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The Fulfillment of Others' Needs Elevates Children's Body Posture

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Much is known about young children's helping behavior, but little is known about the underlying motivations and emotions involved. In 2 studies we found that 2-year-old children showed positive emotions of similar magnitude—as measured by changes in their postural elevation using depth sensor imaging technology—after they achieved a goal for themselves and after they helped another person achieve her goal. Conversely, children's posture decreased in elevation when their actions did not result in a positive outcome. These results suggest that for young children, working for themselves and helping others are similarly rewarding.

Keywords: young children, prosocial behavior, posture, positive emotion, Kinect

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The foundations of human prosociality are already evident in young children who comfort others (Eisenberg & Miller, 1987; Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992), share resources as well as information (Brownell, Svetlova, & Nichols, 2009; Liszkowski, Carpenter, Striano, & Tomasello, 2006), and fulfill others' instrumental goals (Rheingold, 1982; Warneken & Tomasello, 2006; see also Dunfield, Kuhlmeier, O'Connell, & Kelley, 2011). Moreover, young children go out of their way to help others, for example, giving up a valued resource (Svetlova, Nichols, & Brownell, 2010), interrupting an attractive activity or overcoming physical obstacles (Warneken, Hare, Melis, Hanus, & Tomasello, 2007). Nevertheless, despite all of this work on young children's helping behavior, much less is known about their specific motivations to help and its underlying emotions.

One form of children's prosocial behavior that emerges early in ontogeny at an age of 14 months is instrumental helping, when children intervene to fulfill others' interrupted goal-directed behavior (Warneken & Tomasello, 2007). Being prosocial does not necessarily imply that the behavior needs to be proactive, that is, that children help without any explicit cues for help (Warneken, 2013). Rather, by behaving prosocially children actively facilitate and maintain relationships with other individuals (Tomasello & Vaish, 2013). Furthermore, prosocial behavior can be both voluntary as well as solicited and be driven by multiple underlying motivations (Eisenberg & Spinrad, 2014). Young children's instrumental helping is not facilitated by rewards, such as praise or parental encouragement (Warneken & Tomasello, 2008, 2013). Likewise, children's internal arousal decreases in equal degree both when they help as well as when they see someone else help, suggesting that children are not motivated by a desire to receive credit for helping but rather are genuinely concerned for the welfare of the other (Hepach, Vaish, & Tomasello, 2012; see also Eisenberg & Miller, 1987; Roth-Hanania, Davidov, & Zahn-Waxler, 2011; Vaish, Carpenter, & Tomasello, 2009).

Interestingly, rather than reinforcing helping behavior, extrinsic rewards, such as game tokens, can undermine the motivation to help in children as young as 20 months (Warneken & Tomasello, 2008). This raises the question of why young children carry out helpful behavior at all, even when effort needs to be invested (e.g., Warneken et al., 2007). One possible explanation is that instead of seeking out extrinsic rewards, children find helping itself to be rewarding. Fulfilling a goal for others may result in positive emotions similar to those that children experience and express when achieving goals for themselves (see Heckhausen, 1988).

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Work on this topic is limited and has thus far focused on adults or on children's sharing behavior. After sharing charitably, adults report feeling happier (Dunn, Aknin, & Norton, 2008) and helping behavior such as volunteering increases the long-term well-being of the helper (Dillard, Schiavone, & Brown, 2008). In one observational study, triads of 2- to 4-year-olds were given access to one attractive toy while the adult left the room. For children, actively sharing the toy was accompanied by increased positive affect, as seen in their facial expressions, compared with a baseline period (Lennon & Eisenberg, 1987). In another study, an adult asked 2-year-olds to provide a puppet with a valued resource (crackers). Toddlers expressed increased happiness (via facial expression) when sharing with the puppet, and this effect was more pronounced when it was their own resource (Aknin, Hamlin, & Dunn, 2012). Though interesting, it should be noted that the adult experimenter in Aknin, Hamlin, and Dunn (2012) prompted children to share with the recipient (see also Brownell et al., 2009). The respective motivation of such solicited helping may be different from spontaneous helping behavior (Dunfield et al., 2011; Dunfield, 2014; Knafo, Israel, & Ebstein, 2011; see also Hepach, Vaish, & Tomasello, 2013). Therefore the question remains whether children's spontaneous helping behavior is accompanied by a positive emotion providing a sort of affective reward for helping.

In the current studies we assessed young children's emotions during instrumental helping. We studied children at the age of 2.5 years when prosocial behavior is frequent enough to reliably assess the emotions involved. The central question was whether children would express a positive emotion after helping others similar to the types of positive affect they show after completing tasks for themselves (Heckhausen, 1988). To measure positive affect we assessed changes in upper-body posture, which is an established parameter in adult emotion research. Experiencing a positive emotion or being successful is reflected in more upright gait and posture (e.g., Dael, Mortillaro, & Scherer, 2012; Montepare, Goldstein, & Clausen, 1987; Wallbott, 1998) as well as an expanded or elevated chest (Shiota et al., 2003; Tracy & Robins, 2004). We measured the elevation in children's chest height using novel motion sensor technology (Microsoft© Kinect) to capture children's body movement in a live experimental paradigm.

Young children show characteristic elevation in upper-body posture after succeeding on tasks (Heckhausen, 1988; Lewis, Alessandri, & Sullivan, 1992), displaying an emotion similar to that of pride in adults (Heckhausen, 1987; Shiota, Campos, & Keltner, 2003; Tracy & Robins, 2004). We examined whether children show a similar overall positive emotional response when they help others to achieve an outcome. Thus, we systematically compared children's body posture after helping another person and after having achieved a similar outcome for themselves (vs. after having failed to achieve any goal). Our question was twofold: (a) whether children expressed an equally positive emotion in cases of helping oneself as well as others, and (b) whether the emotion expressed in both of these situations was greater as compared to when no goal was achieved.

In accordance with the guidelines of the Open Science Framework (https://osf.io/hadz3/) we report all the measures analyzed, all the experimental conditions tested, details regarding participant drop-outs, and how we determined the sample sizes. A pilot study was conducted prior to Study 1 with the aim of testing the technical equipment and assessing whether the chest's center could be reliably tracked in 2-year-old children using the Kinect system.

Validation Study

One central assumption underlying the present studies using the Kinect technology is that children's upper-body posture increases when a positively valenced emotion is induced and more so compared with when a negatively valenced emotion is induced. Given that no prior work has employed the Kinect in emotion research to specifically measure positive and negative emotions (see also Hepach, Vaish, & Tomasello, 2015), we carried out an additional study to validate our measure of positive affect. Data collection was finished after Study 1 and Study 2 but we present the validation study before Study 1 to increase the coherence of the paper for the reader. No child participated in more than one study.

Participants

Participants were 12 2.5-year-old children (six girls, age range 29 months to 31 months, 1 day; median age 29 months, 26 days), 12 3.5-year-old children (six girls, age range 41 months, 4 days to 42 months, 28 days; median age 42 months, 12 days), and 12 4.5-year-old children (six girls, age range 53 months to 55 months, 1 day; median age 54 months, 9 days). An additional two children were tested but excluded because they did want to participate. Children were recruited from a database and parents gave informed consent before their child participated in the study.

Materials and Design

The equipment used for the validation study was similar to that of Studies 1 and 2. Children played with a marble run which produced a fun sound if wooden marbles were released down the shoot. In addition, we used boxed containers that contained different types of objects: wooden marbles or dull objects that could not be used to play with the marble run. A Kinect camera was connected to a laptop that recorded children's body movements (see also Procedure section of Study 1, below, for details). An additional camera videotaped the entire test session. During the study, the adult experimenter kneeled down behind a barrier such that the Kinect could not capture her and so accidentally track her posture instead of the child's. Each session consisted of four phases: baseline, reward condition, neutral condition, and no-reward condition. The order of the baseline and neutral condition was the same for all children whereas the order of the reward and no-reward conditions was counterbalanced across participants.

Procedure

The study was run by a female experimenter and each session took place at a kindergarten. At the beginning of the study the adult and the child entered the room and the adult showed the child the marble run. She demonstrated how marbles could be thrown down the shoot to produce a fun sound. She did so twice and subsequently allowed the child to take a turn. Next, both the adult and the child moved to the opposite side of the room (between 3 m and 4 m away from the marble run) and opened the first container to retrieve five dull objects. The adult handed each object to the child and encouraged her to walk toward the marble run and to place each object on a table next to it. The marble run shoot and the table were at a similar height. Given that the Kinect was placed next to the marble run, the system recorded each movement of the child while walking toward the marble run. This was the baseline sequence and five separate baseline measurements were taken (see also Study 1 and Study 2).

