later?

C: ...

E: Do you like gym classes at school?

C: ...

E: Do you do sports beyond school?

³⁴The experimenter followed the protocol as closely as possible.

³⁵The text in squared brackets was only employed in the session in November 2009. In the session of January 2008 the understanding of the task was inferred from the child's answer to the task.

C: ...

If yes, E: What kind of sports?

C: ...

E: Are you member of a club?

C: ...

E: Why have you decided this way?

C: ...

E: Thank you for participating. The other child will receive the envelope in a moment. Bye.

C.3 Original German instructions

Original German version of the interaction with the deciders:

Experimentleiterin (E): Hallo! Setz dich. Deine Aufgabe ist es Gummibärchen aufzuteilen. Du nimmst welche für dich selbst und schickst welche an ein anderes Kind. Das andere Kind ist in deiner Klasse, aber du weißt nicht, wer von ihnen das ist, denn dies wird zufällig ausgelost. Du kannst entweder 5 (6) Gummibärchen für dich nehmen und 3 an das andere Kind schicken oder 6 (5) Gummibärchen für dich nehmen und 8 an das andere Kind schicken.

[Wenn du diese Seite nimmst (E. auf eine Seite zeigend), wer bekommt dann wie viele Gummibärchen ?

Kind (K): Dann bekomme ich ... und das andere Kind ...

E: Richtig. (Falls die Antwort falsch war wurde das Spiel nochmals erklärt und die Frage wiederholt, was selten der Fall war.)³⁶

E: Was machst du?

Kind (K): Ich nehme ... für mich und ... für das andere Kind.

E: Wer, glaubst du, will normalerweise mehr Süßigkeiten haben? Jungen, Mädchen oder wollen alle immer möglichst viel haben (*diese drei Optionen in zufälliger Reihenfolge*)?

K: ...

E: Wie viele Brüder und Schwestern hast du?

K: ...

E: Was möchtest du später werden?

K: ...

E: Machst du gerne Sport in der Schule?

K: ...

E: Machst du nach der Schule Sport?

³⁶Der Text in eckigen Klammern wurde nur bei der Datenerhebung im November 2009 gesagt. Bei der Datenerhebung im Januar 2008 wurde von der Formulierung der Antwort des Kindes inferiert, ob dieses die Aufgabe verstanden hat.

K: ...

Falls ja, E: Was für Sport?

K: ...

E: Bist du im Verein?

K: ...

E: Warum hast du dich so entschieden?

K: ...

E: Vielen Dank fürs Mitmachen. Das andere Kind bekommt den Umschlag gleich vorbeigebracht. Tschüß.

D Experiment with Penan

D.1 Background Information on Penan

Historically, the Eastern Penan in the Baram Area south of Brunei, where we conducted our experiment, were chiefly nomadic (Needham, 1953). In the traditional nomadic lifestyle, food was acquired through hunting, gathering, and the harvesting of their main staple food: wild sago. Small groups of Penan would move from one sago hotspot to another in long cycles, in order to allow the existing stocks to recover and replenish before their next return, which could be years later. Outside of this passive management of the sago stocks, the Penan traditionally appear not to have relied on agriculture to any significant degree.

More recently, due to a combination of developments, almost all Penan have transitioned to a sedentary lifestyle, and are based in permanent settlements for at least the larger part of the year. The rainforest in Sarawak has been extensively logged during the past thirty years, so that little of the original primary rainforest remains outside of the national parks. Although logged areas typically re-grow into secondary rainforest, the vegetation changes, and this apparently makes it more difficult to hunt and find other wild forest resources such as sago palms or fruit trees (Sercombe, 2008). The official government policy has been to try to settle the Penan and integrate them into mainstream Sarawakian life. At the time of writing, only one small group (ca. 10–15 families) of fully nomadic Penan remained in the vicinity of our testing area (at Ba Puak).

D.2 Experimental Proceeding in Malaysia

D.2.1 Recruitment of schools/pre-schools

A letter of recommendation was obtained from the Malaysian Ministry of Justice, with which we approached the primary schools in Long Kevok and Long Luteng. Access to the pre-schools was granted by the NGO that runs them: The Borneo Project.

D.2.2 Experimental Protocol

Children were told that their task was to divide up some sweets between themselves and an anonymous second child from the same school. The sweets for the second child were to be put in an envelope and the researcher would give them to a random child from the same school later on. The child was assured that the researcher would not reveal the identity of the decider to the receiving child or anybody else. Children were told that they could not take the sweets out of the room but had to eat them inside before leaving. This was done both to ensure that anonymity remained credible and to ensure that children could not share the sweets after leaving the room (thus uncontrolledly modifying the payoff structure). Payoffs were then explained, and the child was asked whether she has any questions. If not, we tested comprehension of the payoff structure by asking (in random order) questions about all four payoffs, i.e. "If you choose this side, how many sweets do you get? How many sweets does the other child get?". Once we were sure the child had understood the payoffs, the child was asked to make her choice. After the child had made her choice, she was asked a number of additional questions (age, class level, number of siblings, motivation for the choice, etc.).

