



## A New Look at Children's Prosocial Motivation

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Young children routinely behave prosocially, but what is their motivation for doing so? Here, we review three studies which show that young children (1) are intrinsically motivated rather than motivated by extrinsic rewards; (2) are more inclined to help those for whom they feel sympathy; and (3) are not so much motivated to provide help themselves as to see the person helped (as can be seen in changes of their sympathetic arousal, as measured by pupil dilation, in different circumstances). Young children's prosocial behavior is thus intrinsically motivated by a concern for others' welfare, which has its evolutionary roots in a concern for the well-being of those with whom one is interdependent.

Young children are remarkably prosocial. For instance, infants as young as 14 months of age help others achieve their instrumental goals by removing obstacles and fetching out-of-reach objects for them (Warneken & Tomasello, 2006, 2007). Infants of this age also use the pointing gesture to inform others helpfully of the location of a missing object (Liszkowski, Carpenter, Striano, & Tomasello, 2006; Liszkowski, Carpenter, & Tomasello, 2008). By 18 months of age, infants respond sympathetically to the distress of others and attempt to comfort them (Eisenberg & Miller, 1987; Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992). Two-year-olds even share resources generously with others at some cost to themselves (Brownell, Svetlova, & Nichols, 2009; Svetlova, Nichols, & Brownell, 2010).

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The basic developmental course of young children's earliest prosocial behaviors has thus received considerable attention, resulting in an impressively detailed picture. In contrast, however, the question of what motivates young children's prosocial behavior has received relatively little attention, mainly because of the difficulty of tapping into internal motivation states. In our laboratory, we have recently begun to address the question of young children's prosocial motivations, using several different methods.

Here, we review three recent studies. The first study used the logic of the well-known "overjustification effect" from social psychology in an attempt to determine the effect, if any, of external rewards on children's prosocial behavior. The second study induced sympathy in children toward a victim, who was harmed (but did not show emotion), and looked for effects on their subsequent prosocial behavior, in an attempt to determine whether children's early helping is mediated by sympathetic concern for the other's plight, even in the absence of emotional cues. The third study attempted to measure children's internal states directly—that is, via the activity of the sympathetic nervous system as indicated in pupil dilation—during instrumental helping situations. Because pupil dilation has not previously been used to measure internal states during prosocial behavior, we devote extra attention to explicating some of the details of how we used this method and some possibilities for its future application to address new questions.

### IS CHILDREN'S PROSOCIAL BEHAVIOR MOTIVATED BY EXTERNAL REWARDS?

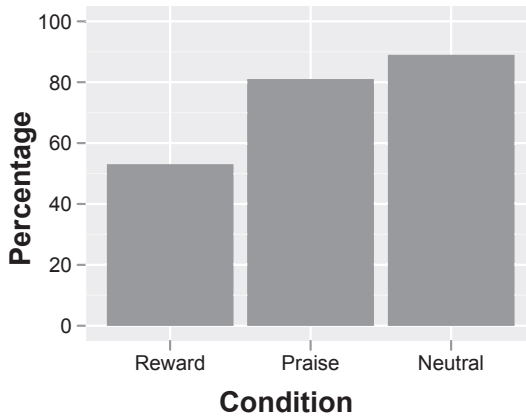
One explanation for why children help others is that they do so to get a reward for their helpful acts. On such an account, helpful behavior carried out for another person is actually motivated by extrinsic rewards, or at least in prospect of them. Alternatively, children could be intrinsically motivated to help others regardless of whether they receive a reward for it or not. The question is how to identify these two alternative sources of young children's prosocial motivation.

One way to distinguish whether a behavior is intrinsically or extrinsically motivated is to look at the effect that material rewards have on it. If the behavior is inherently rewarding, that is, intrinsically motivated, then extrinsic rewards will undermine the intrinsic motivation to engage in the activity, a phenomenon known as the *overjustification effect* (Deci, Koestner, & Ryan, 1999; Lepper, 1981). Furthermore, the reverse can be true for inherently dull and unattractive activities: Subjects will

attribute intrinsically motivating features to a previously performed activity if the reward they received for participating serves only as an insufficient post-hoc justification for engaging in the activity (Festinger, 1957). In a study investigating children's intrinsic motivation to perform a drawing task, 3- to 5-year-old children were assigned to one of three conditions in which (1) they expected a reward for performing the task, (2) they were given a reward only after they had performed it, or (3) they neither expected nor received any reward (Lepper, Greene, & Nisbett, 1973). Only children in the condition in which they expected, and subsequently obtained, a reward showed less interest in the drawing task afterward, suggesting that their otherwise intrinsically motivated behavior was undermined through making them expect extrinsic material rewards.

A recent study in our laboratory made use of the overjustification effect to examine the nature of children's prosocial motivation (Warneken & Tomasello, 2008). In this study, 20-month-old children were presented with an adult who was sitting behind a table performing various tasks, for example, drawing with a pen. At one point, she dropped the pen on the floor and started to reach for it. Thus far, the design was very similar to prior studies on children's instrumental helping, which have shown that an overwhelming majority of children will almost immediately pick up the dropped object and hand it back to the adult (Warneken & Tomasello, 2006, 2007). The critical experimental manipulation then followed. Children were assigned to one of three experimental conditions in the treatment phase. In the first condition, children received a material reward every time they picked up an object for the adult. The reward consisted of a little cube that children could use to operate and play with a desirable toy. In the second condition, children received no material reward but rather the adult thanked them, that is, gave them social rewards (praise), every time they helped. In the third condition, children received no rewards, either material or social, for helping. In the actual test phase, while children played with an attractive distractor toy, the adult again dropped an object and reached for it. The crucial dependent measure was the degree to which children helped the adult in the test phase, during which the adult did not provide children with any reward and remained neutral after children had picked up the object for her.

