HHS Public Access
Author manuscript
*Psychol Sci*. Author manuscript; available in PMC 2016 July 01.

Published in final edited form as:
*Psychol Sci*. 2015 July ; 26(7): 1038–1045. doi:10.1177/0956797615578476.

# Roots and Benefits of Costly Giving: Young Children's Altruism is Related to Having Less Family Wealth and More Autonomic Flexibility

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## Abstract

Altruism, although costly, may promote well-being for those who give. Costly giving by adults has received considerable attention, but less is known about the possible benefits, as well as biological and environmental correlates, of altruism in early childhood. In the current study, we present evidence that children who forgo self-gain to help others show greater vagal flexibility and higher subsequent vagal tone than those who do not, and children from less wealthy families behave more altruistically than those from wealthier families. These results suggest that altruism should be viewed through a biopsychosocial lens; that privileged contexts have an early-emerging influence on children's willingness to make personal sacrifices for others; and that altruism and healthy vagal functioning may share reciprocal relations in childhood. When children help others at a cost to themselves, they could be playing an active role in promoting their own well-being as well as the well-being of others.

### Keywords

altruism; socioeconomic status; childhood; vagal tone; autonomic flexibility

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Although altruism is personally costly in terms of material resources, a growing body of research suggests that it may also confer emotional and physiological benefits for those who give. Helping others can help ameliorate stress (Taylor, 2006; von Dawans, Fischbacher, Kirschbaum, Fehr, & Heinrichs, 2012), is emotionally rewarding (Dunn, Aknin, & Norton, 2014), and is linked to better physical health and longevity (Brown, Nesse, Vinokur, & Smith, 2003; Schreier, Schoner-Reichl, & Chen, 2013). These findings suggest that when adults provide assistance to others, they may get something back in terms of improved well-being. If behaving generously is intrinsically beneficial, we may also expect to see this association in young children. One aim of the present study was to examine whether young children who engage in altruistic giving also show healthier physiological functioning.

Although prosociality emerges early in life and can be rewarding, helping others at a cost to oneself can often be difficult. Altruism (i.e., costly helping) is indeed harder for young children than other kinds of prosocial behaviors (Svetlova, Nichols, & Brownell, 2010), and

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there are considerable individual differences across children (House et al., 2013). A second aim of the present study was to investigate biological and environmental factors related to social engagement as predictors of children's altruism.

Polyvagal theory posits that prosociality is supported by physiological states that foster calm social engagement and inhibit defensive responding (i.e., fight-or-flight behaviors) (Porges, 2011). In the autonomic nervous system, increased parasympathetic (PNS) influence on the heart via the myelinated vagus nerve (i.e., vagal tone) is believed to facilitate perception of the environment as safe, and vagal withdrawal in response to salient tasks supports adaptive orienting and coping with challenge (Porges, 2011; Thayer, Ahs, Fredrikson, Sollers, & Wager, 2012). In threatening situations, increased sympathetic nervous system (SNS) activation mobilizes energy for fight-or-flight responding (Cannon, 1932). Thus, some have proposed that prosociality is supported by activation of the PNS and inhibition of the SNS (Goetz, Keltner, & Simon-Thomas, 2010; Fabes, Eisenberg, & Eisenbud, 1993), but evidence for this is mixed (Hastings, Miller, Kahle, & Zahn-Waxler, 2014). Furthermore, previous research on the autonomic correlates of children's prosociality has focused on empathy, sympathy, and non-costly prosocial behaviors (Hastings et al., 2014). Researchers have not studied the physiological underpinnings, as well as potential benefits or consequences, of children's helping in contexts that require giving up resources for the good of others. Higher PNS and lower SNS activity at rest reflects effective conservation of bodily energy and is related to better mental and physical health (Thayer & Sternberg, 2006). Thus, we tested whether PNS and SNS activity predict children's altruistic giving, and whether these behaviors, in turn, reciprocally predict subsequent levels of PNS and SNS activity.

