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RESEARCH ARTICLE

Evidence for a developmental shift in the motivation underlying helping in early childhood

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Abstract

We investigated children's positive emotions as an indicator of their underlying prosocial motivation. In Study 1, 2-, and 5-year-old children ($N = 64$) could either help an individual or watch as another person provided help. Following the helping event and using depth sensor imaging, we measured children's positive emotions through changes in postural elevation. For 2-year-olds, helping the individual and watching another person help was equally rewarding; 5-year-olds showed greater postural elevation after actively helping. In Study 2, 5-year-olds' ($N = 59$) positive emotions following helping were greater when an audience was watching. Together, these results suggest that 2-year-old children have an intrinsic concern that individuals be helped whereas 5-year-old children have an additional, strategic motivation to improve their reputation by helping.

KEYWORDS

body posture, children, early ontogeny, emotion, Kinect, motivation, prosociality

1 | INTRODUCTION

Virtually all scholars of human evolution agree that human prosociality is unique in the animal kingdom (Henrich, 2015; Hrdy, 2009; Silk, 2007; Tomasello, 2016). Our closest living relatives, chimpanzees and bonobos, help and care for one another, but they do so only in a limited range of contexts and toward a select few individuals (Gruber & Clay, 2016; Muller & Mitani, 2005; Pisor & Surbeck, 2019; Tokuyama & Furuichi, 2016). In contrast, humans across cultures help and share with kin, friends, and strangers alike, and do so in situations ranging from the everyday – opening doors for each other or sharing food – to the extraordinary – donating organs or risking their lives for their community in fights against wildfires. Indeed, even young human toddlers show signs of human-unique forms of prosociality (Warneken & Tomasello, 2006).

There is less scholarly agreement regarding the motivations underlying human prosociality. At the most general level, one can distinguish between intrinsic and strategic motives for prosocial acts. The former are genuinely other-regarding: doing good for the good of others. The latter manifests more self-oriented concerns: doing good to look good. The goal of strategic prosocial acts is not only to improve others' wellbeing, but also to gain various benefits, from an improved reputation to a reciprocated favor. While most scholars agree that prosocial actions are motivated by a complex interaction of intrinsic and strategic motivations (Laffan & Dolan, 2020; Sperber & Baumard, 2012; Tomasello, 2016), some scholars claim that actions such as helping or sharing can be fully accounted for in terms of strategic motivations, and, more specifically, the desire to improve one's reputation (Haley & Fessler, 2005). Experimentally teasing apart the respective contribution of these two types of motivations to a given act of prosociality is far from straightforward, especially when studying young children. One recent empirical route to revealing the motivation underlying prosociality harnesses the fact that intrinsically motivated prosociality (here: improving others' well-being) and strategically motivated prosociality (here: improving one's reputation) aim at subtly but importantly different goals (see for reviews and examples, Dahl & Brownell, 2019; Hay et al., 1999; Hepach et al., 2012; Paulus, 2014; Steinbeis, 2018). Consider a person in need of support. Agents who are intrinsically motivated to help will be satisfied – will experience positive emotions – if the person is helped, regardless of who provides the help. In contrast, strategically motivated individuals, who are concerned about their reputation, will be driven to provide the help themselves. Seeing someone else provide the help means that they have missed out on an opportunity to get credit for a good deed and to consequently reap strategic benefits.

Here, we investigate the development of the motivations underlying helping in early ontogeny focusing specifically on the distinction between children's intrinsic motives (concern for others' well-being) and their strategic motives (concern for their reputation). We combine this theoretical perspective with a novel methodological approach – depth sensor imaging technology – to measure young children's expression of positive emotions.

1.1 | Prior work on young children's underlying prosocial motivations

Children engage in their first prosocial actions soon after their first birthday, helping others to fulfill their behavioral, material, and emotional desires (Dahl et al., 2017; Dunfield & Kuhlmeier, 2013; Eisenberg et al., 2016; Hamlin, 2013; Martin & Olson, 2015; Warneken, 2018). They engage in spontaneous helping at around 14 months of age (Dunfield et al., 2011; Warneken & Tomasello, 2007), comfort others in distress at around 18 months of age (Svetlova et al., 2010; Zahn-Waxler et al., 1992), and begin sharing resources by approximately 24 months of age (Brownell et al., 2009). At around 3 years of age, children become more discerning in terms of who, when, and how they help. They factor others' needs into their decisions, selectively helping poor versus rich individuals (Essler et al., 2020), and consider social relationships, preferentially assisting their friends over neutral peers (Engelmann et al., 2019; Moore, 2009). By 3 years of age, children also engage in so-called paternalistic helping, aiding others in getting not what they want but what they need (Hepach et al., 2019; Martin & Olson, 2013; Martin et al., 2016).

RESEARCH HIGHLIGHTS

- We for the first time directly compared the motivation underlying 2- and 5-year-olds' helping behavior.
- We used depth sensor imaging technology to measure emotions.
- At 2 years of age, children were intrinsically motivated to provide help to see others being helped.
- At 5 years of age children also helped for reputational gain.
- Children's prosocial motivation undergoes a significant shift between the ages of 2 and 5 years.

What motivations drive these early acts of prosociality? There are at least three lines of evidence to suggest that the first prosocial acts of young children – older than 18 months but younger than 5 years – are exclusively intrinsically motivated, and not driven by strategic motivations to invest in their reputation. First, the possibility of getting credit for their acts of helping does not increase toddlers' helping rate. Toddlers around the age of 18 months are equally helpful when they are observed compared to when they are alone while helping (Hepach, Haberl, et al., 2017; Warneken, 2013). Second, early helping shows signs of a well-known behavioral marker of intrinsically motivated actions: it is undermined by extrinsic rewards. In line with the so-called overjustification effect, offering rewards in exchange for helping has a consistent and strong negative effect on children's subsequent motivation to engage in prosocial acts (Ulber et al., 2016; Warneken & Tomasello, 2008). The third piece of evidence to suggest that young children are intrinsically motivated to see others helped comes from a series of studies, which, (1) included a direct measure of internal physiological states: relative changes in pupil dilation, and (2) compared conditions in which children could actively help themselves to conditions in which children merely saw help being provided. Two-year-old children's physiological arousal was reduced when help was provided to a person in need – relative to when the person was not being helped – *independently* of whether the toddlers themselves or a third party provided the help (Hepach et al., 2012; see Hepach, 2017, for a review).

These three sources of data present strong reasons for thinking that children younger than age 5 are intrinsically, but not yet strategically, motivated to help others (see Grueneisen & Warneken, 2022, for a review). For the sake of completeness, we should note that scholars have investigated a variety of factors that could additionally underlie toddlers' prosociality. Specifically, children might help because of a social motivation to interact with others (Brownell & Lab, 2016; Dahl, 2015; Dahl & Paulus, 2019; Giner Torréns & Kärtner, 2017), because helping is emotionally rewarding (Aknin et al., 2012), and because children make others' goals their own goals (Michael & Székely, 2019; see also Köster & Kärtner, 2019, for a recent review).