The results showed that children who had previously received a material reward for their helping were subsequently less likely to help the adult as compared to children who had received either no reward or social praise (see Figure 1 for details). These findings demonstrate that extrinsic material rewards undermined children's otherwise intrinsically motivated helping behavior, providing the first empirical support for the notion that in its earliest occurring forms, children's instrumental helping behavior is indeed intrinsically rather than extrinsically motivated.



**Figure 1** The average percentage of trials in which children helped the adult during the test phase in Warneken and Tomasello (2008). Children helped significantly less after taking part in the reward condition compared to the praise and neutral condition ( $F(2, 33) = 5.66, p < .01, \eta^2 = .26$ ). Graphics created using the ggplot2-package in R (R Development Core Team, 2011; Wickham, 2009).

However, the nature of this intrinsic motivation is still unclear. Is it the case that children were genuinely other-oriented in their motivation to help the adult or was it rather a concern for the self, that is, did children want to “get credit” for their helping? Furthermore, would children’s intrinsic motivation to help the adult also be undermined if an observer of the situation (rather than the recipient of the help) rewarded them? Is children’s intrinsic motivation to help the specific adult who rewarded them or rather their more general motivation to help others undermined? Future studies could investigate whether children in the material reward condition would help less in the test phase if the helpee were a different person than the one in the treatment phase. Finally, the question arises whether children’s motivation to help was based on an other-oriented social emotion such as sympathy, which was undermined by extrinsic material rewards.

#### IS CHILDREN’S PROSOCIAL BEHAVIOR MOTIVATED BY SYMPATHETIC CONCERN FOR THE OTHER?

The human feeling of sympathy is thought to serve as a natural intrinsic motive to help others who are in distress and/or who have been harmed. Darwin (2004) pointed out that the basis of human caretaking behavior may

lie in our ability to feel sympathy for others, which naturally motivates a variety of prosocial behaviors (see also Goetz, Keltner, & Simon-Thomas, 2010). Indeed, there is much work with adults showing that our concern for a person in a distressing situation motivates us to act prosocially toward that person (e.g., Batson, Duncan, Ackerman, Buckley, & Birch, 1981). The question thus arises whether this effect of concern on prosocial behavior is also evident early in ontogeny.

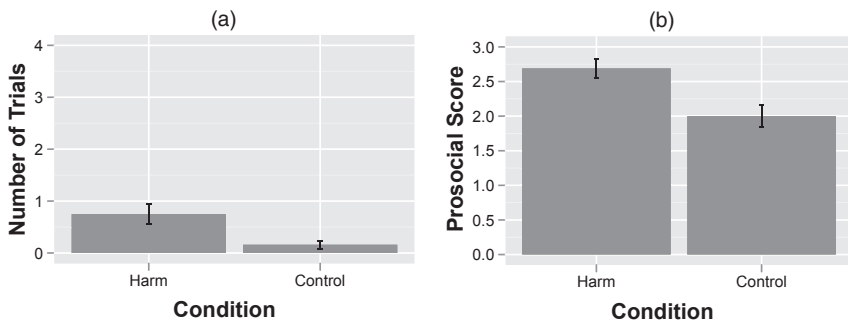
The origins of young infants' empathic (feeling with others) and sympathetic (feeling for others) responses are thought to be based on processes such as emotional contagion whereby infants start to cry in response to another infant's cries (Sagi & Hoffman, 1976). By 14 months of age, infants show negative affect that is resonant with the victim's affect (empathy) as well as concern for the victim (sympathy) and attempt to alleviate the victim's distress by comforting, helping, or sharing with her (Bischof-Köhler, 1991; Zahn-Waxler, Robinson, & Emde, 1992; Zahn-Waxler et al., 1992). Indeed, young children's empathy and sympathy for a distressed individual relate positively with their prosocial behavior (Eisenberg & Miller, 1987; Zahn-Waxler & Radke-Yarrow, 1990), suggesting that empathic and sympathetic responses do serve as prosocial motives.

As the victims in these prior studies demonstrated an emotional response, however, it is unclear whether children can only sympathize by an affective process such as emotional contagion, or whether they can also sympathize in more cognitively complex ways. Thus, in a recent study, we investigated whether children also feel sympathetic toward an individual who had been harmed but showed no emotional cues and whether this sympathy also relates to children's subsequent prosocial behavior toward the individual (Vaish, Carpenter, & Tomasello, 2009).

Eighteen and 25-month-old children were tested in one of two conditions. In the harm condition, one adult stole or destroyed another adult's (the recipient's) belongings while in the control condition, she took or destroyed similar objects that did not belong to the recipient. To get a sense of children's sympathy for the recipient, we coded children's concerned looks toward the recipient (partially adopted from Hobson, Harris, Garcia-Perez, & Hobson, 2009). In a second phase of the study, we measured children's prosocial behavior toward the recipient. Here, children were given two air balloons, and the recipient was given one helium-filled balloon. After a few minutes of individual play with the balloons, the recipient "accidentally" let go of her balloon, which floated to the ceiling and was unreachable. She now displayed sadness through her facial and vocal expressions. Here, we measured the degree of children's prosocial behavior toward the recipient (in the form of helping, comforting, or sharing a balloon).

The results were that children of both ages showed more concerned looks toward the victim while the victim was being harmed than while she was not being harmed. They also showed more subsequent prosocial behavior toward the victim after they had seen her being harmed than after they had seen her not being harmed. Moreover, the level of children's concern in response to viewing the harm was positively related to the degree of their subsequent prosocial behavior toward the recipient (see Figure 2 for details). Thus, by 18 months of age, children sympathize not only with a victim displaying overt distress cues but also with a victim who is displaying no emotional cues at all—where harm has to be inferred from overt actions. They also act prosocially toward victims, and importantly, their concern for the victims correlates with and perhaps motivates their prosocial behavior. The feeling of sympathy for others thus underlies prosocial behavior from early in development.