Next, the first test trial commenced. At this point the child did not have a wooden marble and could not play with the marble run. The adult suggested to search in a separate container. She encouraged the child to open it and see whether a wooden marble was in it. The crucial manipulation was which type of object the child retrieved. In the reward condition, children found an additional wooden marble to play with. The adult expressed joy and shared her excitement so as to induce a positive mood in participants. In the no-reward condition, children retrieved a dull object which they could not use on the marble run. In this condition the adult expressed disappointment and a sad emotion. In both conditions, children subsequently walked toward the Kinect and a measurement of their posture was taken. In the reward condition they put the wooden marble on the marble run shoot. In the no-reward condition the adult asked the child to place the object on the table next to the marble run (where children had put the other dull objects during the baseline condition). The first test trial was succeeded by a neutral condition. The child walked back to the adult who found a dull object and asked the child to put it next to the marble run. The neutral condition was similar to the baseline condition. The purpose was to have a brief break between the two experimental conditions. Children then participated in a second test trial which was different from the first test trial (e.g., reward condition on the first trial and no-reward condition on the second trial).

Data Analysis

During each session seven measurements were taken, five baseline measurements and one measurement for each test trial (see also Data Analysis sections for Studies 1 and 2). During each measurement we focused on the height of two body joints, the chest's center (upper-body posture) and the hip's center (lower-body posture). During the baseline sequence the average height of each of the two body joints was computed from the five separate movements. Similar to Studies 1 and 2, for each test trial we calculated the change from baseline for the hip and chest body joint. Therefore, each child provided four data points: change in chest height from baseline in the reward condition, change in chest height from baseline in the no-reward condition, change in hip height from baseline in the reward condition, and change in hip height from baseline in the no-reward condition. For each child, we compared the change in posture between the reward and no-reward conditions using Wilcoxon's exact tests with the package "exactRankTests" in R (Hothorn & Hornik, 2015; R Core Team, 2015). This form of the Wilcoxon's test computes exact p values (Mundry & Fischer, 1998). In addition, we provide mean differences in posture as effect size estimates and the respective 95% confidence intervals (following suggestions by Cumming, 2014).

Results

Overall, children showed greater changes in upper-body posture in the reward ($M = -0.003$ m, $SD = 0.01$ m) compared with the no-reward condition ($M = -0.01$ m, $SD = 0.04$ m), $\Delta Median = 0.006$ m, 95% CI [0.0002, 0.01], *Wilcoxon's* $T = 438$, $p = .04$. Crucially, with regards to the change in lower-body posture there was no difference between the reward condition ($M = -0.001$ m, $SD = 0.01$ m) and the no-reward condition ($M = -0.007$ m, $SD = 0.04$ m), $\Delta Median = 0.0004$ m [-0.005, 0.007], $T = 324$, $p = .89$. The results suggest that inducing a positive emotion increased children's upper-body posture more than inducing a negative emotion and provide validation for assessing children's postural changes with the Kinect camera.

Study 1

We presented children with several situations each of which included a container that required them to invest effort to retrieve an object trapped inside. The crucial manipulation was whether the object retrieved was useful for the child to continue an interrupted activity (child-need-fulfilled condition), useless for the child (no-need-fulfilled condition), or useless for the child but useful for an adult in need of help (adult-need-fulfilled condition). We measured the change in children's upper-body body posture (compared with a baseline period at the beginning of the study) after they retrieved the object. Given that this study was the first to use the Kinect to measure children's emotions, we collected additional validation data from adult coders who provided ratings on the valence of the child's emotion as well as the number of smiles children showed after retrieving the object. The prediction was that children would show similar and higher posture elevation in the conditions in which they helped themselves and helped others compared to the condition in which their action was useless for both the experimenter's and the child's goal. This would indicate that children's emotion is equally positive after helping others and themselves, and thus both behaviors are equally rewarding for children.

Method

Participants. Participants were 2.5-year-old children ($n = 48$, 24 girls, age range 29 months; 5 days to 31 months; 5 days; median age 30 months; 3 days). An additional five children were tested but excluded due to equipment failure ($n = 1$), not wanting to participate ($n = 2$), or not providing data for at least two out of three experimental conditions ($n = 2$). Children were recruited from a database and parents gave informed consent before their child participated in the study.

Materials and design. The child played with an apparatus that consisted of a tube (2.41 m) into which she could throw wooden marbles to produce a sound (see Supplemental Figure S1). In addition, three different types of containers were used in the test phase of the study: a tube, house-shaped, and box container (see Supplemental Figure S2). All containers were equipped with egg crate foam pieces tied to a string that had to be pulled out to see the contents of the container. Each container had an opening and the foam was pressed into the opening such that it had to be pulled out with effort. A container could contain a wooden marble, a dull irrelevant plastic piece, or a clothes peg. Furthermore, an adult experimenter (E1) carried out a task that consisted of hanging up pieces of cloth on a line in one corner of the study room (see Supplemental Figure S1 for an overview). To familiarize the child with the containers, a separate tube and house container were used in the familiarization phase of the study.

To measure changes in the child's posture we used a Microsoft© Kinect for PC motion sensor adapter. The Kinect is a camera that provides estimates of skeletal joints, for example, the chest's center, as 3D-point-coordinates on x-,y-, and z-axes in meters (two digits behind the period) from the camera similar to point-light-display techniques (e.g., Atkinson, Dittrich, Gemmell, & Young, 2004). The Kinect was connected to a laptop running Matlab (Version 8.2.0.701; R2013b) as well as the Image Acquisition Toolbox (R2013b). Furthermore, we wrote a script in Matlab that recorded data for analyses. The Kinect was positioned such that the child walked toward it during the study (0.5 m to 5.5 m away from the Kinect).

Participants were tested in a within-subject design with three experimental conditions: child-need-fulfilled (A), no-need-fulfilled (B), and adult-need-fulfilled (C) presented in two identical blocks, for example, A–B–C (Block 1) and A–B–C (Block 2). Therefore, each child saw six test trials. The order of A, B, and C within each block was counterbalanced across participants. The sample size (48) was determined by the number of experimental blocks (six) and by the aim to have 16 children who were first presented with the child-need-fulfilled, no-need-fulfilled, or adult-need-fulfilled condition, respectively. In addition, the test phase was preceded by a familiarization phase that was the same for all participants. Type of container was counterbalanced across trials, that is, a different container in A, B, and C.

Procedure. Parents sat on a chair reading a magazine in one corner of the room and were asked not to engage with their child or to comment on the situation. At the beginning the child was provided with a wooden marble and encouraged to throw it into the tube, to walk to the other end of the tube, and to retrieve the marble to repeat the game (and thus walk back toward the Kinect). During that phase a baseline measure of the child's skeletal joints was taken (see also Data Analysis section). While the child played with the tube, E1 (female experimenter, not blind to the study's hypotheses) started hanging up pieces of cloth. After the baseline measurement was collected, E2 (male experimenter, not blind to the study's hypotheses) attached a box to the end of the tube. Importantly, the wooden marbles now disappeared into the box so that additional marbles were needed to continue with the game.

In the following familiarization phase, the child and E2 retrieved the dull object from a new container. E1 demonstrated that the piece was neither usable for the child's game, nor for her own activity. For one half of the participants, E1 placed the object back on the windowsill. For the second half, she placed it in a bucket just in front of the Kinect. This was the same for all conditions and done to ensure that the child knew that there was a specified location for the dull object. Next, E2 picked up a house container, which the child was encouraged to open. The house contained five clothes pegs and five wooden marbles. E1 continued with her activity and the child used the wooden marbles to continue with her game.

The test phase consisted of six trials that followed a similar structure. Once the child ran out of marbles, E1 directed her attention to the child. In the no-need-fulfilled and adult-need-fulfilled conditions she added that she herself (E1) did not have any pegs to continue her activity. E2 then picked up a container from the windowsill. Both E1 and E2 pretended to struggle with opening the container before putting the container on the floor such that the child could try herself (see supplementary materials for details).