There is widespread consensus that the first signs of a specific type of strategic motivation – namely, concern for reputation – emerges around age 5. Children at this age are still intrinsically motivated to help others (Fabes et al., 1989; Rapp et al., 2017), but, in addition, they specifically help those individuals who may reciprocate later, and help more when others are watching (Engelmann & Rapp, 2018; Kenward et al., 2015). Five-year-old, but not 3-year-old children differentiate between one-shot and repeated interactions, selectively increasing their levels of prosociality toward their partner when donor and recipient roles alternate over time, compared to one-shot interactions (Sebastián-Enesco & Warneken, 2015). Within reciprocal interactions, 5-year-old children add yet another layer of strategic calculation by preferentially sharing with those individuals who have more valuable resources over those that possess less interesting items (Xiong et al., 2016). In addition, by age 5 children begin to invest in their reputation and act more prosocially when their actions are public and their reputations are at stake (Banerjee et al., 2020; Engelmann & Rapp, 2018; Silver & Shaw, 2018). They help, share more, and steal less when they are observed by an uninvolved third party (Engelmann et al., 2012; Yazdi et al., 2020) and 5- and 7-year-old children share more with those who have access to valuable resources (Warneken et al., 2019). Likewise, preschoolers are more likely to benefit others when the recipient is aware of their alternatives (Leimgruber et al., 2012) and children are less likely to engage in antisocial actions when their positive reputation is on the line (Fu et al., 2016). In middle childhood, these strategic motivations further include “competitive altruism” as documented by the fact that 8-year-olds selectively increase their prosociality to “outshine” their peers (Herrmann et al., 2019). Moreover, by age 10, children understand others' strategic motivations and evaluate those who abuse a position of power to further their own interests negatively (Reyes-Jaquez & Koenig, 2021; see also Heyman et al., 2014).

Previous research thus suggests the following developmental story regarding children's emerging prosocial motivation. Toddlers' first prosocial actions seem to be driven primarily by intrinsic motivations, whereas by the age of 5 years, preschoolers develop additional, strategic motivations to share and help, most specifically a desire to improve their reputation by acting prosocially. However, most previous studies inferred these underlying motivations indirectly from overt behavior. In addition, the studies reviewed above tested *either* toddlers *or* preschoolers and focused on intrinsic or strategic motivations, but not both. Thus, previous studies are suggestive of a developmental shift in the motivation-underlying helping in young children but have not demonstrated such a shift within a single experimental paradigm.

1.2 | The current studies

Across two studies, we investigated the hypothesized motivational shift in 2-year-olds' compared to 5-year-olds' prosocial behavior. In Study 1, we presented 2- and 5-year-old children with a situation in which an adult needed help. We manipulated whether children could provide the help themselves or whether they saw another adult provide the help (before the child could get to the situation). Based on previous work with 2-year-old children we predicted that children should be similarly motivated to provide help and to see help being provided. In contrast, and based on prior work documenting children's developing strategic motives for helping, we predicted that 5-year-olds would have an additional motivation to provide help themselves (and be less satisfied if someone else provide the help for them). We chose to study 5-year-old children because this is the age by which reputational concerns influence children's prosocial behavior (see Engelmann & Rapp, 2018, for a review). In Study 2, we focused on 5-year-old children and asked to what extent their prosocial motivation to actively help is reflective of reputational concerns (of wanting to appear as a good helper in the presence of others).

In both studies, we used a Kinect motion sensor camera to record changes in children's upper- and lower-body posture. This methodological approach builds on previous work with adults (Dael et al., 2012; Montepare et al., 1987; Wallbott, 1998) – and has recently been validated in young children (Hepach & Tomasello, 2020; Hepach et al., 2017b) – demonstrating that positive emotions result in more upright gait and posture. In a recent study, adults showed increased upper-body posture after recalling emotional episodes of joy and pride but showed decreased body posture if episodes of shame and disappointment were recalled (von Suchodoletz & Hepach, 2021). These changes were specific to participants' upper-body posture but not their lower-body posture, indicating that participants were not merely more active or vigilant while recalling positive as opposed to negative episodes. Similarly, in a recent study with children, 2-year-olds showed similar levels of upper-body postural elevation after helping others and after completing their own goals, whereas posture was lower when their action did not benefit anyone (Hepach et al., 2017b). This pattern of posture changes mirrored the results of ratings by adult coders who, blind to conditions, judged children to be more positive and to show more smiles after helping others and achieving their own goals compared to when their actions did not complete anyone's goals (Hepach et al., 2017b). Similarly, 4-year-old children showed postural elevation when seeing others being helped and lowered postural elevation when they were helped but a more deserving peer was not helped (Hepach & Tomasello, 2020)

Together, previous work suggests that changes in participants' upper-body posture, as measured by the Kinect, reflect changes in emotional valence. For the current studies, we assumed therefore that the more children's underlying motivation to help was satisfied, the greater their resulting positive emotion, that is, the more elevated children's upper-body posture (see Aknin et al., 2012, 2015; Lennon & Eisenberg, 1987, for a similar rational using measures of facial expressions).

2 | STUDY 1

We presented 2- and 5-year-old children with two experimental conditions in which an adult needed help to complete a goal-directed action. Depending on condition, children could either assist the adult themselves (Child-helps condition) or watched as help was provided by a third party (3P-helps condition). The end state across conditions was thus identical – the person in need was helped – but what differed was whether the children themselves or a third party provided the help. Following the helping event, we measured children's positive emotions through changes in upper-body postural elevation, which was quantified via depth sensor imaging technology. Our two hypotheses were as follows: First, we expected 2-year-old children to show positive emotions of similar magnitude across the Child-helps and the 3P-helps conditions, indicating that toddlers possess primarily intrinsic prosocial motivations and are thus satisfied as long as the needy individual is helped (see also Hepach et al., 2012). This prediction is based on a prior study demonstrating that 2-year-old children show positive emotions after helping others but not after seeing others' needs remain unfulfilled (Hepach et al., 2017b). Second, we expected 5-year-old children to display more positive emotions after they provided help themselves, suggesting that preschoolers, in contrast to toddlers, possess additional strategic motivations for helping others. This prediction is based on prior research showing that children first start caring about their prosocial reputation around the age of 5 years (Engelmann & Rapp, 2018).

3 | METHODS

3.1 | Participants

We invited 31 2-year-old children (15 boys, mean age = 2 years, 6 months; range 2 years 5 months 12 days to 2 years 6 months 28 days) and 33 5-year-old children (17 girls, mean age 5 years, 6 months; range 5 years 5 months 3 days to 5 years 6 months 28 days) with their families to our childhood research institute. In addition, 23 children (13 girls) participated in a pilot study. Children were randomly selected from a database of local families. Parents were contacted via telephone and gave written informed consent for their child's participation upon their visit to the childhood research institute, before the study commenced, after they were briefed about the study's goals, and after all their questions were addressed. Children were predominantly of Caucasian ethnicity from middle- to high-income families.

Seven additional children were tested but not included in the final sample because children did not want to participate until the end of the study ($n = 6$) or because they crawled during the test phase of the study in which case no data could be recorded ($n = 1$). Furthermore, for 21 children data from at least one test trial had to be excluded because of equipment failure ($n = 4$), children walked toward the camera with their back turned and no data could be recorded ($n = 8$), children helped although it was the 3P-helps condition ($n = 3$), children did not want to walk toward the camera by themselves ($n = 2$), or because children crawled or crouched down to the effect that no data could be recorded ($n = 4$).

The stopping rule for data collection was the predetermined sample size of 64 children, similar to previous work using the same method (Hepach & Tomasello, 2020; Hepach et al., 2017b).

3.2 | Sample size and power analysis

The choice of a sample size of 64 children was based on prior work (including five separate experiments) using methods and statistical modeling techniques similar to those of the present study (Hepach & Tomasello, 2020; Hepach et al., 2017b) which showed sufficient statistical power (Hepach & Tomasello, 2020). Post hoc power analysis using the package *simr* [version 1.0.5] (Green & MacLeod, 2016) confirmed that sufficient statistical power was achieved. We compared our initial most complex model (including all two-way-interaction of our main predictor variables) against a reduced model without those predictor variables but including all control predictors as well as all random effects (see Section 3.5 below). We used the following command thus basing our power estimation on 10,000 simulations: *powerSim(full.main, test = compare(red.main, method = c("lr")), seed = 321, nsim = 10000).* Posthoc power was sufficient and estimated to be $1 - \beta = 99.98\%$, 95% CI [99.96% 100%].