These results show that from an early age, children do not only rely on a victim's overt distress cues to sympathize with her. However, one may further speculate about situations in which people do display overt distress: Do children who witness such a display automatically sympathize with the distressed person, regardless of the context or the justifiability of the distress, or do they consider whether the distress is justified before sympathizing? Although no prior work has addressed this question, there is some recent work showing that when making moral judgments about scenarios in which one individual is distressed, children do not automatically evaluate the



**Figure 2** (a) Number of trials in which children showed a concerned look in the study by Vaish et al. (2009). Children showed concern in a significantly greater number of trials in the harm condition compared to the control condition ( $t(62) = 2.81, p = .008$ ). (b) Degree of helping during the prosocial task. Children in the harm condition obtained higher prosocial scores than did children in the control condition ( $F(1, 56) = 5.16, p = .027$ ). Children's degree of concern, independent of condition, was also positively correlated with their prosocial score ( $Kendall's \tau = .24, p = .036$ ).

distressed individual as a victim but rather take into account whether or not the distressed individual was in fact harmed (Leslie, Mallon, & DiCorcia, 2006). It is thus possible that viewing unjustified emotional distress also undermines children's sympathetic response and prosocial motivation toward the distressed individual.

### Are children motivated to help the other or to see the other helped?

These two prior studies thus tell us that young children's prosocial behavior is intrinsically motivated and driven by concern for those who are harmed. However, there is still an open question about *why* children help others. There are at least two classes of motives for humans to help one another. The first is that we help others to benefit ourselves, for example, we help in the hopes that observers of our helping (including the helpee) will enhance our reputation and reciprocate in the future (Nowak & Sigmund, 1998; Rockenbach & Milinski, 2006; Trivers, 1971). An alternative hypothesis is that we help others because we are genuinely concerned for their welfare—with our concern deriving evolutionarily from our interdependence with them, such that their well-being directly affects our well-being (Roberts, 2005). On this account, the important thing is not that we help others (so as to “get credit”, for instance) but simply that they be helped (Tomasello, 2009; Tomasello, Melis, Tennie, Wyman, & Herrmann, in press). To understand the origins of human helping behavior, it is critical to distinguish between these two motives, and, to our knowledge, no prior work has addressed this question directly.

In a recent study (Hepach, Vaish, & Tomasello, in press), we thus tried to tease apart these two alternative motives of young children's helping behavior: Do children help others to “get credit” or are they concerned to see the person in need be helped? The difficulty in addressing such a question is that the same behavior can have (at least) two underlying motives. We therefore developed a novel research paradigm enabling us to observe something of children's internal states directly, that is, we measured systematic changes in children's pupil dilation in response to various helping situations. Recently, developmental studies have successfully employed pupil dilation measures and shown that infants' pupillary changes can reveal their expectations about the physical (Jackson & Sirois, 2009) and the social (Gredebäck & Melinder, 2010) world. In the current study, we integrated pupil dilation measurements into an active helping paradigm. We attempted to get children actively involved in a situation in which an adult needed help retrieving an out-of-reach object and to measure their tonic levels of pupil size as an indicator of their sympathetic arousal in response to the situation and to various resolutions of the situation.

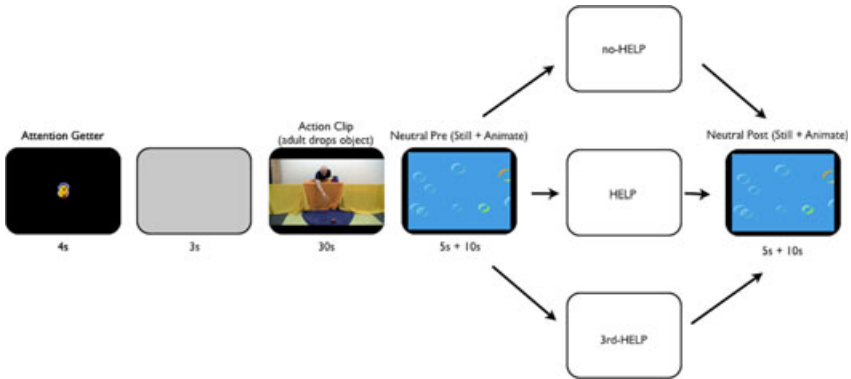
Specifically, we presented 2-year-old children with two typical out-of-reach helping situations in which an adult dropped an object that was needed to finish a task. We assumed that upon viewing these situations, the majority of children would be motivated to act to help the person (as in Warneken & Tomasello, 2006, 2007) and that children's sympathetic arousal (as measured by their pupil dilation) would increase as a consequence. Thus, our first measurement of pupil dilation was taken immediately after children saw the adult needing help, which provided information on children's arousal toward the situation of a person needing help (pre-measurement).

Then, we presented children with one of three "live solutions" to the situation (a between-subjects factor, with 12 children per condition and two trials per child). In the context of our helping task, one group of children were allowed to help the adult themselves (Help condition). In this case, we hypothesized that pupil dilation would now decrease because the situation was resolved for both the child and the adult. A second group of children were held back by their parents and so could not help the adult; the adult was thus not helped (no-Help condition). In this case, we expected pupil dilation to remain high or even to increase, as the situation remained unresolved for the child and for the adult.

Of critical interest was the third group of children, who were also held back from helping but saw a second adult provide the help (3rd-Help condition). The interesting question was: Would the sympathetic arousal decrease or remain high in this third condition? If children wanted to help in order to "get credit", then they would want to provide the help themselves, in which case their sympathetic arousal should remain high because children did not achieve their goal. If, however, it was not essential to children that they themselves provide the help but only that the adult in need receive help, then seeing another adult provide the help should lead to a decrease in sympathetic arousal similar to the decrease seen in the Help condition. The second measurement of pupil dilation was thus taken directly after children saw their respective condition manipulation (post-measurement). We were interested in the change in pupil dilation from pre- to post-measurement across conditions. An illustration of the order of stimuli is given in Figure 3. Details about how measures of pupil dilation were taken and further information on how we analyzed our data are provided in the Appendix section.