The child now opened the container and either found a wooden marble (child-need-fulfilled condition), a clothes peg (adult-need-fulfilled condition), or the dull irrelevant object (no-need-fulfilled condition). Once the child had retrieved the object, E1 crouched down behind the Kinect. The crucial measurement was taken once the child started walking toward E1 until she stood right in front of her and *before* the adult acknowledged the object. Based on the condition, she then stated one of the following: "*Oh,* (a) *you found that* (in a neutral tone; no-need-fulfilled condition); (b) *you found a marble, now you can continue playing* (happy tone; child-need-fulfilled condition); or (c) *you found a clothes peg, now I can continue*" (happy tone; adult-need-fulfilled condition). The adult's language was standardized across conditions. The height at which the child ended up placing the object was the same in all conditions (approximately 35 cm). Once the child had thrown the marble into the tube (child-need-fulfilled condition), or E1 used the clothes peg (adult-need-fulfilled condition), or the irrelevant object was discarded into the bucket (no-need-fulfilled condition) the next test trial commenced and followed the same structure as above.

After the sixth test trial, the child was given the opportunity to retrieve one last set of wooden marbles from a wooden box. No data were recorded for that trial, given that the purpose was to allow the child to play the game one last time.

Data analysis of posture data.

Preprocessing. Data processing was carried out automatically with a separate script written in Matlab (see supplementary materials for details). For the baseline phase, the individual sequences (movements toward the Kinect) were averaged to result in one overall baseline sequence. To estimate the change in children's upper body posture, we focused on the *y*-coordinate (height) of the chest's center as an indicator of postural expansion and elevation (see also Shiota et al., 2013; Tracy & Robins, 2004 for similar estimates, see Figure 1). The decision to focus on the chest's center was made a priori based on prior work in adults and on the pilot work carried out prior to the study. In addition, we analyzed the *y*-coordinate of the hip center to estimate children's lower body height. Moreover we subtracted the data of the baseline measurement from each test trial resulting in six baseline-corrected data series. The data for each test trial were smoothed using a moving-average filter.

Statistical analyses. Not all participants provided data on every test trial either because the Kinect failed to collect data or participants walked off to the side instead of straight toward the Kinect. For 53 trials out of 288 trials in total (18%) no data could be recorded. We therefore averaged data of the two test trials representing the same condition type, reducing the number of data points to three per participant. Six out of 48 participants (13%) provided data for only two condition types. A child had to provide data for at least two conditions to be included in further analyses (see also Participants section).

The statistical significance of the factor condition was tested through comparing a full generalized linear mixed model (GLMM, Gaussian error distribution) to a reduced model using a likelihood

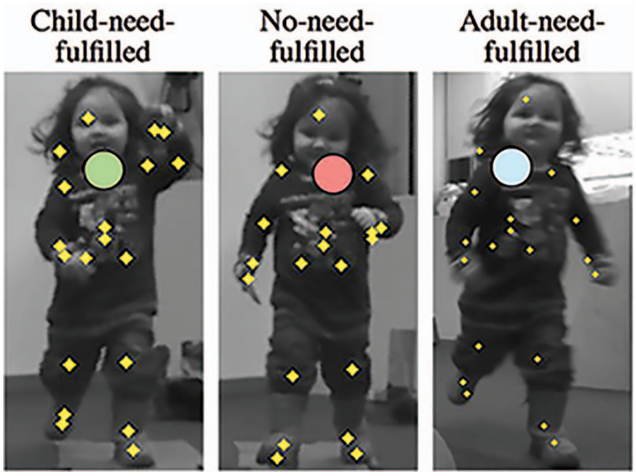

Figure 1. An illustration of the data provided by the Kinect system. A total of 20 body joints are tracked. The joint used for statistical analyses was the chest's center (indicated by the highlighted dot). The authors obtained signed consent from the parents for their child's pictures to be published in this article. See the online article for the color version of this figure.

ratio test (Barr, Levy, Scheepers, & Tily, 2013; Bates, Maechler, Bolker, & Walker, 2014). The full model included the independent factors condition and distance from the Kinect as children walked toward it (z-transformed), the control variables order and gender, as well as a random intercept for subject and random slopes of order, distance, and condition depending on subject (Barr et al., 2013; Schielzeth & Forstmeier, 2009). The reduced model included all of the above factors except condition. The dependent measure was children's change in chest height. In addition, an identical analysis was also carried out with children's change in hip height. Preliminary analyses revealed no interaction effects of condition and distance (see supplementary materials for details).

In sum, a given subject could provide data for six test trials. For each trial we computed both the change in chest height (upper-body posture) as well as hip height (lower-body posture).

Coding.

Valence. Children's overall emotional expression (including the face, body posture, and body movement) during each test trial was coded to ensure that the experimental manipulation influenced children's emotion. Two coders (blind to the study's hypotheses and conditions) rated the emotions for all children and all the trials on the basis of the frame-by-frame recordings of each test trial. Data for individual trials consisted of still-frame images of the sequence as children walked toward the Kinect camera. The exact same data frames were used in the automated posture analysis (see Data Analysis of Posture Data section).

Based on the design of the study, the six test trials were presented to coders in two blocks identical with regards to the counterbalanced order of the three experimental conditions (see Materials and Design section). For a given block, coders were asked to compare the three trials according to how positive the emotion was that the child was experiencing (most positive = 3, least positive = 1; $ICC = .72$) as well as how negative the emotion was that the child was experiencing (most negative ~3, least negative ~1; $ICC = .69$). We included the two valence codings to ensure that the pattern of results observed for the coding of positive affect would be the opposite for the coding of negative affect. Note that coders judged the expressed positive emotion and negative emotions separately. The data were split up into two blocks (A and B) each containing 50% of the data. The coding was blocked for coder 1 as follows: Block A positive–Block B negative–Block B positive–Block A negative. The coding was blocked for coder 2 as follows: Block A positive–Block B negative–Block A negative–Block B positive. We specifically asked coders to focus on how children were experiencing the emotion to tap into children's internal states. Comparing the three trials within each block allowed us to both (a) test the assumption that children in the no-need-fulfilled condition would feel less positive than children in the child-need-fulfilled and adult-need-fulfilled conditions and (b) that children in the no-need-fulfilled condition would feel more negative than children in the child-need-fulfilled and adult-need-fulfilled conditions.

To analyze whether coders' rating differed between experimental conditions we computed two separate GLMMs (Poisson error distribution). The dependent measure for the first model was the rating of each coder for each test trial of how positive the experienced emotion was (from 1 to 3). Note that per child and trial, two ratings (one by each coder) were provided. To control for this repeated measures structure of the statistical model, we included random intercepts for subject, trial block (concatenated information of subject and trial block 1 or 2), trial ID (ranging from 1 to $48 * 6 = 288$), and coder, as well as random slopes for trial number (1 to 6) on subject, and condition (child-need-fulfilled, adult-need-fulfilled, and no-need-fulfilled; dummy coded) on subject. The independent factors were condition, gender, and trial number. The statistical significance of each independent factor was established with likelihood ratio tests comparing a full model to a reduced model without the respective factor. The second model was identical to the first except that the dependent measure was the rating of children's expressed negative emotion.

Number of smiles. To support the valence codings, which are relative assessments comparing the three experimental conditions, we asked the same adult coders to count the number of frames, for each child and test trial, on which the child showed a smile. This number was then divided by the total number of frames on a given trial to arrive at a ratio score. This was an absolute measure of the degree of positive affect within each trial. A frame was coded as containing a smile if one of the following criteria applied: muscle tension around the mouth (raised cheeks), muscle tension around the eyes (laugh lines), or open mouth and wide eyes (laughing). Agreement among the coders as to the number of frames with a smile per child was high ($ICC = .88$). To analyze whether coders' rating differed between experimental conditions we ran a GLMM (binomial distribution error distribution) with the dependent measure being a binary coded variable ("1" if a child showed a smile on more than 50% of the trial; all others "0"). The structure of the model was identical to that of the models investigating the valence within each block and hence the statistical significance of each independent factor was established with likelihood ratio tests comparing a full model to a reduced model without the respective factor.

To follow-up on the overall statistical analyses, we carried out post hoc planned comparisons. For the posture data we calculated paired sample t tests in a 50 cm window (five out of 20 distance bins, for the values averaged over both trials for a condition) when children were halfway between their starting and end point as they were walking toward the camera. For the three rating scores we calculated Wilcoxon's exact tests with exact *p* values (Hothorn & Hornik, 2015; Mundry & Fischer, 1998). The statistical significance value was Bonferroni-corrected for the number of planned comparisons (three) per dependent measure ($\alpha = .05/3 = 0.02$). We calculated mean differences as effect size estimates and computed the respective 95% confidence intervals (following suggestions by Cumming, 2014). The effect sizes for each model comparison were estimated by dividing the variance of the fixed factors by the sum of the variance of the fixed factors and the residual variance. This approach was adapted from Nakagawa and Schielzeth (2013) to arrive at an effect size estimate comparable to the r^2 of linear regressions.