3.3 | Materials & design

Throughout the study, children were engaged in an activity involving regular crayons, colored stamps, and paper with a grid on it. One adult (E1) assumed the role of helpee, playing one of two games: stacking blocks to build a tower or decorating a piece of paper with stickers and stamps. Each game was designed to include a final piece that was needed to complete the adult's goal of completing the game: several blocks to form the tower and a small transparent tube including an additional stamp for decorating the piece of paper. Following the standardized study protocol, the adult "accidentally" dropped each of these objects just before completing their game (see Section 3.4 below). To emphasize E1's need for help, they sat behind a table and wore one of their arms in an arm sling for the entire duration of the study.

Children of both age groups participated in a within-subjects design consisting of one baseline phase, which always preceded a test phase. During the test phase the two experimental conditions, Child-helps and 3P-helps, were presented in an alternating order across four test trials. Across participants we counterbalanced which condition was presented on the first test trial. In the Child-helps condition children could themselves provide help for E1 by picking up the dropped object. The 3P-helps condition was identical to the Child-helps condition with the only difference that just before children picked up the needed object, another adult (E2) was faster than the child and handed the object to E1. In this case, children merely saw the adult (E1) being helped (see Section 3.4 for details).

3.4 | Procedure

The study was run by two experimenters, E1 who needed help during the study and E2 who guided children through the study. Before the actual study session commenced, E2 set up the Kinect camera connecting it to a separate laptop. They then left to greet families in the waiting room where parents were briefed on the study and children could warm up to E2. E1 introduced themselves only briefly to children and then entered the study room to sit behind a large desk in the corner of the room (see Figure 1) where they waited for the child and E2 to enter the room. For the younger age group of 2-year-old children the

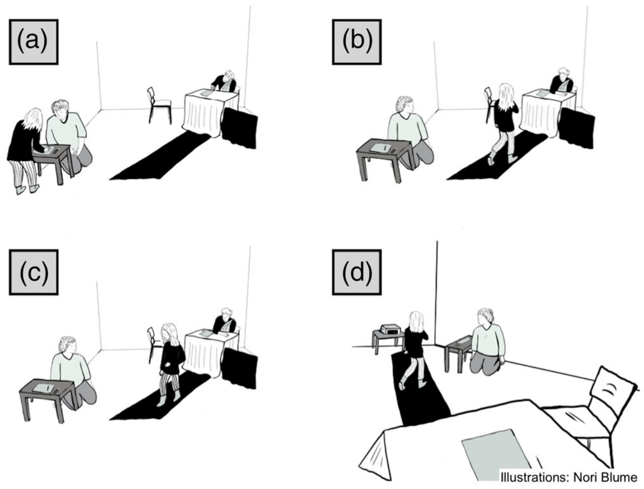

FIGURE 1 *Study 1.* Procedure baseline phase. The child is working on her drawing while the adult (E1; the latter helpee) is working at their desk. The second adult (E2) is with the child (a). E1 asks the child to come to the desk to look at something (b). The child walks back to her desk. The Kinect (positioned on the small table the child walked toward – see d) is recording her posture as she is walking. These "baseline walks" were repeated four times. The Kinect camera was hidden in a small cardboard box facing the child as she walked back from the adult's table (c, d)

parents sat to the side at a table pretending to read a magazine facing opposite the study situation. Parents were asked not to comment on the situation and if their child approached them to encourage them to keep playing.

In summary, children participated in two phases: A baseline phase and a test phase. The test phase was split up into four test trials in which each condition was presented twice with the order or presentation counterbalanced across participants.

3.4.1 | Baseline phase

E2 and the child entered the room where she explained that they were going to play a game and the rule was to walk on the blue carpet stripes, which ran from the small table the child would play at to E1's desk. E2 engaged the child in a drawing activity while E1 sat behind their desk. After a few minutes E1 asked the child to come to them and to look at something they had drawn. This was repeated four times. Each time and while the child walked back from the desk to her table, we recorded their posture with the Kinect (baseline measures of body posture; see Figure 1). After the children had returned from their last "walk", E2 suggested to play a new game thereby proceeding to the test phase.

3.4.2 | Test phase

In the following we illustrate the procedure in which, as part of the counterbalancing, the Child-helps condition was presented first followed by the 3P-helps condition (see Section 3.3).

Trial 1

E2 placed a piece of paper with a grid on it on the table in front of the child who was tasked with completing the grid using stamps and crayons. While the child was engaged in her task, E2 moved to her chair next to E1's desk: "While you fill this out I need to read something over there." By that time E1 was in the process of completing their task of building a tower with wooden blocks. They drew the child's and E2's attention to themselves: "Look, [child's name & E2's name] I will now build a tower!" After 10 s E1 "accidentally" dropped the final piece which fell in front of the table, out of their reach (but accessible to the child and E2; see Figure 2a). E1 verbalized their need in a series of more direct prompts: "Oh!" (Looking at the object for 5 s.), "Oh no, I can"t reach it.' (Extending the arm reaching for the object for 5 s.), "Hm, I can't continue here." (Same pose for another 5 s.), "I need help." (Alternating gaze between the child and the object for 5 s.), "[Child's name] can you help me?" (Looking at the child for 5 s.) Within this sequence of events, E2 was turned away from the situation reading her magazine.

In the Child-helps condition helping involved picking up the dropped object and then further helping E1 to place it correctly onto the tower (see Figure 2b). E1 did not thank the child and continued with the activity. In the 3P-helps condition, E2 waited for children to approach E1's desk but was fast enough to turn toward the situation to pick up the object before the child could. Children then saw E1 being helped by E2 to build the tower. In both conditions, children subsequently walked back to their table to continue their task (*test 1 measure of body posture*; see Figure 2c).

Trial 2

Following the counterbalanced order of tasks (see Section 3.3) E1 now engaged in the second task of decorating a piece of paper with stickers: "[Child's name & E2's name], I will now decorate my sheet of paper." The last item was a small box placed within a tube. Ten seconds after his announcement, E1 "accidentally" dropped the final piece which fell in front of the table, again out of his reach (but accessible to the child and E2). The subsequent steps proceeded identical to test trial 1. Once the tube was picked up by either the child or E2, the helper needed to open the tube and take out the box to provide the adequate help to E1. E1 was instructed to express a neutral facial expression and not to thank or praise the child. After E1 could continue his task, children walked back to their table (*test 2 measure of body posture*; see Figure 2d–f).

Filler trial

After the second test trial children were presented with a trial to provide a procedural break between test trials. We wanted to ensure that in particular the young children were still motivated to walk toward E2's table despite E1 having "interrupted" their helping attempt in the 3P-helps condition. E1 showed children the progress they had made, prompting children to walk toward the table and back again to their drawing table. We did not analyze data for this trial following the logic of previous studies using the Kinect technology with young children (Hepach et al., 2017b).