The results showed that children who actually helped the adult showed significantly less sympathetic arousal, that is, reduced pupil dilation, afterward than children who witnessed the adult receiving no help (see Figure 4 for details). Resolving the situation thus reduced arousal. Crucially, those children who were held back from helping but saw the adult being helped by a third person also showed significantly less sympathetic arousal compared to children who saw no help provided at all. The overall pattern is thus that



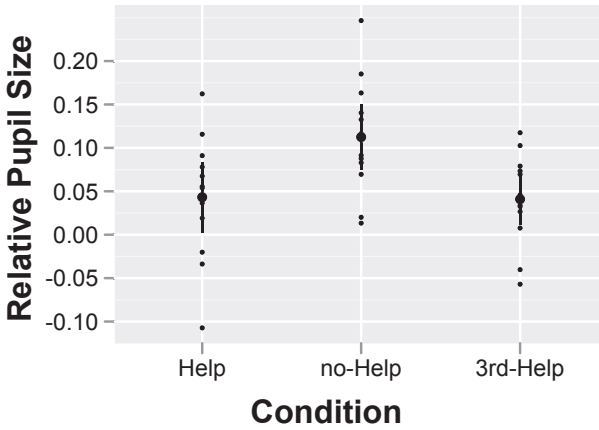


**Figure 3** Illustration of the order of stimuli in one test trial in Hepach et al. (in press). During presentation of the action clip, the adult is shown performing a task, for example, stacking cans to form a tower, until he drops the last object. He is shown reaching for it for 5 sec. The crucial measurements of pupil dilation are taken on the two neutral clips. In between those two clips, the experimental manipulation takes place during which children either get to help the adult (Help), or are restricted from helping and nobody helps (no-Help) or are restricted from helping but see another adult help (3rd-Help). The relative change in pupil dilation from the pre-measurement to the post-measurement was the dependent measure.

children's arousal was reduced if the adult was helped at all, regardless of whether they themselves provided that help.

A follow-up question that we have since begun to explore is whether changes in pupil dilation are associated with children's subsequent behavior, that is, we were interested in whether and to what extent pupil dilation provides a window into children's prosocial motivation. We thus examined the correlation between children's level of arousal after they saw the adult needing help and the latency of children's helping behavior. Naturally, this analysis could only be carried out for children in the Help condition. As this would result in an analysis with only 12 children and thus a low power for correlational analysis, we included three additional children, who were tested after the study had been concluded and were thus not included in the main analyses reported in Hepach et al. (in press). Of these 15 children, two did not help on either test trial and one child did not help on the first test trial. The latency to help was measured as the time from children being directly confronted with the helping situation and the time at which they handed the object to the adult. Children who did not help on a given trial were assigned a maximum value of 15 sec (see Figure 5).

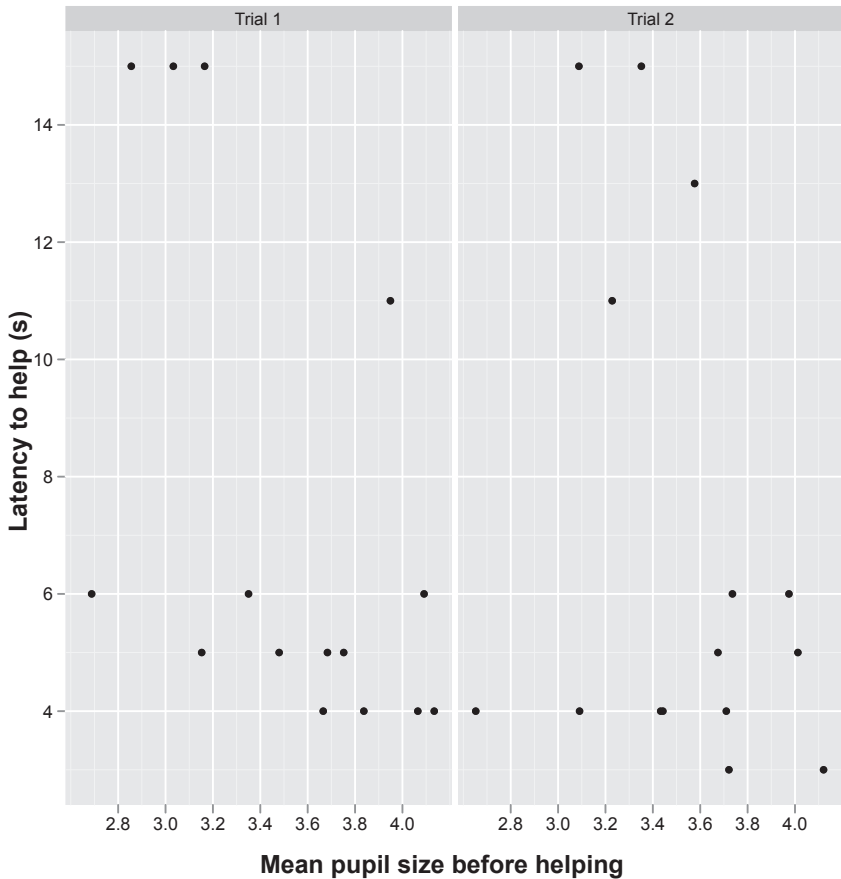
Our analyses indicated that on the first of the two helping trials, there was a significant correlation between the average pupil size before children