Results

Body posture. Children's change in chest height varied significantly between experimental conditions, GLMM: $\chi^2(2) = 9.27$, $p = .0097$, $r^2 = .1$ (see Figure 2), with no effects of distance, $\chi^2(1) = 1.72$, $p = .19$; order, $\chi^2(1) = 0.02$, $p = .88$; or gender, $\chi^2(1) = 0.0002$, $p = .99$. On the other hand, there was no significant effect of condition on the change in children's hip height; GLMM: $\chi^2(2) = 3.13$, $p = .21$ (see Figure 2). This suggested that the change in children's chest height was not an effect of their bodies as a whole being more elevated (e.g., through skipping while moving toward the Kinect), but rather the postural change was specific to their upper body. Additional analyses suggested no main effect of order when including all six test trials and no interaction of order and condition. Likewise, analyses of the first trial on which children achieved a positive outcome yielded the same effect of condition on children's chest height as the analyses of all the test trials combined (see supplementary materials for details).

Further focused post hoc analyses revealed that, halfway toward the adult, children's chest was more elevated in the child-need-fulfilled ($M = 0.02$ m, $SD = 0.04$ m) compared with the no-need-fulfilled condition ($M = 0.003$ m $SD = 0.03$ m), $\Delta Mean = 0.01$ m, 95% CI [0.004 0.03], $t(43) = 2.84$, $p = .007$. Likewise, children's chest was more elevated in the adult-need-fulfilled ($M = 0.01$ m, $SD = 0.03$ m) compared with the no-need-fulfilled condition, $\Delta Mean = 0.009$ m [0.001 0.02], $t(42) = 2.31$, $p = .03$. On the other hand, there was no difference between the child-need-fulfilled and adult-need-fulfilled conditions, $\Delta Mean = 0.006$ m [−0.003 0.02], $t(44) = 1.44$, $p = .16$. This was not the case in the control analyses for the change in children's hip height. Here the

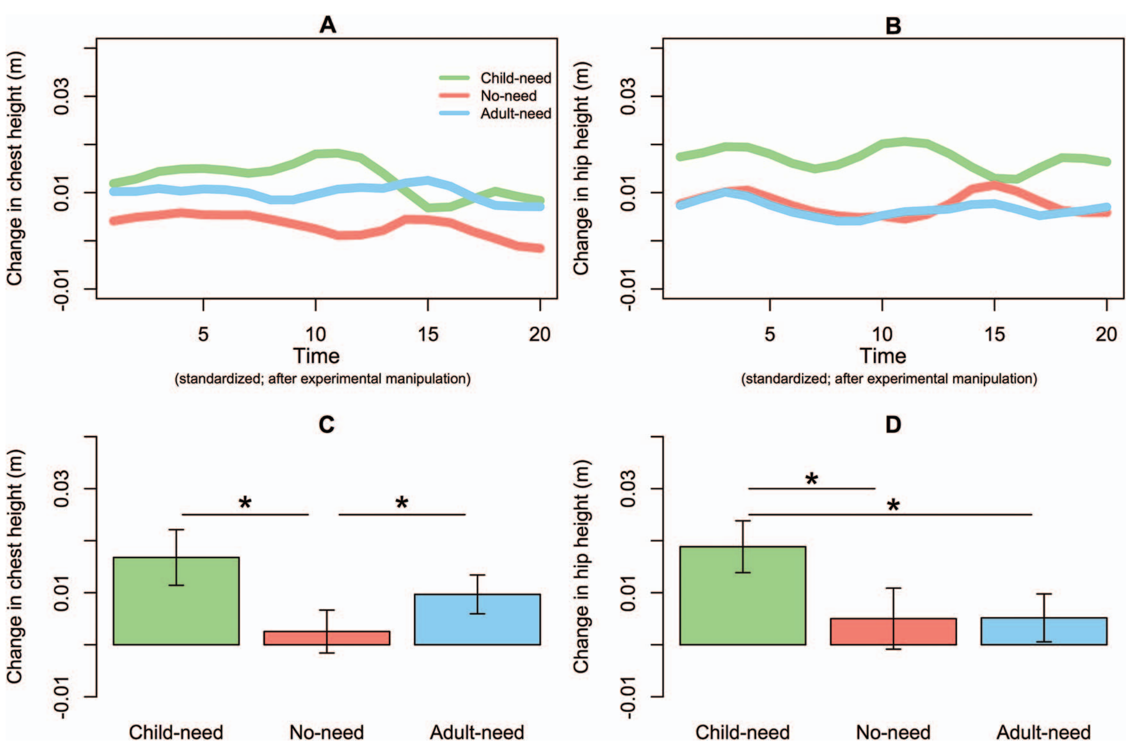

Figure 2. Study 1. (A and B) The main analyses examined the trajectory of the change of posture height across time. (A) The height of children's upper body posture (the chest's center) differed between experimental conditions. (B) The height of children's lower body posture (hip center) did not differ between experimental conditions. (C and D) Supporting post hoc analyses focused on the center time window (time windows 8 to 12). (C) This revealed that children's upper body posture was more elevated in the child-need-fulfilled and adult-need-fulfilled conditions compared to the no-need-fulfilled condition. (D) Within the focused time window, children's lower body posture was more elevated in the child-need-fulfilled condition compared to the no-need-fulfilled and adult-need-fulfilled conditions. Note that this latter analysis is merely illustrative given that, overall, there was no effect of condition on children's hip height across the entire trial duration. Lines represent standard error bars. * $p < .05$. See the online article for the color version of this figure.

height in the child-need-fulfilled condition ($M = 0.02$ m, $SD = 0.03$ m) was greater compared with the no-need-fulfilled ($M = 0.005$ m, $SD = 0.04$ m), $\Delta Mean = 0.01$ m [0.002 0.03], $t(43) = 2.3$, $p = .03$. Similarly, the height in the child-need-fulfilled condition was greater compared to the adult-need-fulfilled ($M = 0.005$ m, $SD = 0.03$ m), $\Delta Mean = 0.01$ m [0.003 0.02], $t(44) = 2.59$, $p = .01$. There was no difference between children's hip height between the no-need-fulfilled and adult-need-fulfilled condition, $\Delta Mean = 0.00006$ m [−0.02 0.02], $t(42) = 0.008$, $p = .99$ (see Figure 2 and Table 1 for descriptive statistics).

Valence. Children's expression of positive emotion varied between the experimental conditions, GLMM: $\chi^2(2) = 27.16$, $p < .001$, $r^2 = .04$ (see Figure 3). Children expressed more positive emotion in the child-need-fulfilled ($M = 2.41$, $SD = 0.59$) compared to the no-need-fulfilled ($M = 1.52$, $SD = 0.54$) condition, $\Delta Median = 1.19$, 95% CI [0.75 1.5], *Wilcoxon's* $T = 704$, $p < .001$, CI [0.75 1.5], and in the adult-need-fulfilled ($M = 2.07$, $SD = 0.61$) compared with the no-need-fulfilled condition, $\Delta Median = 0.69$ [0.25 1.13], $T = 592$, $p < .001$. In addition, there was a difference between the child-need-fulfilled and adult-need-fulfilled condition but this did not reach statistical significance after controlling for multiple comparisons (adjusted $\alpha = .02$), $\Delta Median = 0.44$ [0 1], $T = 466$, $p = .04$. There were no effects of gender, $\chi^2(1) < 0.001$, $p = .999$, or trial number, $\chi^2(1) = 0.03$, $p = .86$.

Similarly, children's expression of negative emotion varied between the experimental conditions, GLMM: $\chi^2(2) = 19.34$, $p < .001$, $r^2 = .02$ (see Figure 3). Children expressed more negative emotion in the no-need-fulfilled ($M = 2.38$, $SD = 0.58$) compared to the child-need-fulfilled ($M = 1.67$, $SD = 0.58$) condition, $\Delta Median = 0.94$ [0.38 1.25], $T = 689$, $p < .001$, and compared to the adult-need-fulfilled condition ($M = 1.95$, $SD = 0.59$), $\Delta Median = 0.57$ [0 1], $T = 595$, $p = .01$. In addition, there was no difference between the child-need-fulfilled and adult-need-fulfilled condition, $\Delta Median = -0.31$ [−.88 1.3], $T = 210$, $p = .08$. There were no effects of gender, $\chi^2(1) < 0.001$, $p = .997$, or trial number, $\chi^2(1) = 0.05$, $p = .82$.