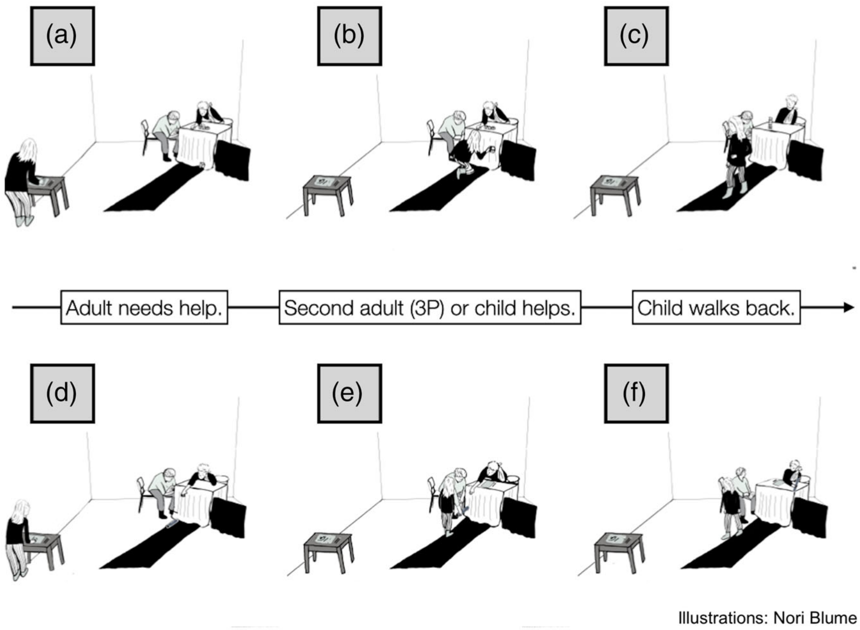

FIGURE 2 *Study 1*. Procedure Test Phase. E1 dropped his wooden block (a) or tube (d). In the Child-helps condition the child picked up the dropped object (b) whereas in the 3P-helps condition the second experimenter (E2) was faster to help (e). After the help was provided, children walked back toward the Kinect while we recorded their body posture (c) and (f)

Trials 3 and 4

The final test trials were identical to the first 2 test trials (thus providing *test measures 3 and 4 of body posture*). After the conclusion of the study, all children were presented with a final opportunity to help E1 to ensure that all children could sufficiently express their helpfulness. E1 retrieved a transparent box with a small opening and gently dropped it in the floor in front of his desk. E1 encouraged children to reach down the tube to retrieve the objects one by one from the bottom of the box, thus providing multiple opportunities for children to help. These data were not analyzed. This final situation simply provided a psychological debriefing of sorts for children who may have been inconvenienced by the fact that they could not provide help themselves on every prior occasion.

3.5 | Statistical models and preliminary analyses

The recording and extraction of skeletal information was automated using processing-routines written in Matlab. The entire recording and processing code is available on the first author's *Github*-site (https://github.com/rhepach/Kinect). The result of the Matlab-routines was a table, which included for each participant and each trial the xyz-coordinates for 20 skeletal points (see Figure 3 for illustrations). Data were further processed using automated routines in *R*. For each child, we calculated eight dependent measures: The baseline-corrected upper-body posture (chest height) as well as the baseline-corrected lower-body posture (hip height) for each of the four test trials (see Figures 1–3). The dependent measure was calculated as follows: For each walk, during the baseline and test phases, we captured children's chest (and hip) height, that is, the y-value as mapped by the Kinect, as children walked away from the experimenter's table toward their own table. We estimated – using the automated routines in the *Step1-R*-scripts provided on OSF (https://osf.io/7gfkx/) – the height of the two skeletal points in each of 20 distance bins (width 10 cm) between the child being 3.2 and 1.2 m away from the Kinect as they walked toward it. That is, each child provided time-series data for every trial (for every walk) consisting of 20 data points for their chest (and hip) height. We then subtracted the 20 baseline-values from the corresponding 20 values of each test trial to arrive at 20 baseline-corrected values capturing the change in children's chest (and hip) height. Note that for the final statistical analyses we included 19 distance bins because, following the preprocessing, no data was recorded for the most distant bin, that is, 3.2 to 3.1 m away from the Kinect (see *Step2-R*-scripts provided on *OSF*). In sum, children could provide eight time-series of data consisting of the 19 baseline-corrected change values in their upper-body posture (four time-series) and lower-body posture (four time series). Linear mixed models were fitted using the package *lme4* in *R*. For all statistical analyses we calculated *p*-values based on likelihood-ratio tests for each fixed effect term using the function *drop1()* by comparing the full model to reduced models without the respective fixed effects.

3.5.1 | Model 1 (Main analysis)

The dependent measure was the change in children's upper-body posture, that is, the baseline-corrected chest height values. We included all 2-way-interactions of time-distance (the 19 data points as children walked toward the Kinect), condition, and age group. The control predictor variables were trial number and gender. Furthermore, the model included a random intercept for the ID of the experimenter team who ran the study, as well as for subject and we included random slopes for time-distance (z-standardized) as well as trial (z-standardized) on subject. In contrast to previous studies (e.g., Hepach et al., 2017b, Hepach & Tomasello, 2020), we did not have similar amounts of data points per time-distance bin across subjects and therefore concluded that we

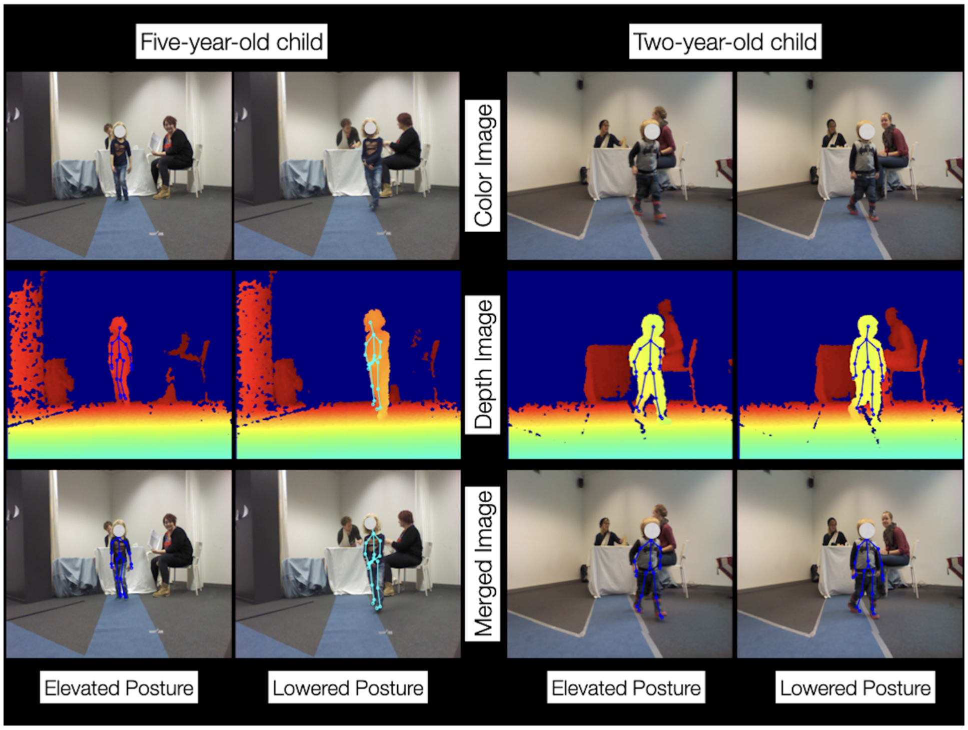

FIGURE 3 Example of Kinect-data being mapped onto the live image for both a 5- and a 2-year-old child with elevated and lowered posture

could not with confidence interpret a 3-way-interaction including time-distance.

3.5.2 | Model 2 (Control analysis)

Based on the main analysis, we ran a second model to test the effects of all 2-way-interactions on the change in children's lower-body posture, that is, the baseline-corrected hip height values. The remaining model structure was identical to that of the main model.

For our statistical analyses, the number of data points in each condition were as follows: 5-year-olds/Child-helps ($n = 59$), 5-year-olds/3P-helps ($n = 46$), 2-year-olds/Child-helps ($n = 55$), and 2-year-olds/3P-helps ($n = 50$). The data and all analysis script are available at OSF: https://osf.io/7gfkx/.