**Figure 4** The relative change in pupil size, collapsed across trials, for each individual subject within the three experimental conditions in Hepach et al. (in press). The group averages are illustrated with the larger dots. The solid lines mark the edges of the 95%-confidence interval for each condition. A two-way repeated measures ANOVA with trial and condition as independent measures and change in pupil size as the dependent measure revealed a significant effect of condition ( $F(2, 29) = 3.74, p = .036$ ). There was no difference in the time between the end of the pre-measurement and the start of the post-measurement across conditions ( $F(2, 33) = 2.27, p = .12$ ) and neither an interaction effect of time and condition ( $F(2, 30) = .25, p = .78$ ) nor a main effect of time on the change in pupil size ( $F(1, 30) = .82, p = .37$ ).

had the opportunity to help and their latency to help (*Spearman's rho* =  $-.56, p = .029$ ). That is, the more aroused children were after seeing the adult needing help, the faster they initiated their helping behavior. The second trial showed the same pattern of correlation but did not reach significance (*Spearman's rho* =  $-.27, P = .33$ ). It is possible that the pre-level of average pupil size reflects something different on trial 2 given that children in the Help condition knew they would get a chance to help the adult. Thus, the level of sympathetic arousal on the first trial may more accurately reflect children's response to seeing the adult needing help, and this showed that children's pupil dilation at seeing the adult needing help was related to their subsequent helping behavior.

In summary, the results showed that 2-year-olds are not especially motivated to provide help themselves (e.g., in order to "get credit" for their actions), but rather because they want to see the person in need be helped. Furthermore, children's willingness to help seems to be related to how aroused they are by seeing the person needing help.



**Figure 5** The relationship between the levels of pre-arousal and the subsequent latency to help the adult in the study by Hepach et al. (in press). Data for the two trials are presented separately.

Future work should also try to address what it is that brings children's sympathetic arousal down in the Help and 3rd-Help conditions. Is it the fact that a goal-directed action is completed, that is, an object went into a hand, or is it that children consider the situation resolved because the adult got the object he needed to finish the task? How would children in the 3rd-Help condition react if the person in need were handed an irrelevant object by the other adult? How much does helping have to do with taking into account what the helpee needs rather than only that the helpee's goal-directed action be completed?

### What is pupil dilation and how can it inform us about individuals' motives?

Pupillary movements are controlled by two muscles, the sphincter and the dilator. Pupil dilation can occur in two ways: Either the constriction of the pupil via the sphincter is inhibited or the dilation of the pupil via the dilator muscle is excited, although the two are not mutually exclusive processes. Importantly, both processes are induced by heightened activity of the sympathetic nervous system. Under constant environmental conditions, that is, if the light falling into the eye is constant, the pupil oscillates and dilates in response to psycho-sensory stimulation (Loewenfeld, 1993; Loewenstein, Feinberg, & Loewenfeld, 1963).

At every moment in time, the pupillary movements represent the individual's state of maintaining homeostasis through varying activity of the sympathetic tone and hence its influence on pupil dilation (Wilhelm, 1991). Any event in the environment severe enough to demand the organism's momentary attention will lead to activation of the autonomic nervous system (e.g., Levenson, 2003). As a consequence, sympathetic tone, and hence pupil dilation, increases. The number and variety of such events is conceivably large and ranges from cognitive processes, such as mental effort (e.g., Kahneman, 1973; Kahneman & Beatty, 1966), to processes such as emotional excitement and activation (Bradley, Miccoli, Escrig, & Lang, 2008; Nunnally, Knott, Duchnowski, & Parker, 1967; Partala & Surakka, 2003; see, Goldwater, 1972, for a review, and Loewenfeld, 1993, for an extensive account of the human pupillary system).

In our study, we measured children's pupil dilation while they were shown a neutral stimulus both just before they got up to help and immediately after they returned from their respective helping situations (see Appendix section for details). Upon returning, those children who remained in a state of heightened sympathetic arousal were expected to show an increase in pupil dilation both because the initial light reflex to the neutral stimulus would be inhibited and because the re-dilation phase, after initial constriction to that stimulus, should be enhanced. Crucially, the higher the level of sympathetic arousal the greater both the inhibition of the light reflex, that is, reduced constriction, and the dilation of the pupil, which should result in overall higher levels of tonic arousal state. Furthermore, in addition to reflecting levels of sympathetic arousal, we propose that the changes in pupil dilation we observe are part of a more specific psychological process in the context of motivation.

### Tension exhibited toward cooperative others' unfulfilled goals

In describing the motivation that underlies human goal-directed behavior, Lewin (1935) formulated the concept of *tension systems* corresponding to

an individual's needs. A tension arises within an individual as she is pursuing a goal or fulfilling a need. The individual will remain in a state of tension so long as the goal, or need state, is not reached and she will be motivated to reduce that tension. Subjects who are given a set of tasks, some of which are interrupted and others that are completed by the subject, will better recall those tasks that were interrupted rather than those that were completed, presumably because tension is maintained in the unresolved cases (Zeigarnik, 1927). Further investigations studied the concept of tension in social relations and found that an individual's tension, for example, the propensity to recall interrupted tasks, can be reduced if a cooperative compared to a competitive other completes the individual's goal or task (Deutsch, 1949; Lewis & Franklin, 1944). Additionally, an individual's tension can also be aroused if a cooperative partner has an unfulfilled goal, a phenomenon Hornstein (1972) termed *promotive tension*. In one study, pedestrians found two "misplaced" envelopes by the same sender, one stating a political attitude of the sender either in accordance or in contrast with the finder's own, while a second envelope contained the sender's contribution to a research institute. Subjects were more likely to complete the sender's goal (by mailing the second envelope) if the political opinion of the sender resonated with their own (Hornstein, Masor, Sole, & Heilman, 1971). Social relationships in which individuals are linked cooperatively with one another constitute situations in which (1) one person's own tension is reduced if the other attains the goal for him and (2) one's own tension is created if another's goal is unattained. Based on this prior work, one can propose that the changes in pupil dilation we observed in our study reflect children's tension aroused by the adult (who is judged to be a cooperative partner) having an incomplete goal (see also Loewenstein, 1920, for another example of inducing tension to study changes in pupil dilation).