The set-up parallels the German set-up of the experiment as closely as possible, while introducing some additional control questions to check for proper induction of values. In particular, we wanted to make sure that the children believed they were going to like the sweets (Question M1), had monotonic preferences over the sweets themselves (Question Q3), and also believed recipients to have such preferences (Question M2). M2 was asked because if a child does not believe the recipient's preferences are monotonic, then it is not clear what choice option is pro-social.

D.2.3 General Remarks on Reliability

In general, Penan children are rather shy in interacting with strangers, particularly if they are visibly foreign (i.e. Caucasian). To mitigate this effect, all interaction was done by a translator fluent in Penan, who has many years

of experience in working with Penan children, as she is involved in running Penan preschools. Shyness particularly impacted our question relating to the motivation for making a certain choice (Question Q1: "Why did you decide this way?"). Responses here were often preceded by a long (e.g. 1–2 minutes) silence. For this reason, and because there is arguably a strong social desirability motive not to state an egoistical (envious) motive explicitly, our trust in the responses to this particular question is relatively limited. This should not have impacted choice however, as the question was asked after the choice had been made. In general, choices were made and all other questions were answered without the large delays observed for Q1.

D.3 Experimental Instructions Penan

Below is the full list of instructions. Differences to the experiment with the German sample are highlighted and commented.

D.3.1 Instructions in English (original):

Experimenter: Are you Penan? (Question T1; does not appear in German set-up)

Child: ...

Experimenter: Do you think you would like to eat these sweets? (Question M1; does not appear in German set-up)

Child: ...

We were not sure ex ante whether the children were going to like the sweets we used as payoffs. To check for this, we asked each participant whether (he or) she thinks she would like eating the sweets. If the participant said yes, the experiment proceeded. If the participant said no, we gave her one sweet to try (as some of the children did not previously know this particular brand of sweets) and asked the question again. Participants who still said no were to be removed from the participant pool (this did not occur). This control question was included beginning with participant number 36.

Experimenter: Here are some sweets. Some are for you, and some are for another child. Later, you will make a choice. There are some on this side and some on this side. If you choose this side, then you get 6 and another child gets 8. If you choose this side, then you get 5 sweets and the other child gets 3 sweets.

When you choose, you must eat your sweets right away. You may not take any of them out of this room. We will put the sweets for the other child into an envelope. We will give them to another child later. The other child is also from this village, but you do not know who it is. The other child will be randomly selected. The other child will also not know who sent the sweets. Nobody except for us will know how you decided, and we will not tell anyone. The other child must also eat all the sweets itself, and is not allowed to give them to anyone else.

Do you have any questions? *If the child says no, then comprehension is briefly tested by asking about the payoffs in random order. If the child makes any mistakes, this is repeated until the child has understood.*

What will you do?

Child: I will take ... for myself and send ... to the other child.

Experimenter: You may take the sweets now. You must eat them all while you are still here in this room. I will put the sweets for the other child into this envelope. The other child will receive them soon.

Why did you decide this way? (Question Q1)

Child: ...

Experimenter: Who likes these sweets more: Boys, girls, or do both like it the same? (Question Q2; answer options presented in randomized sequence)

Child: ...

Experimenter: What do you think is better: to have many sweets or just a few? (Question Q3; does not appear in German set-up; answer options presented in randomized sequence)

This question was designed to test for monotonicity of preferences regarding our payoff. The sequence of response options was randomized and the question was asked after the child had made her choice.

Child: ...

Experimenter: How old are you? (Question Q4a)

Child: ...

Experimenter: What grade are you in? (Question Q4b)

Child: ...

Experimenter: How many brothers and how many sisters do you have? (Question Q5)

Child: ...

Experimenter: Do the other children like these sweets? (Question Q5; does not appear in German set-up)

Child: ...

This question was designed to record the child's beliefs about the preferences of the recipient. The question was asked after the choice had been made. It was introduced beginning with participant number 56.

Experimenter: How many brothers and how many sisters do you have?
(Question Q5)

Child: ...

Experimenter measures how tall the child is. (Question Q6)

Experimenter notes gender of child. (Question Q7)

Experimenter: Thank you for participating! Please do not tell anyone how many sweets you ate. We will also not tell anyone. Good bye!