4 | RESULTS

Changes in children's upper-body posture varied systematically as a function of both condition and age group (i.e., an interaction effect), $\chi^2(df = 1) = 23.06$, $p < .001$ (see Figure 4). Five-year-old children who helped the adult had greater postural elevation ($M = 0.003$ cm, $SD = 1.91$ cm, $n = 32$, 95% CI = [–0.69, 0.69]) than children in this age group who merely saw help being provided, ($M = -0.56$ cm, $SD = 2.02$ cm, $n = 29$, 95% CI = [−1.33, 0.21]). In contrast, 2-year-old children showed similar levels of upper-body posture change after they helped the adult ($M = -0.30$ cm, $SD = 1.43$ cm, $n = 31$, 95% CI = [–0.83, 0.23]) and after they saw the adult being helped ($M = -0.31$ cm, $SD = 1.36$ cm, $n = 28$, 95% CI = [–0.84, 0.22]). We found no interaction effect of time-distance and condition, $\chi^2(df = 1) = 2.58$, $p = .11$, or time-distance and age group, $\chi^2(df = 1) = 0.08$, $p = .78$. In addition, we found no effect for gender, $\chi^2(df = 1) = 0.66$, $p = .42$, but an effect of trial, $\chi^2(df = 1) = 4.21$, $p = .04$. Children's upper-body posture decreased across trials, $\beta = -0.0025$ ($SE = 0.0012$).

As expected, we did not find similar effects on children's lower-body posture. There were no interaction effects of time-distance and condition, $\chi^2(df = 1) = 0.36$, $p = .55$, time-distance and age group, $\chi^2(df = 1) = 0.72$, $p = .40$, or age group and condition, $\chi^2(df = 1) = 2.79$, $p = .10$. In addition, we found no effects of trial, $\chi^2(df = 1) = 0.12$, $p = .73$, but an effect of gender, $\chi^2(df = 1) = 5.53$, $p = .02$, on children's lower posture changes. Boys showed overall greater decrease in lower-body posture ($M = 0.75$ cm, $SD = 1.99$ cm)than girls ($M = -0.07$, $SD = 2.45$). Together, these control analyses indicate that the effects of condition and age were specific to children's upper-body posture and did not affect children's general elevation. This is important because it rules out alternative interpretations of the effects on upper-body posture, for example, through children jumping.

5 | DISCUSSION

In Study 1 we found that 5-year-old children showed greater postural elevation after themselves helping an adult compared to merely seeing the adult being helped (by a third-party). In contrast, 2-year-old children showed similar levels of upper-body posture when they

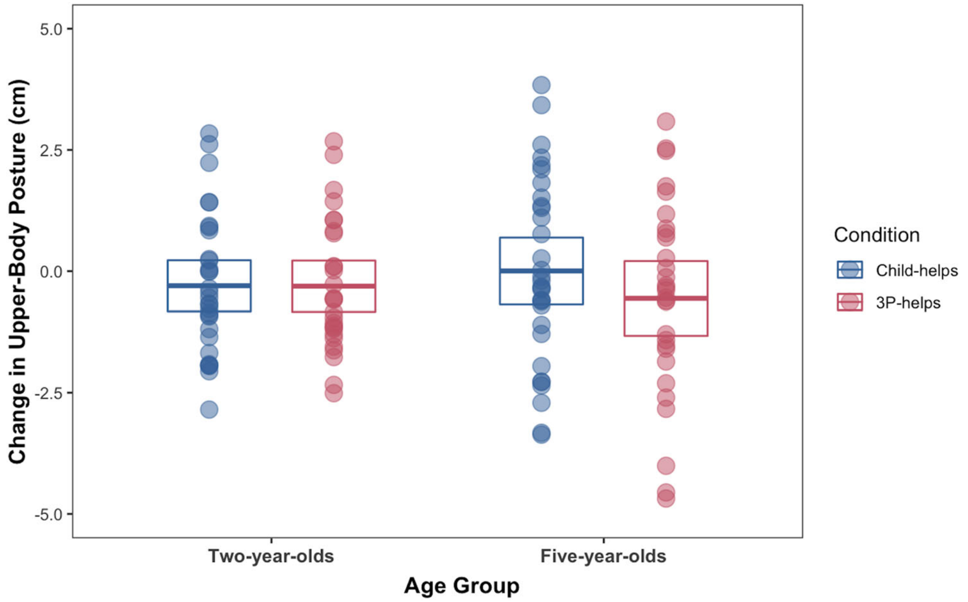

FIGURE 4 Results of Study 1. The average baseline-corrected change in upper-body posture. The data are split up by condition and age group. Error bars represent the 95% confidence interval from the mean.

provided help and when they saw help being provided. This relative pattern of results confirms both of our hypotheses which were themselves grounded in prior work (Engelmann & Rapp, 2018; Engelmann et al., 2012; Hepach et al., 2012, 2017a; Kenward et al., 2015; Leimgruber et al., 2012). The absolute levels of postural elevation, i.e., the average change in upper-body posture across conditions and age groups, was below "0." This result did not confirm our initial predictions that providing help and seeing help provided – themselves positive events – should overall result in elevated body posture, that is, in absolute levels above "0." This latter finding does not undermine our key conclusions regarding the relative pattern of upper-body posture changes, but it does require further discussion.

The change values in upper-body posture on which we based our statistical analyses are reference values to a baseline-phase that was the same for all test trials across all conditions and participants.[1] Our decision to focus on tonic changes in posture mirrors previous studies in which children's emotions were studied via changes in facial expression or body posture. For example, Aknin and colleagues measured tonic as opposed to phasic changes in 2-year-old (Aknin et al., 2012) and 2- to 4-year-old (Aknin et al., 2015) children's facial expressions following sharing behavior.

Importantly, the relative difference in emotions between test trials was not affected by the choice of baseline. Similarly, in a previous study on changes in 2-year-old children's body posture, the pattern of relative difference in upper-body posture across conditions was mirrored in adult coders' judgments of how positive (or negative) children's overall expressions were across conditions (Hepach et al., 2017b). In the current study, therefore, it would be misleading to conceive of values below "0" to indicate that children experienced an emotion with negative valence after providing help and after seeing help being provided. This pattern of results can also be explained, for example, in terms of the fact that the baseline phase, at the beginning of the study, was particularly engaging and positive for children. Likewise, had the results indicated positive posture changes, that is, overall values above "0", then this by itself would not be an indication that children experienced positive emotions in both conditions. The more parsimonious interpretation is that for the younger age group in the current study, helping and seeing help provided resulted in similar emotional valence states compared to baseline. It remains an important question to address in future research how the choice in baseline phase, for example, what children do during the baseline phase and how long before the test phase the baseline phase is conducted, affects absolute levels in body posture.

The pattern of body posture changes for 2-year-old children in the current study provides an important replication of prior work, which experimentally manipulated whether children could complete the helping action themselves. Two- and 3-year-old children's physiological arousal, as measured via changes in pupil dilation, was similar in conditions where children could themselves provide the help as opposed to seeing the help being provided (Hepach et al., 2012; Hepach et al., 2017a, 2019). Those previous studies did include control conditions in which children's arousal was found to be increased if they could not themselves complete the helping behavior, e.g., if they had accidentally caused harm (Hepach et al., 2017a) or if the person needing help had previously helped the child (Hepach et al., 2019). These prior findings provide an important frame of reference for the current study, which is the first to use a measure of valence (indexed by body posture) in an experimental paradigm where children could not themselves provide help (on some trials). The similar levels of body posture across the Child-helps and 3P-helps conditions for 2-year-old children suggest that younger children primarily wanted to see the adult in need being helped (regardless of whether they could do so themselves or not). This "null result" replicates prior work, which used a different measure (pupil dilation): 2-year-old children were in a similar emotional state after helping others and after seeing others being helped (see also Steckler et al., 2018). In contrast, in the current study, older children were more sensitive to the strategic benefits resulting from their helping behavior. Thus, 5-year-olds showed a higher upper-body posture (indicating more positive emotions) when they helped themselves compared to when help was provided by another agent.

From the pattern of results obtained for the 5-year-old children, the question arose whether the observed changes in posture reflected a strategic concern to manage their prosocial reputation or whether these preschoolers were generally more motivated to complete any action in the presence of others (in which case postural elevation would not be unique to helping others). Therefore, in Study 2 we focused on this older age group to investigate the kind of (strategic) concern that provided the additional incentive to actively provide help.