Thinking of our results in terms of tension allows us to draw a number of further interesting conclusions. Firstly, the concept of tension offers an intuitive way of thinking about how children experience the state they are in while their sympathetic arousal is high. Hornstein (1982) gives an illustrative example of a waiter who, as long as the bill for a table is not paid, will recall the items each guest at that table has ordered and he will remember to regularly check the table to see whether his customers are satisfied. During this process, the waiter experiences increased tension as his attention is directed toward the unresolved situation. However, once the bill has been paid, the waiter will have a much harder time recalling what each guest had ordered, given that his tension is no longer aroused. Children in our study likely experience tension in a similar way without it necessarily being a negative state. Rather, children become and remain attentive to the adult's unfulfilled goal.

Therefore, this (promotive) tension is both an other-oriented and an other-initiated motivational force.

Secondly, the concept of tension illustrates the relatedness of the motivational force guiding an individual's goal-directed behavior toward her own *and* toward others' goals. Just as much as children may be motivated to retrieve objects they themselves have dropped, they may strive to retrieve objects for others. This allows us to speculate about what has to evolve and what has to develop for children to be motivated to help others. All organisms have some sort of motivational force guiding their behavior essential to their survival, for example, finding food, mating, and fighting off competitors. With the degree of the sociability of a species, a motivation directed at others' goals may have evolved from the same motivation directed at one's own goals. That is, biologically, rather than selecting for a new type of prosocial motivation per se, an organism's own-directed tension evolved to be linked to others' goals and became other-oriented.

In summary, while sympathetic arousal is the physiological correlate measured by pupil dilation, tension is likely a more accurate descriptor of the motivational state children are in and possibly the source of psychological forces guiding their behavior as well.

## DISCUSSION

Previous empirical reviews and theoretical summaries of children's prosocial behavior have focused very little on the question of why children help others, that is, the underlying motivation. Here, we reviewed three recent studies that addressed this question. The first study demonstrated that children's instrumental helping behavior is intrinsically motivated given that external material rewards undermine children's propensity to be helpful to others (Warneken & Tomasello, 2008). The second study demonstrated that children's sympathetic responses motivate their prosocial behavior (Vaish et al., 2009). The third study showed that children are not motivated to "get credit" for their helping acts but rather want to see the person in need be helped (Hepach et al., in press). From a motivational point of view then, children's earliest helping behaviors appear intrinsically motivated to benefit others. Children help others out of a concern for the person in need.

These recent findings add importantly to our understanding of prosocial behavior more generally. From early on, infants show a number of social cognitive abilities through which they are able to "tune in" to the social dimension of others' behavior (Grossmann & Johnson, 2007). These include discriminating emotional facial and vocal expressions (e.g., Barrera & Maurer, 1981; Soken & Pick, 1992), goal attribution (Tomasello, Carpenter, Call,

Behne, & Moll, 2005), and joint attention (Carpenter, Nagell, & Tomasello, 1998). Furthermore, 12-month-old infants expect an actor (a geometric shape) to approach a character who had previously helped rather than hindered the actor (Kuhlmeier, Wynn, & Bloom, 2003). Likewise, 6- and 10-month-old infants prefer a character who had previously been helpful to another character over one who was unhelpful to that character (Hamlin, Wynn, & Bloom, 2007). The studies and methods reviewed in the present study go beyond asking about these early social evaluations of others' actions by addressing the issue of the motivational mechanisms underlying children's early prosocial behavior. One mechanism can be described as an intrinsic motivation to help others fulfill their goals (Warneken & Tomasello, 2008) for the sake of seeing the other be helped (Hepach et al., in press) while the second mechanism is the feeling of sympathy for those in need (Vaish et al., 2009).

Based on these conclusions, one may wonder whether these other-oriented motives extend to further situations in which children engage in more complex third-party interactions. Children's intrinsic, other-oriented motivation to help others may not be limited to situations in which they help others themselves, that is, in a one-on-one situation, but could also account for a variety of more indirect, third-party interventions in which young children readily act on another's behalf through enforcing norms (Rakoczy, Warneken, & Tomasello, 2008; Vaish, Missana, & Tomasello, 2011), enforcing third-party property rights (Rossano, Rakoczy, & Tomasello, 2011), and engaging in third-party intervention, such as through selective helping (Vaish, Carpenter, & Tomasello, 2010). Crucially, in all of these studies, children intervene from a third-party, agent-neutral perspective when seemingly nothing is directly at stake for them, indicating an early moral sense in which we care about those with whom we are interdependent (Tomasello, 2009; Tomasello et al., in press; Vaish, 2010). In light of the findings from the three studies summarized here, one could ask whether children's prosocial behavior in these other, third-party situations is also intrinsically motivated and based on a concern for other persons. Furthermore, do children in third-party interactions behave prosocially to get credit as norm enforcers and therefore only seemingly act on the other's behalf? Is it crucial for children that they themselves enforce norms or do they care primarily about help being provided and norms being enforced?