Number of smiles. The ratio of smiles children showed during a test trial (more than 50% of the time or not) varied between the experimental conditions, GLMM: $\chi^2(2) = 6.22$, $p = .04$, $r^2 = .78$ (see Figure 3). Children showed more smiles in the child-need-fulfilled ($M = 0.55$, $SD = 0.34$) compared with the no-need-fulfilled ($M = 0.22$, $SD = 0.29$) condition, $\Delta Median = 0.33$ [0.24 0.43], $T = 956$, $p < .001$, and in the adult-need-fulfilled ($M = 0.44$, $SD = 0.34$) compared to the no-need-fulfilled condition, $\Delta Median = 0.2$ [0.1 0.3], $T = 826$, $p < .001$. In addition, there was also a difference between the child-need-fulfilled and adult-need-fulfilled condition, $\Delta Median = 0.14$ [0.04 0.21], $T = 777$, $p = .003$. There were no effects of gender, $\chi^2(1) = 0.001$, $p = .97$, or trial number, $\chi^2(1) < 0.001$, $p = .98$.

Discussion

The aim of this study was to investigate the emotion that children express after helping others achieve their instrumental goals. Children's upper-body posture was more elevated both after they achieved a goal for themselves as well as after helping another person. This was not the case when children's effort did not result in a positive outcome for either. These results suggest that children find fulfilling their own and others' instrumental needs similarly enjoyable compared to not fulfilling any need. This interpretation of postural elevation is supported by independent ratings of adult coders who judged children's emotion to be more positive and the number of smiles to be greater in both the child-need-fulfilled and adult-need-fulfilled conditions compared to the no-need-fulfilled condition. Crucially, the reverse pattern emerged with regards to children's negative affect. Children in the no-need-fulfilled condition were rated as expressing the most negative emotion and showed the lowest number of smiles.

The comparison of the three dependent measures, that is, posture, overall valence rating, and number of smiles, suggests that the difference between the own-goal and help conditions is more nuanced than their respective contrast to the no-need-fulfilled condition. While the upper-body posture measure did not show a statistically significant difference between the adult-need-fulfilled and child-need-fulfilled conditions, coders rated children as showing more smiles in the child-need-fulfilled compared with the adult-need-fulfilled condition. Likewise, children in the child-need-fulfilled condition were rated as experiencing more positive affect than in the adult-need-fulfilled condition (though this difference was at a statistical trend). Even though the degree of posture elevation and positive affect may be similar after children achieved an outcome for themselves and others, this does not imply that a single process underlies the expression of positive emotions in both situations. Children may experience the child-need-fulfilled and adult-need-fulfilled conditions differently. The degree of positive emotion in the adult-need-fulfilled condition is less pronounced because it is still someone else's goal that is being completed. In the child-need-fulfilled condition children additionally get to carry out the task which they likely find attractive whereas in the adult-need-fulfilled condition they see an adult complete an action. In addition, it is important to note that the adult-need-fulfilled condition is at the same time also disappointing because the object children found did not allow them to continue their game and this in turn may result in fewer smiles compared to the child-need-fulfilled condition.

Table 1
Descriptive Statistics for the Change in Chest Height for Study 1

Condition	Mean	Median	Variance	Max	Min
Child-need-fulfilled condition	.02 m	.008 m	.001	.15 m	−.07 m
No-need-fulfilled condition	.001 m	.003 m	.0008	.07 m	−.08 m
Adult-need-fulfilled condition	.01 m	.009 m	.0009	.09 m	−.07 m
Total	.009 m	.008 m	.001	.15 m	−.08 m

Note. Within each condition, a child could provide up to two data points.

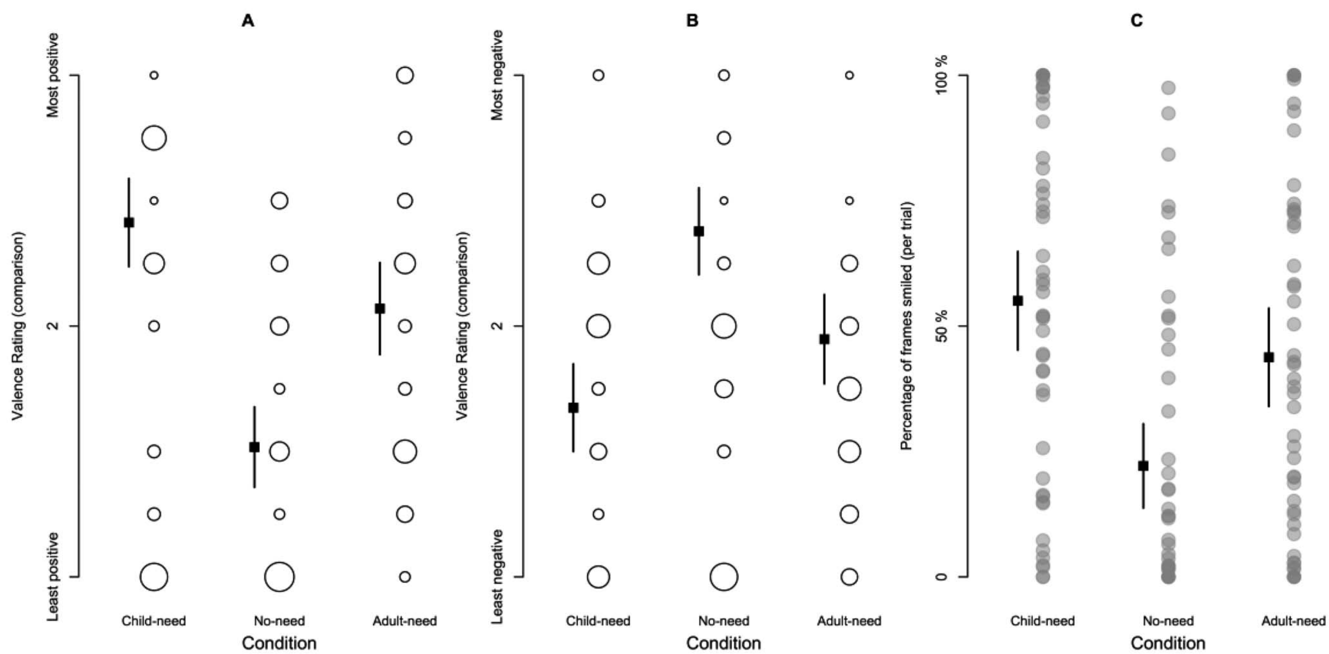

Figure 3. The results from the emotion codings for children's emotional expression during the test trials of Study 1. (A and B) The ratings of the valence of children's emotion are based on the direct comparison of the three trials within an experimental block. The size of the dots represents the number of observations for a particular rating value. (C) Summary of coders' ratings regarding the number of smiles a child showed during each trial. The values reflect ratio scores, that is, number of frames smiled/total number of frames of the respective trial. For each condition the 95% confidence intervals as well as the mean are provided on the left hand side of the data.

The results from Study 1 raised an important question: Is children's positive affect in the help condition a consequence of them having *achieved* a helpful outcome for the adult or is it the fact that the adult was helped that triggered their positive emotion? Instead of deriving satisfaction from the helping per se, the positive emotion in the help condition may be a kind of cognitive dissonance reduction or effort justification (e.g., Alessandri, Darcheville, & Zentall, 2008; Benozio & Diesendruck, 2015) because children actively contributed and invested effort into opening the box to achieve the outcome for the adult. We addressed this question in a second study that additionally provided an opportunity to replicate the effect on children's posture with a new group of subjects.

Study 2

Children in Study 2 were presented with similar situations as those who participated in Study 1. However, this time we used two different types of containers, one of which was identical to Study 1 and required effort to be opened (effort) and a second type where merely a piece of cloth had to be lifted to retrieve the object (no effort). In the no-effort condition children also had to carry out an action (instead of merely observing a helpful behavior) so as to make their movement and posture more comparable to the effort condition.