6 | STUDY 2

Five-year-old children were presented with two scenarios: one in which they could help an adult and a second one in which they could complete their own goal. In both cases, the adult was not present in the room and did not see the child help them or complete their own goal. What we varied was whether children were observed by two other adults who were present in the room but engaged in a different activity that prohibited them from interfering with the situation. We hypothesized that children would show greater postural elevation after helping in the presence of an audience compared to helping anonymously. If this reflected a specific concern for managing their prosocial reputation, then we would expect the pattern to be different in the scenario where children fulfilled their own goal. On the other hand, if children were generally more motivated to complete any task in the presence of others, then we would expect a similar pattern across the two scenarios, that is, more postural elevation after completing a task in the presence of others compared to completing the task in anonymity.

6.1 | Participants

For Study 2, 59 5-year-old children (29 boys, mean age = 5 years, 6 months; range: 5 years, 5 months, 1 days to 5 years, 6 months, 29 days) participated. Children were randomly selected from a database of local families. Nine additional children (five boys) participated in a pilot study. Parents were contacted via telephone and gave written consent for their child's participation upon their visit to the child research institute, before the study commenced, after they were briefed about the study's goals, and after all their questions were addressed. Seventeen additional children were tested but excluded from the final sample because the child did not want to participate ($n = 3$), because of equipment failure ($n = 1$), because no data could be collected during the baseline phase ($n = 3$) or test phase ($n = 1$), because the automated processing did not yield data ($n = 2$), or because the child did not help on the first test trial ($n = 7$). In addition, for nine children, data from the second test trial had to be excluded because of equipment failure ($n = 2$) or because the child did not help ($n = 7$). The stopping rule for data collection was the predetermined sample size of 64 children like in Study 1 but not all children provided data points following the preprocessing of the raw data. The algorithms are provided on OSF (https://osf.io/7gfkx/).

6.2 | Sample size and power analysis

We ran the same simulations ($n = 10{,}000$) to estimate statistical power by comparing our initial model (including all two-way-interactions of our main predictor variables) against a reduced model without the predictor variables but including all control predictors and random effects (see Section 6.5 below). Post hoc power was sufficient and estimated to be at $1\text{-}\beta = 86.26\%$ CI [85.57% 86.93%].

6.3 | Materials & design

Similar to Study 1 children completed a picture using crayons and stamps. The observing adult was engaged in an activity of repairing a piece of furniture with tools. To create a helping situation, which did not require the main adult to be present, we built a contraption that allowed us to drop objects from a table by pulling a string from outside the study room. The object to drop was a small ceramic vase with a plastic flower in it. The vase was placed at the edge of a table and pulling the string resulted in the vase dropping on the floor. The overall set-up of the room was identical to Study 1 (see Figure 5).

Children participated in a within-subjects design consisting of 2 (condition) × 2 (context) experimental conditions: child-helps/observer-present, child-helps/anonymous, child-completes-own-goal/observer-present, and child-completes-own-goal/anonymous. The between-subjects factor was context whereas the within-subjects factor was condition. Children participated in two test trials the order of which was counterbalanced across participants. Children were randomly assignment to a specific order of conditions.

6.4 | Procedure

The study was run by three experimenters; E1 led the child through the study and one additional adult (the observer) was present for half of the participants (constituting the observer-present context). One experimenter (E2) oversaw running the Kinect-laptop and recording the sessions The laptop was positioned outside the testing room. E2 also joined the observerving adult in the observer-present context in which case E1 operated the Kinect-laptop. The study progressed through two phases: an introductory and a test phase.

Introductory phase. The main experimenter (E1) entered the room with the child and pointed out the striped markings on the carpet. The rule of the game was to only walk along the markings to

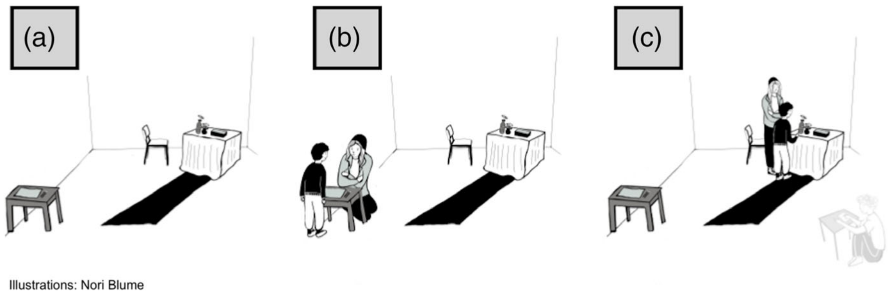

FIGURE 5 Study 2. The overall set-up of the empty study room (a). The child engaged in her warm-up activity while E1 was with her (b). E1 shows the child the props on the table and instructs her to walk up to the table to place her finished pieces of paper in the box. During this phase of the study, and in the observer-present context only, one adult was present in the room (c)

motivate children to walk in a straight line (to reduce additional movement for our measures of body posture). In the observer-present context E1 pointed to the observer who was sitting in one corner of the room behind a piece of furniture: "Look, he is building something, but we can play here." The observer waved at E1 and the child. In the anonymous context no additional adult was present in the room. The sequence of events during the introductory phase mirrored those of Study 1. The child was encouraged to work on her drawings (see Figure 5b) and to walk to E1's table twice. This allowed us to record two baseline measurements as children walked back to their table.

6.4.1 | Test phase

E1 showed the child four large pieces of paper pointing out that the grid on each paper had to be filled out with stamps. E1: "You complete each sheet of paper by using these stamps and once you are done you fold each paper and walk toward my table and place it in the small box there. Then, you walk back and work on the next sheet of paper. Once you complete all four sheets of paper you will receive a reward from me at the end of the study. Try it out!"

Each sheet of paper was large enough that children had to carry one sheet at a time. In the *observer-present context* E2 entered the room, waved at E1 and the child (saying "Hello") before joining the observer to work on the piece of furniture. We decided to have two adults in the room to increase the salience of being observed. E1 waited for the child to finish the first sheet of paper before both moved to the larger table. She pointed to the small box: "This is where you place each sheet of paper." The child placed her sheet into the box. E1 then said: "Very nice. And this is how you will do it with the remaining three sheets." Before returning to the child's table, E1 pointed to the vase at the edge of the table (see Figure 5c): "Have you seen my flowers here? I've collected them myself. Aren't they beautiful? Sometimes they fall down and then I am very happy if someone helps me and places them back on the table." E1 waited for the child to return to her drawing table. She then said: "You can continue playing. And I will go outside to get that reward of yours."

Next, children participated first in the child-helps condition or in the child-completes-own-goal condition (order counterbalanced).

6.4.2 | Child-helps condition

The child worked on her second picture while E1 monitored the situation from outside the study room (via video cameras installed in the study room; see Figure 6a). Once the child had completed about two thirds of the sheet of paper, E1 made the vase drop to the floor (see Figure 6b. In the observer-present context the two adults looked at the dropped object (2 s), then looked again at their activity (2 s), then looked at the dropped object (2 s), then looked at the child (2 s). Children could get up from their table to pick up the vase at any time point. In the observer-present context, the adults then focussed their attention back to their activity. Once children picked up the vase and walked toward their table we took the first test measure of body posture (see Figure 6c and d).

6.4.3 | Child-completes-own-goal condition

The child worked on her third picture. The vase did not drop from the table. Once the child completed the picture on her sheet of paper, she walked toward E1's table. In the observer-present context the two adults did not look at the child but were engaged in their activity. After children placed the picture in the box and walked back toward their table we took the second test measure of body posture.

After the child participated in both conditions and while they were working on an additional sheet of paper E1 returned with the child's reward. To provide children with an opportunity to tell her what happened in her absence she entered the room saying: "Did anything happen while I was gone?"