From a methodological point of view, a natural follow-up question is to validate the measure of pupil dilation in the context of a helping task. To gain a better understanding of what pupil dilation is tapping into, it would be interesting to know whether similar condition effects as those observed in Hepach et al. (in press) would also be found using other physiological measures. Previous studies have found associations between

skin conductance and prosocial behavior in children, showing that high levels of skin conductance are positively associated with measures of distress and negatively associated with measures of concern, and are likely to undermine children's helpful behavior toward others (Eisenberg, Fabes, Schaller, Carlo, & Miller, 1991; Eisenberg et al., 1996). Similarly, heart rate deceleration has been associated with children's feelings of concern while heart rate acceleration has been associated with measures of distress (Eisenberg et al., 1990; Fabes, Eisenberg, & Miller, 1990), although the evidence for this is mixed (see Hastings, Zahn-Waxler, & McShane, 2006, for a review). However, previous studies have examined the associations between these measures and prosocial behavior indirectly, such as by measuring children's physiological changes in response to videos of people in distress and correlating this with children's helpful behavior toward other individuals in other situations (e.g., Eisenberg et al., 1996). A future study could try to co-assess measures of heart rate and skin conductance with pupil dilation in an active behavior paradigm much like our own.

One limitation of the measure of pupil dilation is that it can tell us very little about the quality of children's other-oriented motivation. That is, what do children feel when they see others needing help and their pupil dilation shows sympathetic arousal? And how do they feel once the situation is resolved? Therefore, it would be interesting to combine the pupil dilation measure with Vaish et al.'s (2009) approach of measuring children's concern for victims as measured in their facial expression. In combination, measures of pupil dilation and facial expression may provide rich insights into the quality and origin of young children's other-oriented concern, such as the extent to which it arises from feelings of sympathetic concern.

More generally, each of the studies reviewed here has its own advantages and disadvantages, and we would like to propose that combining the methods in future research would allow us to address a number of interesting questions. For example, why do children in the social praise condition in the study by Warneken and Tomasello (2008) continue to show high levels of helping? They may help as much as children in the no reward condition, but for different reasons. For instance, children who had received no reward for their helpful acts may continue to help in order to benefit the adult, whereas children in the social praise condition may subsequently be less other-oriented and more motivated to receive credit. Given that social praise has positive consequences for the helper's self image, children in this condition may begin to care more about providing the help themselves and receiving the positive attention. This speaks to the more general question regarding the developmental trajectory of children's motivation to help others.



While 2-year-old children show an other-oriented pattern in their prosocial motivation, adults' motivation to engage in helpful behavior appears to be motivated by additional concerns for reciprocity and reputation. For instance, adults act more cooperatively in contexts where they can expect to be repaid in kind by those whom they have helped and also when return benefits are conveyed to them more indirectly via an enhanced reputation (e.g., Nowak & Sigmund, 1998; Rockenbach & Milinski, 2006). School-aged children also show similar effects. By 6 years of age, for example, children care about enhancing their chances of being chosen to participate in a game with others (Aloise-Young, 1993) and will help more if they believe that an imaginary person is observing their actions (Piazza, Bering, & Ingram, 2011). Thus, with development, additional, more self-oriented concerns also come into play in motivating children's prosocial behavior.

The question is how children's concern for reciprocity and reputation might develop. One possibility is that giving children attention and praise for their actions is fundamental to the way adults teach and influence children's behavior. Thus, if children receive attention and praise for helping others, they may over time adapt to this and begin pursuing less other-oriented motives in instances where others need help. A second possibility for how children's concern for reciprocity and reputation emerges could lie in the human tendency to evaluate others' actions. Not only do 6- and 10-month-old infants engage in social evaluation by preferring helpful over unhelpful actors (Hamlin et al., 2007), but by 21 months of age, children also take into account an adult's past actions when subsequently deciding whether to help or not (Dunfield & Kuhlmeier, 2010). Furthermore, 3-year-olds are less helpful toward an individual who had previously harmed another person (Vaish et al., 2010). With cognitive advance and the development of self-awareness, children presumably turn these evaluative abilities onto themselves and become increasingly aware of the fact that others are evaluating them. This in turn leads to increasing concerns for their own reputation and eventually influences the nature of their prosocial behavior as well. Thus, although very young children's prosocial behavior might be primarily driven by other-oriented concern, that of older children and adults is likely also driven by less other-oriented motives, such as self-reputational concerns, that together lead to more differentiated and complex social and prosocial interactions. An interesting future question is thus when and how in ontogeny this transition from evaluating others to caring about others' evaluation takes place.

The work reviewed in this paper provides, in our view, a first step toward a better understanding of the motivations behind young children's prosocial behavior. Young children help those for whom they feel sympathy; they are not motivated by extrinsic rewards; and they are less concerned that they

provide help than that the person in need be helped. Young children's prosocial behavior is thus intrinsically motivated by a concern for the other's welfare, which has its evolutionary roots in uniquely human forms of social and cultural interactions in which individuals are concerned about the well-being of those with whom they are interdependent.

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## APPENDIX

### Measuring pupil dilation

The nature of the human pupil puts several constraints on how one can measure changes in pupil dilation to infer underlying physiological changes. Most importantly, pupil size changes constantly. The spontaneous pupillary movements, hippus, are a direct consequence of the pupil constricting to the amount of light in the environment and the ongoing psycho-sensory stimulation, spontaneous thoughts, and emotional excitement of the subject (Loewenfeld, 1958, 1993). Therefore, simply having participants watch a live scene while recording changes in pupil dilation would not suffice given that in such a case, the perceptual configuration of the scene would constantly change, including subtle fluctuations in brightness. Moreover, even if all lighting were kept equal and participants saw a photographed scene (e.g., one in which the adult is helped and one in which he is not helped), pupil dilation might nevertheless vary in response to the perceptual differences rather than the conceptual differences in the photographs. We therefore showed children in all three conditions the same neutral stimulus, which was unrelated to the helping scene, during the pre- and post-measurement phase. All stimuli in which pupil dilation measurements were taken were presented on a computer screen.