Similar to Study 1 we additionally manipulated the outcome which was either helpful for the adult (positive outcome) or not (negative outcome). We measured the change in children's upper-body posture and gathered the same ratings regarding valence and number of smiles from two adult coders (who had not coded the data of Study 1). The hypotheses were as follows: If children's positive emotion after helping is driven by seeing an adult be helped, then there should be a main effect of outcome regardless of whether children actively contributed and invested effort to retrieve the object. On the other hand if the positive affect after helping is a consequence of both the outcome and the amount of effort involved then the two independent factors should interact (though we had no a priori hypotheses with regards to the direction of the effect).

Method

Participants. Participants were 2.5-year-old children (n = 48, 24 girls, age range 29 months; 4 days to 31 months; 5 days; median age 30 months; 16 days). An additional four children were tested but excluded due to equipment failure (n = 1), not wanting to participate (n = 2), or not providing data for both experimental conditions (n = 2, see details below). Children were recruited from a database and parents gave informed consent before their child participated in the study.

Materials and design. Children played with the same apparatus from Study 1. Two types of containers were used in the test phase: a tube and box. Depending on the experimental condition, the containers were either easy (no-effort condition) or difficult (effort condition) to open. Similar to Study 1 each container had an opening and egg crate foam was pressed into the opening such that it had to be pulled out with effort. This made it more difficult to open the container in the effort condition. The effort needed in the respective condition in Study 2 was similar to the effort needed in all experimental conditions in Study 1. The object children could retrieve from the containers was either helpful for the adult (e.g., an additional clothes peg; positive-outcome condition) or not helpful (dull object; negative-outcome condition). Participants were tested in a mixed design with four experimental conditions: effort/positive-outcome, effort/negative-outcome, no-effort/positive-outcome, and no-effort/negative-outcome. Effort was a between-subjects factor, whereas outcome was a within-subjects factor. Each child was presented with four test trials of two identical blocks (two trials each) within which the order of positive outcome (clothes peg) or negative outcome (dull object) was counterbalanced. Between Trials 2 and 3, we presented children with a "motivation" trial in which they always obtained two wooden marbles for themselves. Two wooden cases, one with a picture of a clothes peg and the other with a picture of the dull object, were placed next to one another at the location where children had to throw their wooden marbles into the tube. This ensured that the height of the endpoints for both the helpful and nonhelpful objects was identical. The position of the cases (i.e., left and right of the tube opening) was counterbalanced across children.

Procedure. Similar to Study 1, children were introduced to two containers in the familiarization phase. In the no-effort condition, both containers (a tube and a box) were easy to open. In the effort condition, physical effort had to be exerted to open the two containers. On the first familiarization trial, children retrieved the dull object and E1 (not blind to study's hypotheses) encouraged them to put it in the case with the picture of the dull object. On the second familiarization trial, children retrieved the clothes peg and were encouraged not to put it into E1's hand but rather into the case with a picture of a clothes peg.

The test phase began with the child running out of marbles with which to play and E1 not having any clothes pegs to continue her task. They both called E2 (not blind to study's hypotheses), who picked up the first container (either tube or box) from the windowsill. In the no-effort condition, the container was easy to open and E2 took out the object (which was wrapped in a piece of paper such that the object itself could not be seen; similar to the effort condition), remarked that there was something in the container, and then placed the wrapped object back into the container. He then handed the container to E1, who also noted that there was something in the container. E1 then encouraged the child to see what was in the container and placed the container on the floor. In the effort condition, both E2 and E1 pretended that they were not able to open the container because their hands did not fit into the container's opening. Furthermore, a piece of foam had to be removed with physical effort in order to retrieve the object. The openings were just big enough for children's hands to fit in and the foam pieces ensured that children could only retrieve the container's content with enough effort and perseverance. In the negative-outcome condition children found the dull object, whereas in the positive-outcome condition they found a clothes peg. Similar to Study 1, children were encouraged to walk toward E1 (who was standing behind the Kinect camera) before they could put the object into the case. After the last test trial, children were given the opportunity to retrieve another set of wooden marbles from a box.

Data analysis of posture data. The preprocessing was identical to that of Study 1. The data for each test were baseline-corrected and each child could provide data for four test trials. For 32 trials out of 240 trials in total (13%) no data could be recorded. We therefore averaged data for trials of the same kind, reducing the number of data points to two per participant. Therefore, each child provided two baseline-corrected data points for no-help and help (see also Participants section). The statistical significance of the factor outcome (helpful or nonhelpful) and task difficulty (effort or no-effort) was tested through comparing a full generalized linear mixed model (GLMM, Gaussian error distribution) with a reduced model using a likelihood ratio test. The full model included the interactions of outcome and distance (z-transformed) as well as the interaction of task difficulty and distance along with the control variables order within a block (one to two) and gender. In addition, the analysis included a random intercept for subject and random slopes of order, distance, and effort depending on subject. The reduced model included all of the above factors except that outcome, task difficulty, and distance were entered as main effects. The dependent measure was children's change in chest height. In addition, an identical analysis was also carried out with children's change in hip height. Preliminary analyses revealed no three-way-interaction of outcome, task difficulty, and distance, and no interaction of outcome and task difficulty (see supplementary materials for details and Figure 4). Furthermore, we carried out the same post hoc analyses as we did for Study 1.

Coding. Two adults coders (blind to the study's hypotheses and conditions) coded the entire data set with respect to the experienced positive valence ($ICC = .84$), negative valence ($ICC = .71$), and the number of smiles a child displayed during a given test trial ($ICC = .86$). The task was identical to that of Study 1. Given that each block consisted of two trials, and to increase the number of trials which coders could base a relative judgment of positive and negative valence on, each coder was presented with all four test trials of a child and hence ratings ranged from 1 to 4 (given that there were four trials in total). The data were split up into two blocks each containing 50% of the data (Blocks A and B). The coding was blocked for Coder 1 as follows: (a) Block A positive, (b) Block B negative, (c) Block B positive, and (d) Block A negative. The coding was blocked for Coder 2 as follows: (a) Block A positive, (b) Block B negative, (c) Block A negative, (d) Block B positive.

The statistical models analyzing the two valence ratings and the smiles ratings paralleled those of Study 1 with two important differences: The two conditions (effort and outcome) were entered as main effects and a random slope was entered for outcome on subject (given that effort was a between-subjects factor). Similar to the posture data, we carried out the same post hoc analyses as we did for Study 1.

Results

Body posture. Children's change in chest height varied significantly between conditions, GLMM: $\chi^2(2) = 7.19$, $p = .03$, $r^2 = .14$ (see Figure 4 and Table 2 for descriptive statistics). More