6.5 | Statistical models and preliminary analyses

The analysis strategy paralleled that of Study 1. For the predictor variable time-distance, we included 18 distance bins (instead of 19 in Study 1) given that no data were recorded for the two most distant bins, that is, 3.2–3.1 m, and 3.1–3 m away from the Kinect (see *Step2-R-script* provided on *OSF*). In sum, children could provide four time-series of data consisting of the 18 baseline-corrected change values in their

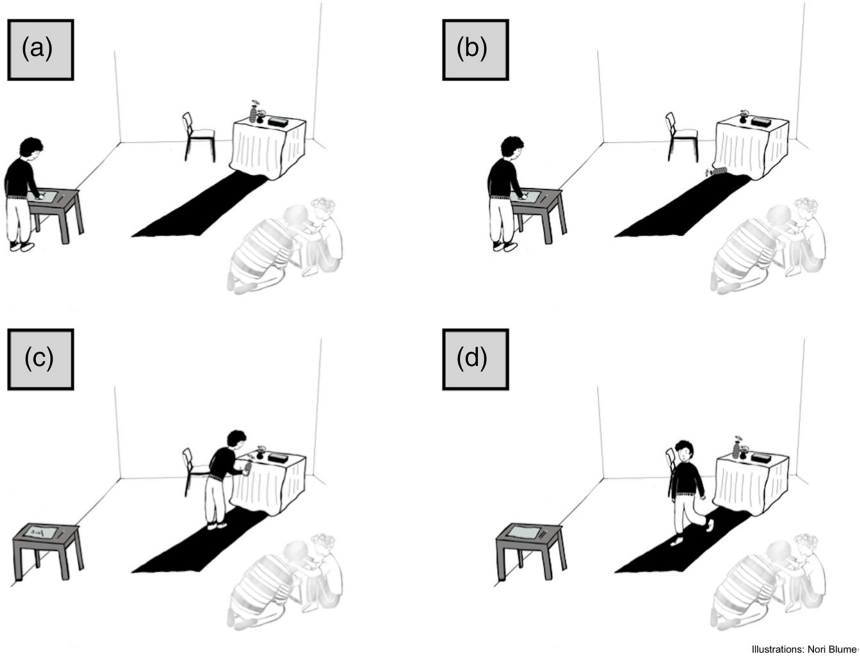

FIGURE 6 Study 2. The crucial elements of a test trial (example of the child-helps condition). In the observer-present context, two adults were watching the situation (illustrated in the corner of each image). The child is engaged her activity (a). The vase drops while the child was engaged in her activity (b). The child picks up the vase to places it back on the table (c). The child walks back to her table. At this timepoint the measurement of body posture is taken (d)

upper-body posture (for both test trials) and lower-body posture (for both test trials).

6.5.1 | Model 1 (Main analysis)

The dependent measure was the change in children's upper-body posture, that is, the baseline-corrected chest height. We included all 2-way-interactions of time-distance, context (observer-present vs. anonymous), and condition (child-help vs. child-completes-own-goal). The control predictor variables were trial number and gender. Furthermore, the model included a random intercept for the ID of the experimenter team who ran the study as well as for subject and we included random slopes for time-distance (z-standardized) as well as trial on subject. The *p*-values for the interaction effects and control predictors were calculated through individual likelihood-ratio test using the function *drop1()*.

6.5.2 | Model 2 (Control analysis)

The second model tested the effects of all 2-way-interactions on the change in children's lower-body posture, that is, the baseline-corrected hip height. The model structure was identical to that of the main model.

7 | RESULTS

The main analysis revealed only a marginally statistically significant interaction of context and condition, $\chi^2(df = 1) = 3.35$, $p = .07$ as well as of time-distance and context, $\chi^2(df = 1) = 3.32$, $p = .07$. We therefore fitted two additional reduced models, one lacking the predictor variable context and one lacking the predictor condition. More specifically and to calculate the *p*-values for the main effects of context and condition, we compared the main model to the additional reduced models without the respective predictor variable using the function *anova()*. This revealed a main effect of context, that is, that being observed resulted in an increase in children's upper-body postural elevation in both the child-helps as well as the child-completes-own-goal condition, $\chi^2(df = 3) = 8.26$, $p = .04$ (see Figure 7). Children's change in posture was greater after helping the adult (in her absence) while being observed ($M = 0.34$ cm, $SD = 1.83$ cm, $n = 23$, 95% CI = [−0.46,1.13]) compared to when they were helping anonymously ($M = -0.49$ cm, $SD = 2.48$ cm, $n = 25$, 95% CI = [−1.51, 0.54]). Similarly, completing their own goal while being observed resulted in greater postural elevation ($M = 0.64$ cm, $SD = 2.21$ cm, $n = 24$, 95% CI = [−0.29,1.58]) compared the anonymous context in which children were not observed, ($M = -0.53$ cm, $SD = 1.79$ cm, $n = 27$, 95% CI = [−1.24, 0.18]).

We found no main effect of condition, $\chi^2(df = 3) = 5.55$, $p = .14$ and no main effect of gender, $\chi^2(df = 1) = 1.24$, $p = .26$. Finally, children's upper-body posture did increase from the first to the second test trial across conditions and contexts, $\beta = 0.52$ ($SE = 0.26$), $\chi^2(df = 1) = 3.85$, $p = .0496$.

In contrast to our main analysis on children's upper-body posture we did not find similar effects on changes in children's lower-body posture. There were no interaction effects of time-distance and context, $\chi^2(df = 1) = 1.033$, $p = .309$, time-distance and condition, $\chi^2(df = 1) = 1.027$, $p = .31$, or context and condition, $\chi^2(df = 1) = 1.18$, $p = .28$. Furthermore, there was no main effect of context on changes in children's lower-body posture, $\chi^2(df = 3) = 2.82$, $p = .42$, and no main effect of condition, $\chi2(\text{df} = 3) = 2.95$, $p = .4$. In addition, we found no effects of trial, $\chi^2(df = 1) = 3.08$, $p = .08$, or gender, $\chi^2(df = 1) = 0.51$, $p = .48$, on children's lower posture changes. Similar to Study 1, these

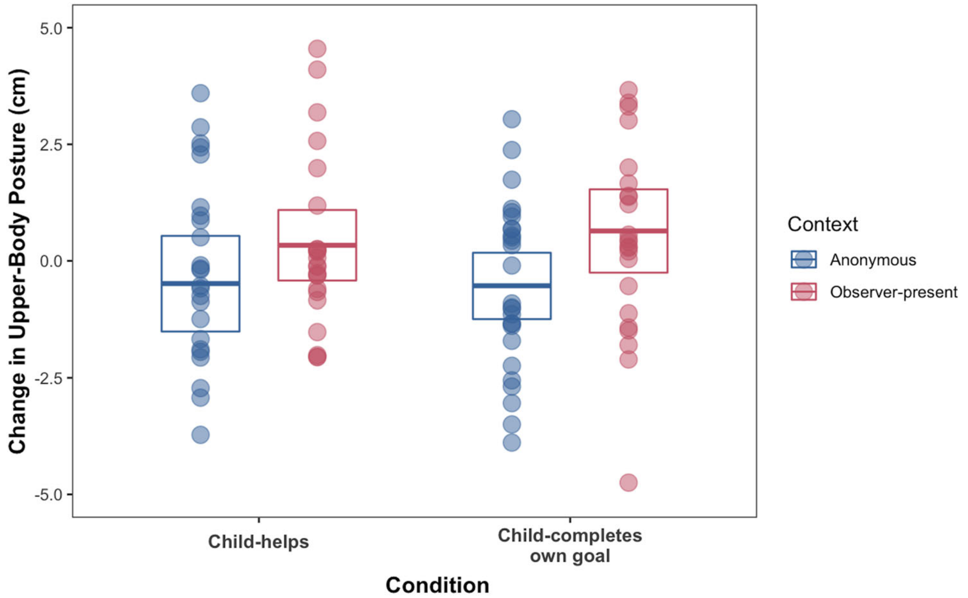

FIGURE 7 Results of Study 2. The average baseline-corrected change in upper-body posture. The data are split up by condition and context. Error bars represent the 95% confidence interval from the mean

control analyses indicate that we could rule out alternative interpretations of the effects on upper-body posture, for example, through jumping.