Children's altruism is not just a function of biology, but also their environmental contexts. Recent research points to socioeconomic status (SES) as an important environmental factor that shapes social engagement (Kraus, Piff, & Keltner, 2011). High SES has been linked to less prosociality in adults (Piff, Kraus, Cote, Cheng, & Keltner, 2010; Stellar, Manzo, Kraus, & Keltner, 2012). One explanation for this finding is that greater access to material resources decreases reliance on others (Kraus et al., 2011). As a result, high SES may increase self-focus and decrease interpersonal sensitivity. Whether the link between high SES and increased self-focus extends to young children's altruism is unclear. Examinations of the relation between family SES and children's altruistic giving using the dictator game, which asks children to allocate resources between themselves and others, have produced inconsistent findings (Benenson, Pascoe, & Radmore, 2007; Chen, Zhu, & Chen, 2013). These studies, like many that use the dictator game, are missing two important motivational elements for altruism: 1) information about the emotional state or need of the potential recipient (de Waal, 2008), and 2) giving resources accumulated through work or effort (Warneken, Lohse, Melis, & Tomasello, 2010). Current evolutionary models posit that altruism evolved out of a system for providing caregiving to dependent, vulnerable offspring, but that altruism can be directed towards non-kin when the situation shares similar features, such as vulnerability (Preston, 2013). Furthermore, many real world opportunities for altruism, like charitable donation, involve distributing one's own earned resources to vulnerable or less fortunate individuals. Thus, we should study children's altruism in contexts that are both evolutionarily meaningful and ecologically valid.

To the extent that maintaining a state of calm social engagement is important for providing costly helping, we expected that greater PNS and lower SNS activity in response to perceiving others' needs would predict more altruistic giving. We also hypothesized that more altruistic giving would confer the physiological benefits of subsequent higher PNS and lower SNS activity. Lastly, we predicted that children from wealthier families would be less altruistic than children from less affluent families.

# Method

## Participants

This analysis included 74 preschool age children (*M* = 4.09 years-of-age, *SD* = 0.12, 40 girls). These data were collected, in the context of an ongoing longitudinal study, from every family that participated when the donation procedure was administered. Families were predominantly Caucasian (74%) and were middle- to upper-middle SES (*M* = $75,000-$90,000; range from $15,000 -$30,000 to over $120,000). Families were recruited via direct mailings, local advertisements, and letters distributed to daycares. Children with serious cognitive or physical impairments that might interfere with their ability to complete procedures were excluded from the study.

## Procedure

Families visited the laboratory for testing. After arriving, children played with an examiner for approximately 10 minutes while another examiner obtained mothers' informed consent. During this time, the examiner explained to children that they would be earning tokens over the course of the visit which could be traded in for a prize at the end. Approximately 15 minutes into the laboratory visit, electrodes were attached to the child's torso to obtain electrocardiograph (ECG) and impedance cardiograph (ICG) signal. By completing a variety of activities over almost 2 hours each child gradually earned 20 prize tokens, which were kept for the child in a "token box." Just before the end of the visit, children participated in a donation task with their prize tokens.

## Measures

**Altruism—**Altruistic behavior was assessed using a donation task (Grusec & Redler, 1980), administered near the end of the lab visit and before children received their prize. Children were given an opportunity to donate their prize tokens to anonymous sick children (fictitious), so that they could also get prizes even though they were unable to come into the lab. The task was divided into three sections:

**Section 1: Instructions:** The examiner explained the donation task to children while they were seated at a table. Children were told that they had earned 20 prize tokens, enough to get a really great prize. The examiner then said she had another job working at a hospital with sick children who couldn't come to the lab to earn prizes. The examiner explained that if the children wanted to, they could donate some of their own prize tokens by moving tokens from their own box to a separate box reserved for the children in the hospital. Both boxes were placed on the table in front of the seated children. Children were told "You can give them all of your tokens, some of your token, or none of your tokens. It's up to you." To ensure children understood the task, the examiner asked children to identify which box was for their tokens and which box was for the children in the hospital. Children were given a bell to ring when they were finished deciding, and the examiner then left the room.