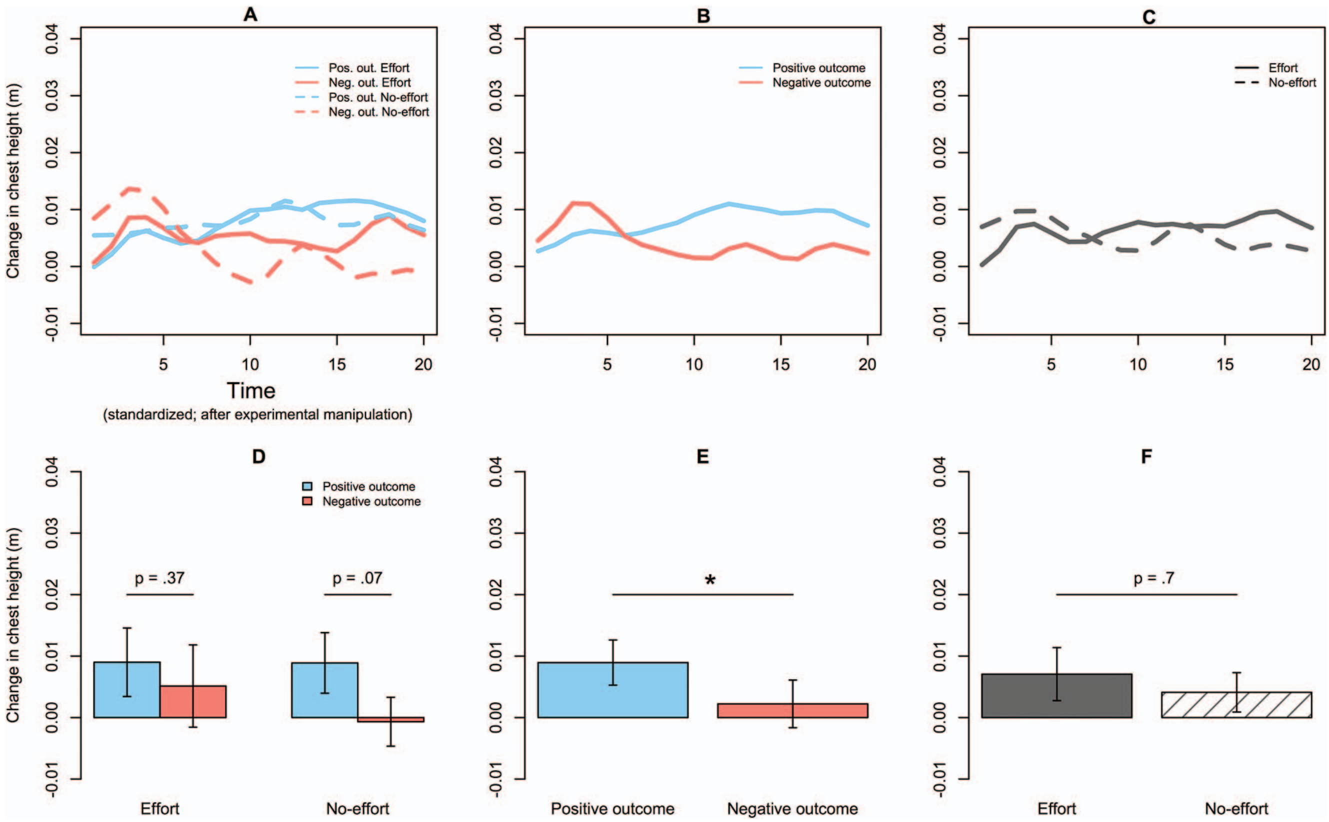

Figure 4. Study 2. (A–C). The main analyses examined the trajectory of the change of posture height across time. The top three panels illustrate the time course of the average change in chest height across the distance (standardized to 20 units) that children walked away from the task immediately after they had obtained the positive or negative outcome. (A). The change in children's upper body height, that is, the chest's center, as a function of effort and outcome. (B). The change in children's upper body height as a function of outcome. (C). The change in children's upper body height as a function of effort. (D–F). The bottom three panels illustrated the focused analyses within the time window at the average distance between starting and stopping point (time windows 8 to 12). (D). There was no interaction of outcome and task effort on the change in children's posture. (E). Children's upper body elevation differed between positive and negative outcome. (F). There was no difference in children's upper body height depending on whether they invested effort or not into retrieving an object. Lines represent standard error bars. See the online article for the color version of this figure.

specifically, there was a significant interaction of outcome and distance, $\chi^2(1) = 6.48$, $p = .011$, indicating that the height of children's upper body as they walked toward the recipient increased over time after they retrieved the helpful object ($\beta = 0.0003$) whereas this increase was less pronounced after retrieving the nonhelpful object ($\beta = -0.0003$). There was no effect of order, $\chi^2(1) = 0.98$, $p = .32$, or gender, $\chi^2(1) = 0.62$, $p = .43$, and there was also no interaction of effort and distance, $\chi^2(1) = 0.73$, $p = .39$ (see Figure 4). In addition, there was no significant effect of conditions on children's lower body (hip height); GLMM: $\chi^2(2) = 0.22$, $p = .9$. This suggested that the change in children's chest height was not an effect of their bodies as a whole being more elevated, but rather a postural change specific to their upper body.

On average, halfway to the adult, children's chest was more elevated after they retrieved the helpful object ($M = 0.009$ m,

Table 2
Descriptive Statistics for the Change in Chest Height for Study 2

Condition	Mean	Median	Variance	Max	Min
No-effort/Positive outcome condition	.009 m	.007 m	.0006	.07 m	−.05 m
No-effort/Negative outcome condition	−.0007 m	.005 m	.0004	.04 m	−.04 m
Effort/Positive outcome condition	.009 m	.01 m	.0007	.06 m	−.07 m
Effort/Negative outcome condition	.005 m	.009 m	.001	.07 m	−.07 m
Total	.006 m	.007 m	.0007	.07 m	−.07 m

SD = 0.03 m) compared with the nonhelpful object (*M* = 0.002 m, *SD* = 0.03 m), Δ*Mean* = 0.009 m, 95% CI [0.0002 0.01], $t(47) = 2.07$, $p = .04$ (see Figure 4). On the other hand there was no difference in children's upper body height after they had to invest effort (*M* = 0.007 m, *SD* = 0.03 m) compared with when the object could be retrieved without effort (*M* = 0.004 m, *SD* = 0.02 m), Δ*Mean* = 0.003 m, 95% CI [−0.01 0.01], $t(47) = 0.51$, $p = .61$ (see Figure 4).

Valence. Children's expression of positive emotion varied between the outcome of their action, GLMM: $\chi^2(1) = 14.67$, $p < .001$, $r^2 = .03$ (see Figure 5). Children expressed more positive emotion when their action benefitted the adult (*M* = 3.03, *SD* = 0.53) compared with the no-help (*M* = 1.97, *SD* = 0.53) condition, Δ*Median* = 1.13, 95% CI [0.5 1.75], *Wilcoxon's T* = 418, $p < .001$. There were no effects of effort, $\chi^2(1) < .001$, $p = .996$; gender, $\chi^2(1) < .001$, $p = .99$; or trial number, $\chi^2(1) = .96$, $p = .33$. Similarly, children's expression of negative emotion varied between the outcome of their action, GLMM: $\chi^2(1) = 14.58$, $p < .001$, $r^2 = .03$ (see Figure 5). Children expressed more negative emotion when the adult was not helped (*M* = 2.93, *SD* = 0.49) compared with when the adult was helped (*M* = 2.07, *SD* = 0.49), Δ*Median* = 1.13, 95% CI [0.5 1.55], $T = 318$, $p < .001$. There were no effects of task difficulty, $\chi^2(1) < .001$, $p = .99$; gender, $\chi^2(1) < .001$, $p = .98$; or trial number, $\chi^2(1) = 2.48$, $p = .12$.

Number of smiles. The number of smiles children showed during a test trial did not vary as a factor of whether the adult was helped or not, $\chi^2(1) = .03$, $p = .87$, $r^2 = .01$; task difficulty, $\chi^2(1) = .04$, $p = .84$; gender, $\chi^2(1) = .03$, $p = .87$; or trial number, $\chi^2(1) = .002$, $p = .97$.

General Discussion

In the present studies, young children expressed a positive emotion after helping another person, and this emotion was similar to that expressed after they achieved a goal for themselves. More specifically, children's upper-body was more elevated immediately after their action benefitted an adult needing help or themselves. Crucially, this was not the case when their actions did not result in a positive outcome for anyone. In the first study we found that children's positive emotion after helping was more similar to when they achieved a goal for themselves than when their actions did not fulfill any need. In addition to children's posture being more elevated, they showed more smiles, more overall positive affect, and less overall negative affect when benefitting others and themselves compared to a situation where neither was helped. In the second study we replicated the effect of Study 1 that helping increased children's upper-body posture. Similar to Study 1, children were rated as experiencing a more positive emotion after helping compared to the no-help conditions. It is important to note that in Study 2 the analysis of children's smiles did not reveal a significant difference between conditions although the overall pattern was similar to that of the valence ratings. This may indicate that measuring the number of children's smiles captures a different aspect of emotion than posture changes and ratings of children's overall affect. In addition, in the second study we found that varying the degree of effort children had to invest did not affect their postural elevation. It is possible that children in Study 2 did not view the effort task as indeed being effortful. Nevertheless, the crucial finding was that children's body posture increased even in