8 | GENERAL DISCUSSION

These current results provide the first direct evidence that children's motivations for prosocial acts undergo a significant shift during early childhood. In short, we find that helping at age 2 is driven primarily by a genuine concern for the well-being of others, while by the age of 5 children have developed additional, strategic motivations to help others. We argue that the latter are grounded in 5-year-olds' desire to develop a positive reputation.

Two- and 5-year-old children showed identical behavior in Study 1: They helped a person in need. Where the two age groups differed was in the *nature* of their motivation. Children of the younger age group displayed similar emotional valence when they helped a person themselves and when they saw that same person being helped by a third party. Two-year-old children thus displayed an intrinsic motivation to help others, which does not require that children perform the helping act themselves and get credit for it, but rather requires only that the person in need is helped. Importantly, prior studies have shown that children at this age show less positive emotions when others are not helped at all (Hepach et al., 2017b). Five-year-old children, in contrast to 2-year-olds, displayed more positive emotions when *they* could provide help themselves. One interpretation of this finding is that 5-year-old children are motivated to care for others in part by strategic considerations: namely, wanting to get reputational credit. The results of Study 2 support this account. Helping in a setting where their reputation was at stake (because they were observed by two adults) resulted in more positive emotions for 5-year-old children compared to an anonymous context.

This finding supports and extends previous work on children's burgeoning concern for how they are seen by others. From at least the age of 5 onward, children's self-presentational motives are not only expressed in their overt behavior, such as when they selectively turn up their levels of prosociality in the presence of others (see Engelmann & Rapp, 2018, for a review), but also in their underlying emotions. In Study 2, 5-year-old children showed identical helping behavior in both conditions, observer-present and anonymous. But helping in the presence of observers resulted in the expression of more positive emotions than helping in an anonymous conext. Study 2 also tracked children's emotional response as a function of audience presence in a situation where children achieved their own goal. We included this additional pair of conditions as a validation context, following the approach of Hepach et al. (2017b). Based on previous research (Engelmann et al., 2016; Heckhausen, 1987; Lewis et al., 1992), we hypothesized that 5-year-old children would display more positive affect when achieving their own goal in front of an audience. Had we not found an audience effect in the helping context of Study 2, then including the own goal condition would have allowed us to rule out alternative interpretations of such a null effect, for example that our audience manipulation was too weak to result in detectable changes in emotional response. However, we observed a measurable effect of the observers being present on children's emotional expression in both contexts, own-goal and helping. This result might suggest that children manage different aspects of their reputation in the two contexts. Their reputation as a prosocial individual in the helping context, and their reputation as a competent individual in the own-goal context. However, additional research, possibly using a more qualitative approach, is needed to investigate whether completing the goal in both situations resulted in distinctly different experienced emotions. Future research should further investigate whether and how children manage different aspects of their prosocial and competency-based reputation, given that the majority of previous research has focused on children's self-presentation in the context of cooperation (for exceptions, see Asaba & Gweon, 2019; Gweon & Asaba, 2018).

On our account, the fact that 5-year-old children showed more positive affect when they helped, and especially when they helped while being observed, provides evidence for a strategic motivation in this age group. Could our age effect also be understood as simply showing that older but not younger children prefer doing things themselves? This appears unlikely. Previous research suggests that the impulse of "wanting to do it oneself" emerges early in ontogeny. A series of studies shows that this motivation is in place as early as 20 months of age (Heckhausen, 1984, 1988). In addition, this alternative interpretation does not fit the observed pattern of results well. It would predict that children find the two unobserved conditions of Study 2 – where they themselves enact a change in the world – more rewarding than the third-party help condition of Study 1, where they were unable to complete an intended action. Visual inspection of the respective changes in upper-body posture suggests that this is not the case.

We have suggested that the prosocial actions of 5-year-old children are underpinned by two different motives, a genuine concern for others and a strategic concern to improve their reputation. This motivational pluralism raises interesting questions. How do these two motivations interact in giving rise to prosocial behavior? How do children navigate situations in which genuine prosocial concerns pull in one direction and strategic considerations in another? For example, in a forced-choice situation, would children choose to help a needy peer in private, or decide to aid a less needy peer in public? To our knowledge, only one previous study has specifically addressed the interaction between self- and other-oriented prosocial motivations. Kenward et al. (2015) report that the presence of strategic motivations for sharing in 4-year-old children (selectively channeling resources toward rich individuals in the hope of reciprocation) correlates negatively with a measure of intrinsic motivation (spontaneous helping). This result is interesting because it indicates reliable individual differences in the extent to which prosocial behavior is self- versus other-oriented even in early childhood. Future research should investigate the interplay between intrinsic and strategic prosociality both from a first-party perspective (focusing on children's own behavior) and a third-party perspective (e.g., how children evaluate those who help for strategic over intrinsic reasons).

8.1 | Limitations

The present studies provide first evidence for a developmental shift underlying 5-year-olds' compared to 2-year-olds' prosocial motivation. Measuring changes in body posture allows us to investigate the underlying mechanisms in a scenario where children's overt behavior was identical (i.e., there were no differences in how much children helped across conditions). This novel depth sensor imaging measure comes with its own caveats that deserve attention. Changes in posture indicate the valence of an emotional expression rather than being diagnostic of a specific emotion. As a consequence, we cannot interpret the absolute values of posture change across conditions and age groups in terms of "just as happy" or "twice as happy." More research is needed to capture emotions via additional modalities, for example, through measuring children's facial expression (Aknin et al., 2015). On a more theoretical note, the pattern of findings observed in Study 2 limits our conclusion that children at the age of 5 manage a prosocial reputation as opposed to more generally being motivated to complete tasks in the presence of observers. For future research it will be worth asking children about why they completed the respective actions to provide a window into the nature of their strategic concerns.

9 | CONCLUSIONS

People engage in prosocial actions for many different reasons. They might help a needy individual because they feel sympathy for them, or because they experience an inner obligation. Alternatively, they might do so because they realize that helping might not only fulfill someone else's needs, but also their own interests, and so they support others to build and maintain a favorable reputation. The current results demonstrate that strategic motives underlie the prosocial behavior in preschoolers (see Engelmann & Rapp, 2018, for a review). Cognitively, strategic prosociality might be beyond the abilities of young toddlers, as managing one's reputation might require second order mindreading in the form of "I am thinking about what you are thinking about me." Motivationally, young children might not yet have to worry about investing in their reputation via strategic prosociality, as they are (ideally) surrounded by caregivers who provide them with unconditional support. The general hypothesis is that as children's circle of altruism expands to include unrelated peers and adults, maintaining cooperative relationships with those new partners require children to be more strategic in how they allocate their (prosocial) resources.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS STATEMENT

The study was carried out following ethical approval by the Max Planck Institute for Evolutionary Anthropology Child Subjects Committee. Parents were informed about the study and informed written consent was obtained from parents before the beginning of each respective study session.

DATA AVAILABILITY STATEMENT

All our data and analyses scripts are provided on OSF: https://osf.io/7gfkx/.

The scripts used to run the study are provided here: https://github.com/rhepach/Kinect.

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ENDNOTE

[1] Such *tonic* baseline-corrected changes are different from *phasic* baseline-corrected changes where the baseline phase immediately precedes the test phase and consequently a value of "0" refers to the emotional state 'just before' the experimental manipulation.

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