Furthermore, we wanted to get children to look at the neutral stimulus for as long as possible to get as much pupil data as we could. The stimulus thus needed to be inherently appealing while not distracting from the actual study (e.g., short episodes of cartoons with characters would not be appropriate). We therefore used colorful computer-animated bubbles on a colored background for a total of 15s, the first 5 of which were still and silent while the next 10 s were animated with music. The latter was done to get participants to look back at the screen in case they had disengaged in the first few seconds, because we could only measure participants' pupil size as long as they looked at the computer screen and their eye movements were recorded.

To integrate a computer screen into a behavioral paradigm, we borrowed the "magic window" method developed by Troseth and DeLoache (1998). Through a number of procedural steps, we made children believe that they were looking through a real window from the outside of a house apparatus whereas in fact they were watching pre-recorded videos of the helping scenes presented on a computer screen. The scenes (i.e., videos) that children watched matched the scenes that children experienced live "inside" the house. Importantly, the experimental manipulation was live. The average time of exposure during the live situations was similar across the three experimental conditions and was based on the average time it took children in the help condition to help the adult. Specifically, on average, children in the help condition initiated their helping behavior after 6 s on the first test trial and after 4 s on the second test trial. Thus, for all children in the no-Help and 3rd-Help conditions, the time of exposure was yoked to 6 s on the first trial and 4 s on the second trial. After the pre-measurement, parents carried their children "into" the house where they could either help themselves, they saw another adult help, or no help was provided at all. Children were then carried back from their respective helping situations in front of the computer screen, and the post-measurement was taken.

While children were in front of the "magic window", they sat on their parent's lap at a distance of approx. 40 cm from the eye tracking apparatus. The stimuli were presented on a 24" computer screen at a resolution of 1920 × 1080 pixels. The luminance of the room was the same for all participants. Two soft portray lights provided the only source of illumination (other than the computer screen). The screen's contrast and brightness levels were always set to the same values across all children. In addition, half an hour prior to a participant's arrival, a video was played on the presentation screen for the device to reach its working temperature. The neutral stimuli, in which the actual measurements were taken, were created in Adobe Photoshop and Adobe Flash to ensure that they had the same overall luminance.

### Analyzing pupillary datasets

The eye tracking unit used in our study, a Tobii X120, samples at a frequency of 60 Hz, that is, 60 samples per second. The time windows of interest for our analysis were the first 10 seconds immediately after children saw the adult needing help (pre-sequence) and the first 10 seconds immediately after children returned from their respective helping situations (post-sequence). Thus, each sequence (pre- and post-sequence) consisted of 600 potential samples, each containing information about the pupil size of the right and the left eye separately. The crucial dependent measure was the average difference in pupil size from the pre-sequence to the post-sequence.

In principle, participants could have provided us with 600 samples during the pre-sequence and 600 samples during the post-sequence. The actual number of samples per participant were lower, however, for a number of reasons. First, unlike typical eye tracking or pupil dilation studies, which restrict participants' movements to reduce movement artefacts, participants in our study moved around the room; indeed, this was an essential part of our study design. In particular, the fact that children were carried away from the eye tracker and computer screen (for the live helping interaction) and then carried back to it led to variations in the time needed for individual participants to first fixate the screen. During the post-measurement phase, children may also have not returned to sitting at an optimal distance to the screen (between 60 and 80 cm). Second, given that during the pre-measurement phase children "knew" they would go inside the house because they had been familiarized to the apparatus, many started looking away from the window as soon as they saw the adult needing help, indicating that they were ready to go. However, all participants had to wait for the full 15 s (the first 10 s of which were analyzed) before they were carried to the inside of the house. Third, while children sat in front of the window they would frequently lean forward as if wanting to get a better look inside the house. This created additional noise in the data because participants did not remain at the optimal distance from the eye tracker. All three points taken together, we were faced with time series of pupil data with gaps in between, because children would not look at the neutral stimulus for the entire 10 s during the pre- and the post-measurement. Furthermore, the data contained spikes, that is, rapid changes in pupil size, particularly resulting from subjects not always being at the optimal distance from the presentation surface. Therefore, our data varied quite a lot across participants in terms of found samples and quality.

However, in collaboration with Roger Mundry, an experienced statistician working at the Max Planck Institute for Evolutionary Anthropology, we were able to develop an analysis strategy that could deal with the particularities



of our dataset. This involved writing a series of functions for the R statistics package (version 2.14; R Development Core Team, 2011). The first function was a filter to remove the spikes and outliers. We did not use common moving average filters or low-pass digital filters (e.g., Jackson & Sirois, 2009) because these are designed for datasets with few gaps and more or less continuous data. Instead, we sought to preserve the overall shape of our data while removing the most extreme outlying values. We did so by computing the absolute distance between found samples and removing the upper 10% of those distances. The second step was the interpolation of missing data. Here, we took a rather conservative approach. Given that our dataset contained a number of gaps of varying sizes and at varying time points, we only filled gaps of no more than 4 samples ( $\sim 70$  ms) between found samples through a linear regression technique, that is, connecting the dots with a straight line (see also Jackson & Sirois, 2009).

The crux of our analysis is a baseline-averaging technique developed for the purpose of our study. If one pictures the data as curves over time both for pre- and post-measurement separately, then we estimated the difference between the two curves in the following way: Only time points for which data for both pre-measurement and post-measurement were found were used, and for each time point, the pre-measurement was subtracted from the post-measurement. Each single difference was then divided by the pre-measurement value to correct for the pupil size during pre-measurement. Finally, all these difference scores were averaged to arrive at a single value per subject per trial: The baseline corrected change from pre- to post-measurement. In other words, we computed the average distance between the two curves to estimate the increase in pupil size from pre- to post-measurement, correcting for the pupil size during pre-measurement phase. Redescribed in terms of sympathetic activity, we computed the change in sympathetic arousal state from pre- to post-measurement, correcting for how aroused children were after initially seeing the adult needing help.