**Section 2: Decision:** Children were left alone in the room to decide whether and how much to share by taking tokens out of their box and placing them into a box for the sick children. Children rang a bell to signal that they were done and ready for the examiner to come back into the room.

**Section 3: Conclusion:** The examiner returned to the room, closed the token boxes without looking inside, and put away materials. Children were not offered feedback on their behavior during this time.

**Cardiac data—**Three disposable, pre-gelled electrodes were attached to children's chest to obtain ECG signal. An additional 4 electrodes were placed on children's chest and back to obtain ICG signal. Cardiac data were collected, edited, and processed using ambulatory monitors and software from MindWare Technologies (Gahanna, Ohio).

Respiratory sinus arrhythmia (RSA) refers to heart rate variability that corresponds with breathing and is a measure of parasympathetic nervous system activity (i.e., vagal tone) (Berntson et al., 1997). Spectral analysis of the ECG data was used to compute RSA (Berntson et al., 1997). The frequency band-pass parameters to quantify RSA were set to .24 to 1.04 Hz (Huffman et al., 1998) and sampling rate was set at 500 ms. The first derivative of change in the impedance signal (dz/dt) was used as an estimate of respiration (Ernst, Litvack, Lozano, Cacioppo, & Berntson, 1999) and was controlled for in the computation of RSA. RSA values were computed in 15-s epochs over the course of the altruism task. This is a common epoch length for computing RSA in developmental studies using shorter tasks (Huffman et al., 1998; Miller et al., 2013).

Pre-ejection period (PEP) refers to the time in milliseconds between ventricular depolarization and the opening of the aortic valve, and is a measure of SNS activity. PEP was defined as the average time interval between the onset of the R-spike, as marked by the Q-point in the ECG signal (Berntson, Lozano, Chen, & Cacioppo, 2004), and the B-point in the dz/dt signal (Lozano et al., 2007). Shorter PEP indicates greater SNS activity. PEP values were computed in 15-s epochs over the course of the altruism task.

Epochs were averaged to form three mean RSA and PEP scores that corresponded with the three different sections of the altruism task (instruction, decision, and conclusion). The duration of the instruction and decision sections of the altruism task varied across children, from 47 to 138 seconds for the instruction section ($M$ = 89.69, $SD$ = 16.45) and 9 to 275 seconds for the decision section ($M$ = 49.49, $SD$ = 43.15). Decision RSA and PEP were not computed for 3 children who took less than 15-s before ringing the bell. 20 children also had incomplete physiological data due to refusing to wear the cardiac monitor or not providing useable cardiac data for one or more sections of the task. Thus, the number of children with useable RSA or PEP data for each of the sections of the altruism task ranged from 51 to 62.

**Family income—**Mothers reported on their annual family income before taxes using a 9-point scale with $15,000 increments, ranging from (1) 0-$15,000 to (8) $105,000-$120,000, with the final scale point (9) for incomes over $120,000.

### Analyses

We used structural equation modeling to examine hypothesized relations between children's physiology, altruistic giving, and family income. Separate models were tested with RSA and PEP as the physiological variables of interest. In both models, we included an autoregressive component to control for rank-order stability in physiology over the course of the donation task. Model fit was assessed using $\chi 2$, the Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). Good fit is indicated by non-significant $\chi 2$ values, and CFI and TLI values higher than .95 (Hu & Bentler, 1999). $\chi 2$ difference tests were used to compare fit between different models. Full information maximum likelihood estimation (FIML) was used to produce model estimates and account for missing data.

## Results

Descriptive statistics and correlations between the main variables are presented in Table 1.