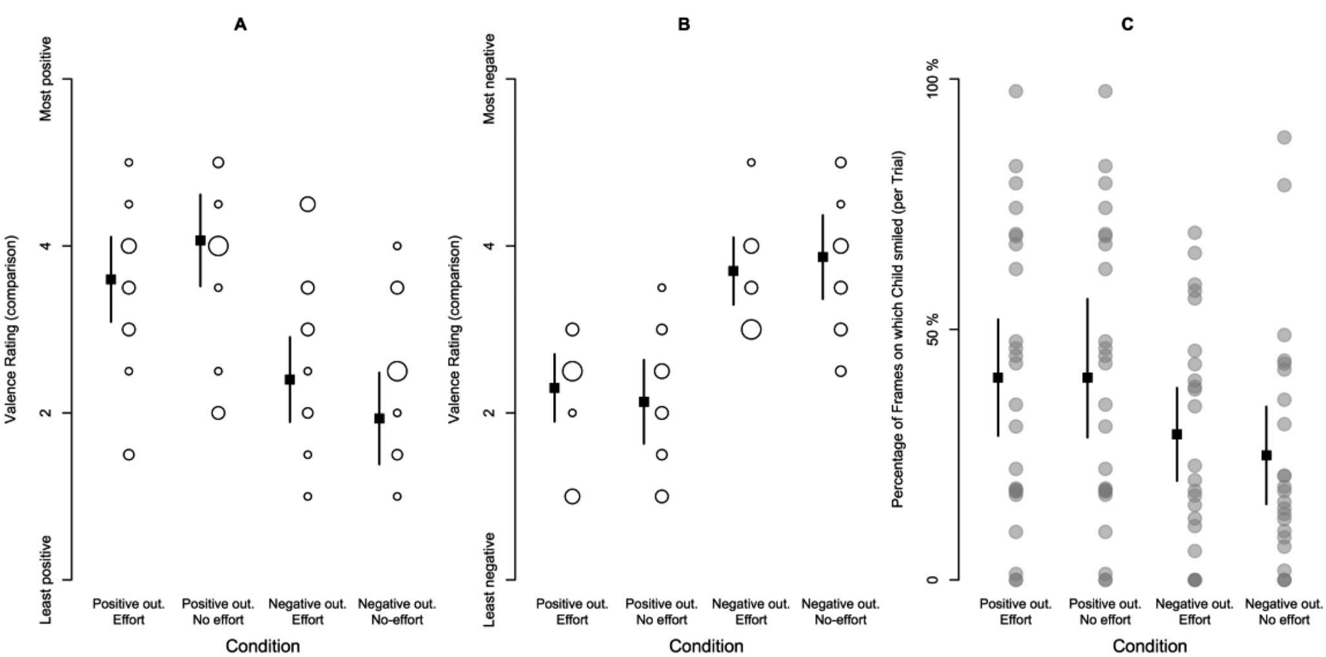

Figure 5. The results from the emotion codings for children's emotional expression during the test trials of Study 2. For each condition the 95% confidence intervals as well as the mean are provided on the left hand side of the data. (A and B). The ratings of the valence of children's emotion are based on the direct comparison of the three trials within an experimental block. The size of the dots represents the number of observations for a particular rating value. (C). Summary of ratings regarding the number of smiles that children showed during each condition.

situations where they contributed little to no effort in achieving the goal for the adult. What mattered was whether or not the person in need was helped.

These findings are in line with previous work showing that children's internal arousal increases to seeing others in need and decreases both when they themselves and someone else provides the help (Hepach et al., 2012). However while such documented changes in arousal are indicative of what motivated children to help, the present results further suggest that seeing others achieve their goals is positively rewarding to a similar degree as fulfilling one's own needs. An interesting avenue for future research would be to combine measures of internal arousal (to measure the intensity of a motivation) with measures of posture (measuring the valence) to investigate whether a decrease in arousal results in greater positive emotion. Together with findings that parental encouragement does not influence toddlers' instrumental helping at the age of two (Warneken & Tomasello, 2013) and that their motivation does not stem from wanting to actively provide the help themselves (Hepach et al., 2012) the positive emotions expressed in the present helping conditions are unlikely the sole result of wanting to socially engage with an adult. Toddlers are motivated to help others even when they cannot get credit for it. It is possible that children in the present studies feel positively in the child-need-fulfilled and adult-need-fulfilled conditions because a functional outcome in the world was achieved. The question whether children view retrieving an object for others and themselves as equally functional and emotionally positive was part of the empirical question we asked. However, it is an interesting question for future research to specify and further investigate whether achieving functional outcomes that do not help either themselves or someone else also result in a positive emotion.

By including a crucial comparison condition we found that children's positive expression was more similar when they achieved a desirable outcome for themselves and when their efforts benefitted another person compared to when their actions did not fulfil any need. Children in the present studies found completing their own goals and fulfilling the needs of others as being similarly positive. This suggests that children's emotions are tied to the fulfillment of others' needs. These results complement findings of similar-aged children showing that helping is intrinsically motivated by a sympathetic concern for another's need (Eisenberg & Miller, 1987; Hepach et al., 2012; Vaish, Carpenter, & Tomasello, 2009; Warneken & Tomasello, 2008; Zahn-Waxler et al., 1992; see also Hepach, Vaish, & Tomasello, 2013). Whereas previous studies focused on the emotions and motivations that trigger helping, the present results suggest that helping others—even at some cost—in turn results in a positive emotion that potentially reinforces future helping behavior. This could aid in explaining why children sometimes go out of their way to spontaneously help others (Svetlova et al., 2010; Warneken et al., 2007). Extrinsic rewards, such as social praise, may not have an influence on children's instrumental helping (e.g., Warneken & Tomasello, 2008) because children find the behavior of aiding another person itself rewarding. Future research could explore the emotions that follow from children's helping in different contexts given that prosocial behavior at home is influenced by praise and encouragement from caregivers (Dahl, 2015; Pettygrove, Hammond, Karahuta, Waugh, & Brownell, 2013; Waugh, Brownell, & Pollock, 2015).

There are three relevant points to highlight that impact the general conclusion to be drawn from the present results about children's prosociality. In comparison with previous work, children in the current studies did not have to decide whether or not they wanted to help prior to opening the containers (with or without effort). Instead, in the help (or adult-need-fulfilled) conditions of both studies, children "found out" after opening the container whether their action had produced an object that could serve their own needs or help the recipient. This is different from children actively deciding to provide help. We decided in favor of the current design to rule out that a positive emotion in the help (adult-need-fulfilled) condition could be the result of successfully carrying out an intended action (regardless of its outcome). That is, children who decide to help have two reasons to experience a positive emotion: the outcome for the adult and the completion of an intended action. In the present studies children continued to express a positive emotion in the help (adult-need-fulfilled) conditions despite the fact that their initial intention may have been to retrieve an object for themselves. Based on these findings, we propose that children would also show a positive emotion in more prototypical helping situations in which they both initially intended and succeeded in helping another person, but more research is needed to clarify this relation.

The second relevant point to note is the timing of the measurement in the current studies. Children's posture was measured after they retrieved the object and as they were walking toward the adult and their game. This is after they knew that they could help but before they saw the adult complete her action. In this sense it is a measure in anticipation of helping (or completing one's own action) thus ruling out that children's positive emotion is a consequence of seeing actions completed. An interesting question for future research is, when children actively decide to help, do they show a positive emotion even before they engage in the helping behavior?

Finally, our conclusion based on the role of effort in Study 2 is tentative given that we did not find an effect of effort. Our aim was to reduce the amount of active contribution that children make in helping the adult thus making the results more comparable to previous work where children merely saw an adult being helped (Hepach et al., 2012). Nevertheless, the role of effort does give rise to interesting future research questions. Is it more rewarding for children to go out of their way to help others? This is comparable with more costly forms of helping such as children sharing with others (Aknin et al., 2012; Brownell et al., 2009; Lennon & Eisenberg, 1987). On the other hand it is possible that children show more positive emotion when they achieve a goal for others with little effort—thereby acting efficiently (F. Warneken, personal communication, July 4, 2014). This is only one example of the possibilities for future research to investigate.

In the present studies we focused on children's chest height given that it is an established marker of positive affect in the adult literature (Dael et al., 2012; Montepare et al., 1987; Wallbott, 1998). Interestingly, the postural elevation and expansion may provide a communicative signal. Indeed, the emotional expression we see in the present study may represent a precursor to the pride display of expertise and skill in adults (e.g., Draghi-Lorenz, Reddy, & Costall, 2001; Tracy & Robins, 2004). However, the present studies did not directly assess the postural expression of pride. Indeed, the complex social emotion of pride consists of several behavioral markers, including head tilt and characteristic arm postures (Tracy & Robins, 2007). Still, in both of our studies the coders' ratings did support the conclusion that the emotion children experience after helping is similarly positive as after achieving goals for themselves. More research is needed to further investigate the ontogeny of positive emotional expressions such as pride but also negative emotions, as well as to investigate whether the Kinect system can assess the respective characteristic posture changes.

In sum, young children in the current studies showed a positive emotion after they spontaneously helped another person, even when helping was difficult (effortful). This complements and extends previous findings that sharing of a resource results in increased happiness (Aknin et al., 2012; Dunn, Aknin, & Norton, 2014; Lennon & Eisenberg, 1987), and that volunteering prolongs adults' subjective well-being (Dillard et al., 2008). From early ontogeny, positive emotions likely provide intrinsic rewards that reinforce prosocial behavior toward those who are dependent on our help.

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