D.3.2 Penan translation

Translation of original English instructions into Penan language³⁷

E: Ineu rengah, jian menyun.

T1: Penan ko?

E: Siteu puun kacang mee.

M1: Lem seruh ko, kelo ke kon kacang?

E: Puun eh tong jah bilak iteu ngan jah bilak iteu. Jeluak ngan ko, jeluak ngan irah anak eh jah. Mao iteu da kaah perlu ngevele eh mah kenelo ko. Hun ko ngevele jah bilak iteu, kaau ala 6 ngan irah anak eh jah ala 8. Hun ko ngevele jah bilak iteu, kaau ala 5 ngan anak eh jah ala 3 kacang.

Hun mah ke ngevele, kaau mesti kuman kacang inah hun iteu. Kaau bek omok mihin eh musit jin lamin iteu. Amee ala kacang jah bilak inah modo lem sarung surat. Amee menak kacang inah ngan anak eh jah daap.

Anak inah peh jin lebo iteu, tapi kaau bek jam see iah uban amee ngevele eh sebarang awah. Anak eh jah peh bek jam see menak kacang inah. Bek puun eh jam ineu eh kevele ko jin lao amee ngan amee peh bek bara ngan irah jah.

Anak eh jah peh kuman kacang iteu tenge ngan bek omok menak kacang inah ngan irah jah.

Puun ineu-ineu juk teneteng? ...

Sa bilak mah ngevele ko? ...

Kaau omok ala kacang inah hun iteu, Kaau mesti kuman teloong kacang inah tovo ko lem retek iteu. Akeu modo kacang ngan anak jah lem sarung surat iteu. Irah ala eh daap.

Q1: Ineu maneu ke ngevele eh kenat?

Q2: Lem penyeruh ko, see jin belah anak lakei ngan anak redo eh lebih kelo kuman kacang atau peh roh kuak awah?

Q3: Kineu eh, puun kacang eh pina lebih jian jin eh kerat?

Q4a: Kura umun ko?

³⁷The English original instructions were translated to Penan by Satang Lekit, who is presently an employee of The Borneo Project. She is ethnically Kenyah, but is fluent in Penan has been working with Penan children for many years. Satang also conducted all interaction with the children during the experiment.

Q4b: Darjah kura ko?

Q5: Kura kekat padaee lakei ngan padee redo ko?

M2: Lem seruh ko, kelo ke irah jah kon kacang iteu?

Q6: requires no translation

Q7: requires no translation

Jian kenin uban menak kerja kuak, amai bara ngan see-see peh kura mung kacang eh lepah kinan ko.

D.3.3 Back-translation

Back-translation of the Penan instructions to English³⁸

How are you? Have a seat please.

T1: Are you a Penan?

Here are some Peanuts.

M1: Do you think you would like to eat these peanuts?

On this side we have some peanuts, and on the other side we also have some peanuts. Some will be for you, and some of them will be for an other child.

After this, you have to choose what you want. If you choose the one on this side, you will get 6, and the other child will get 8. If you choose this (other) side, you will get 5 and the other child will get 3 peanuts. Whichever one you choose, you have to eat it now. You are not allowed to bring it out from this room. We take this side of the peanuts and put it inside the envelope, and give it to the other child later on. That child is also from this village. But you do not know him/her, because we choose them randomly. The other child also does not know who gave the peanuts. The other child does not know what you have chosen. Beside us, nobody will know, because we will not be telling them. The other child will also eat these peanuts alone and he/she cannot give it to the others.

Do you have any questions?

Child: ...

Experimenter: Which side do you choose? ...

You can get the peanuts now. You have to eat it all while you are inside this room. I put the peanuts for the other child inside this envelope, and they will take/eat it later.

Q1: What made you choose that way?

Q2: In your opinion, is it the boys or the girls who like to eat the peanuts most? Or are they the same?

Q3: What do you think: is it good to have more peanuts or less peanuts?

³⁸To make sure that our translation accurately corresponds with the intended wording, we had an independent second translator back-translate the instructions to English. The back-translation was performed by Mr. Dominic Langat (contact details available on request from the authors), who has worked with the Penan for more than 20 years in several NGOs (Sahabat Alam, BRIMAS, BMF, NTFPEP) and has worked as an official translator of Penan for the BBC and Al Jazeera.

Q4: How old are you?

Q4b: In which class are you now?

Q5: How many brothers and sisters do you have?

M2: Do you think other people would also like eating these peanuts?

Q6: ...

Q7: ...

Experimenter: Thanks for your cooperation, don't tell anybody the amount of peanuts that you have eaten.