There was high rank-order stability in RSA and PEP over the course of the donation task, and a negative association between family income and number of tokens donated. 54% of children chose to donate at least one token to the sick children (40 and 34 children chose to donate and not donate, respectively). The number of tokens donated ranged from 0 to 20 (*Mdn* = 3). Analysis of variance (ANOVA) tests showed that there were significant differences in RSA [$F(2,53) = 13.83$, $p < .001$] and borderline significant differences in PEP [$F(2,46) = 2.92$, $p = .06$] over the course of the altruism task. Follow up analyses showed that RSA was significantly higher during the conclusion than during the instruction and decision sections of the altruism task. PEP was significantly longer (i.e., less SNS activation) during the decision than instruction and conclusion sections of the altruism task.

The structural equation model including RSA as the physiological variable of interest is presented in Figure 1. The paths from sex predicting children's RSA during the decision and conclusion sections of the task were not significant, and removing them from the model did not significantly diminish overall model fit ($\chi 2(2) = .29$, $p = .86$). We excluded these paths to provide a more parsimonious model. Conversely, girls tended to donate more tokens than boys ($\beta = .19$, $p = .08$), and removing this path from the model decreased model fit at the trend level as shown by a $\chi 2$ difference test ($\chi 2(1) = 3.15$, $p = .08$). This variable and path, although not shown in Figure 1, were retained in the final model. We controlled for covariation between RSA during the instruction section of the altruism task and family income and sex, but these associations were not significant (both $|r| < .04$, both $p > .78$).

Our final model showed good fit with the data, $\chi 2(6) = 7.35$, $p = .29$, CFI = .99, TLI = .95. The model accounted for 23% of the variance in children's altruism and 68% of the variance in children's RSA in the conclusion section of the task. Children with higher RSA during the instruction period, and lower RSA during the decision period, donated more tokens ($\beta = .43$ and -.41, respectively, both $p < .01$). Altruistic giving, in turn, predicted higher RSA levels after the task (β = .23, $p < .01$) over and above the direct and indirect contributions of children's RSA during the decision and instruction periods. Family income negatively predicted the number of tokens donated (β = -.28, $p < .01$) but positively predicted RSA during the conclusion period (β = .15, $p = .05$) (see the Supplemental Material available online for additional analyses using RSA change scores rather than RSA values).

We fit a second identical model that included PEP instead of RSA as the physiological variable of interest. This model showed poor fit to the data, $\chi 2(6) = 23.20$, $p = .001$, CFI = .92, TLI = .71. PEP showed high rank-order stability over the course of the altruism task (both β = .92, p < .001), but was not significantly associated with children's donation behaviors or family income (all |β| < .13, all p > .71).

## Discussion

Previous research has shown that altruism, although costly in material resources, can promote well-being for adults who give (Dunn et al., 2014), and that adults' prosociality is closely tied with neurobiological functioning and socioeconomic resources (Keltner, Kogan, Piff, & Saturn, 2014). Children's prosociality, broadly defined, also has been the subject of considerable neurobiological (Hastings et al., 2014) and socialization research (Hastings, Miller & Troxel, 2014). However, the potential benefits, as well as biological and environmental correlates, of children's altruism are less documented. The current study provided evidence that: 1) children who sacrifice resources to help others demonstrate healthier parasympathetic functioning, both in terms of greater vagal flexibility during an altruism task and higher vagal tone immediately afterwards; 2) children from less wealthy families behave more altruistically than children from wealthier families; and 3) altruism augments vagal tone for children from both lower and higher income families, perhaps offsetting the physiological disadvantage linked to coming from a less economically prosperous background.

To our knowledge, this is the first study of autonomic regulation underlying children's costly giving. The observed changes in the associations between RSA and altruism over the course of the donation task reflect the principles of Polyvagal Theory (Porges, 2011), in that varying contextual factors influence whether decreased or increased vagal engagement is appropriate (Hastings, Kahle, & Han, 2014). Our findings help to resolve prior evidence that both vagal suppression and augmentation are associated with children's prosocial tendencies (Hastings & Miller, 2014) by suggesting that these associations emerge over the changing demands of an altruistic event. Initially, children listened to the examiner present an opportunity to help others in need, and greater vagal influence would have reflected children's calm engagement with that experience. Thus, children with higher RSA were in a physiological state underlying a perception of safety that may have allowed them to experience other-oriented emotions like compassion. To act on that in the decision period would require a mobilization of resources for behavior. Withdrawal of vagal influence in the decision section would have supported children's ability to engage in altruistic action. Children showed less change in SNS activity over the course of the task, but SNS levels were lowest (longest PEP) during the decision section. Therefore, the physical act of sharing more tokens, which would require increased energy, was supported by releasing the ‘vagal brake' without engaging threat-related SNS arousal. Taken together, altruistic engagement with others appeared to be intrinsically linked to vagal flexibility – the ability to increase and decrease PNS activity as conditions changed (Miller et al., 2013). It should be noted that vagal flexibility might support active engagement in tasks in general, rather than altruism specifically. Future research with comparison conditions will be needed to address this possibility.

Recent studies with adults suggest that the cultural milieu of higher SES is characterized by increased self-focus and decreased interpersonal sensitivity (Kraus et al., 2011). Our finding that family income negatively predicted altruism implies that this culture of self-focus could potentially be present in children from higher SES backgrounds as early as 4 years. The implication that their parents socialize greater self-interest in these children is consistent with findings that parents of higher SES value autonomy and individualism as socialization goals, whereas parents of lower SES are more concerned with fostering respectfulness and obedience (Hoff, Laursen, & Tardif, 2002). Parents of higher SES may also model less prosociality in their daily lives, as these communities tend to be less altruistic (Kraus et al., 2011). However, further research is necessary to replicate our findings and clearly identify potential mechanisms by which higher family income might lead to less altruism in children. In addition, we cannot specify the extent to which our findings may be unique to the strongly individualistic cultural milieu of the United States; cross-cultural comparisons of these biopsychosocial processes would be very informative.

We found two pathways to children having higher vagal tone after the donation task, through donating resources, and by coming from more economically advantaged families. The first path suggests that children's altruism may confer physiological benefits by increasing subsequent vagal tone. This is consistent with a previous finding that toddlers show decreased autonomic arousal after helping or seeing someone help an experimenter in need (Hepach, Vaish, & Tomasello, 2012). Increased parasympathetic influence may underlie perceptions of safety (conscious or unconscious), thus helping to promote health by decreasing stress and related wear and tear on the body (Porges, 2011; Thayer et al., 2012). Furthermore, RSA has been linked to reported positive emotions and well-being (Kreibig, 2010; Oveis et al., 2009). Forgoing self-gain to help others may in turn help children to feel safe and calm at a physiological level. Thus, our findings suggest that children may intrinsically derive a sense of security from the act of helping others.

The path from higher family income to higher vagal tone after the task is consistent with the well-established link between high childhood SES and better health (Bradley & Corwyn, 2002; Schreier & Chen, 2013). In the context of the full model, children from less wealthy families were more altruistic, and this countered the risk for lower vagal tone associated with their lower family income. Exposure to family stress related to economic strain could negatively impact children's vagal functioning, but our findings suggest that altruism can serve as a compensatory pathway to physiological resilience for children who may otherwise be at risk. Conversely, although children from wealthier families donated less, the ones who did may have gained a boost in vagal functioning over and above what they gained from their advantaged family circumstances. Thus, altruism may represent a path to enhancing healthy physiological functioning regardless of wealth.

An important consideration is that families in our sample ranged from lower-middle to upper-middle SES in terms of family income. It is noteworthy that we observed this effect in a sample with restricted variance in income, but the extent to which our findings apply to children in true poverty, or extreme wealth, is unclear. Previous research examining SES and children's prosociality, although limited, has generally found a negative association between family economic strain and prosocial development (Hastings et al., 2014b). This is contrary to our finding, but it should be noted that most of this research involved questionnaire measures of children's empathy and prosocial behavior rather than behavioral measures of altruism. Still, the possibility remains of a nonlinear association between SES and children's altruism such that children from middle-class families tend to be more altruistic than children from impoverished or privileged families.

This study speaks to the importance of viewing children's altruism through a biopsychosocial lens. Children from less affluent families, as well as those who showed more vagal flexibility, were more likely to sacrifice their earned resources to promote the wellbeing of other, less fortunate children. Furthermore, economic advantage and altruism in turn predicted higher vagal tone after the task. To the extent that vagal activation supports detection of safety in the environment, our findings suggest that children derive security (at the physiological level) from providing costly help to others. Altruism appears to be intrinsically beneficial for physiological functioning, and encouraging children's altruism may help protect against adverse health outcomes.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgements

We thank the families that participated and the members of the Healthy Emotions, Relationships, and Development Lab.

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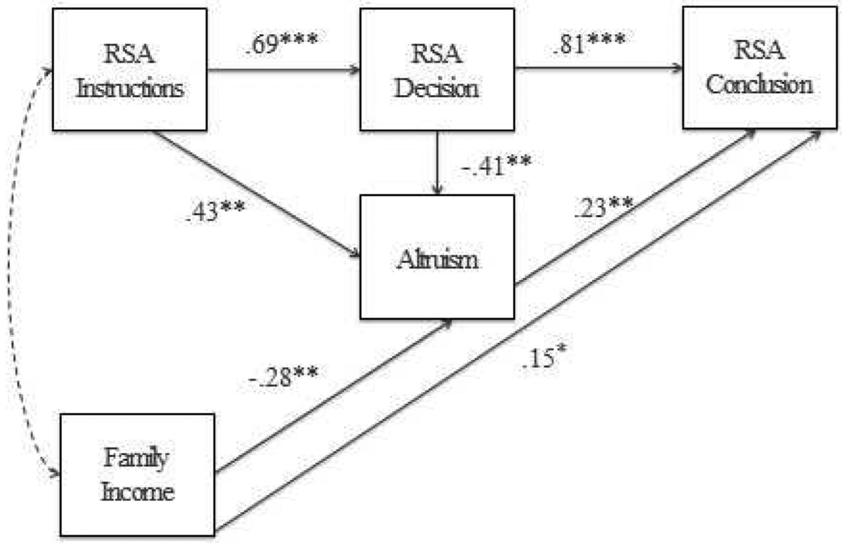


**Fig. 1.**
Model of relations between altruism, RSA, and family income. *$p < .05$, **$p < .01$, ***$p < .001$

**Table 1**

Descriptive Statistics and Correlations

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. |
|---|---|---|---|---|---|---|---|---|
| 1. Tokens Donated | 1 | | | | | | | |
| 2. Altruism Instructions RSA | .17 | 1 | | | | | | |
| 3. Altruism Decision RSA | −.08 | .66*** | 1 | | | | | |
| 4. Altruism Conclusion RSA | .09 | .73*** | .78*** | 1 | | | | |
| 5. Altruism Instructions PEP | .03 | .14 | .04 | .16 | 1 | | | |
| 6. Altruism Decision PEP | .04 | .00 | −.01 | .07 | .92*** | 1 | | |
| 7. Altruism Conclusion PEP | .00 | .04 | .05 | .14 | .94*** | .93*** | 1 | |
| 8. Family Income | −.28* | −.05 | .09 | .09 | .01 | .07 | .08 | 1 |
| *M* | 5.09 | 5.45 | 5.37 | 5.89 | 94.34 | 95.24 | 94.35 | 6.69 |
| *SD* | 6.34 | 1.15 | 1.16 | 1.08 | 9.94 | 9.76 | 9.43 | 2.30 |
| *N* | 74 | 62 | 58 | 60 | 56 | 51 | 52 | 74 |

Note.

* $p < .05$

*** $p < .001$