

Understanding of Goals, Beliefs, and Desires Predicts Morally Relevant Theory of Mind: A Longitudinal Investigation

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Developmental continuity between infants' understanding of intentional agency (goals, beliefs, and desires) and young children's attributions of moral intentions were studied in a 4-year longitudinal study ($N = 77$ children). First, goal encoding at the age of 7 months and implicit false belief understanding at 18 months were predictive of children's understanding of an accidental transgressor's moral intentions at the age of 5 years. Second, 24-month-olds' understanding of subjective desires was predictive of children's ability to understand an accidental transgressor's false belief at 5 years. These correlations remained significant when controlling for gender and verbal IQ. These findings support the theory that an early understanding of intentional agency is foundational for moral cognition in childhood.

An understanding of intentionality is central for moral judgment. Determining the moral status of an act necessitates knowing one's intentions when interacting with others (Turiel, 2002). For example, children understand that pushing someone so that they avoid a more serious injury such as falling from a ladder is viewed as a morally worthy action due to the avoidance of detrimental harm to another (Jambon & Smetana, 2014). In contrast, pushing someone out of dislike because of the color of their skin or the language they speak has been judged as a violation of moral norms about the fair treatment of others (Killen, Mulvey, & Hitti, 2013).

Piaget's (1932/1965) early research was the first to focus on intentionality in the context of children's moral judgment; it demonstrated that younger children (3–6 years of age) focus on outcomes rather than intentions. More recent research has shown, however, that children as young as 3 years can distinguish between intentional and accidental acts and assign more blame when harm

was done intentionally than when it was caused accidentally (Chandler, Sokol, & Hallett, 2001; Chandler, Sokol, & Wainryb, 2000; Yuill & Perner, 1988). Furthermore, moral judgment in early childhood involves an understanding of the distinction between acts and consequences; well-intentioned acts with negative outcomes are evaluated differently from negatively intentioned acts with positive outcomes (see Killen & Smetana, 2015, for a review).

An understanding of intentionality does not emerge for the first time in preschool aged children, it has its origins in infancy. Infants in the 1st and 2nd years of life interpret human action in terms of agents' goals and intentions rather than spatiotemporal surface properties of actions (Woodward, 2009). Furthermore, they distinguish between intentional and accidental action outcomes, and they reenact intended actions when they observe a failed attempt (Meltzoff, 1995). Moreover, infants in the 2nd year of life begin to appreciate the subjectivity of desires (Repacholi & Gopnik, 1997), and they take agents' epistemic states into account when inferring their action goals. In particular, infants in the 2nd year of life anticipate an agent's action

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based on the agent's false belief rather than the state of reality (Baillargeon, Scott, & He, 2010; Southgate, Senju, & Csibra, 2007).

Not only do infants show such remarkable understanding of intentional action, but also longitudinal studies indicate that infants' agent representations predict later explicit reasoning about the mind. A longitudinal study by Wellman, Lopez-Duran, LaBounty, and Hamilton (2008) assessed understanding of goal-directed action in 10- to 12-month-old infants ($N = 45$) in a habituation task and tested these children again at the age of 4 years with a theory-of-mind battery. Decrement of attention in the habituation task predicted later false belief understanding, when controlling for IQ, executive function, and verbal competence. This study corroborated earlier findings by Wellman, Phillips, Dunphy-Lelii, and LaLonde (2004) in a smaller sample (see also Aschersleben, Hofer, & Jovanovic, 2008; Yamaguchi, Kuhlmeier, Wynn, & VanMarle, 2009, for converging findings). While these studies have established a link between infants' understanding of agents' goals and preschoolers' false belief understanding, one longitudinal study ($N = 70$) found that belief-based anticipatory looking in an implicit false belief task at 18 months significantly predicted verbal false belief reasoning at 48 months, controlling for verbal IQ (Thoermer, Sodian, Vuori, Perst, & Kristen, 2012).

To date, the relationship between infant psychological reasoning (goals, beliefs, and desires) and the development of moral intentions in early childhood has not been investigated. Given that intention understanding is foundational for morality, and given that infant understanding of intentional action is predictive of later false belief understanding, we expected developmental relations between core elements of infant psychological reasoning and later moral judgment. Therefore, we conducted a longitudinal study testing for predictive relations between infants' understanding of goals, beliefs, and desires as core components of psychological reasoning in infancy, and 5-year-old children's moral judgment in a context that required a representation of a transgressor's false belief.

Our proposal is that theory of mind, the ability to know that other agents have mental states different from the self (e.g., Premack & Woodruff, 1978), and moral understanding, which comprises prescriptive norms about the interindividual treatment of others regarding fairness and equal treatment (Turiel, 2002), are interrelated in cognitive development. One direction of influence is that understanding mental states (e.g., theory of mind)

is a prerequisite for moral judgment in the sense that children need to be able to infer an agent's intentions to morally evaluate another's acts, and sometimes an agent's intentions can only be understood when the beliefs of another are correctly represented. But there is also the reverse direction of influence, for example, the valence of a morally relevant act influences intentionality judgments in children (Leslie, Knobe, & Cohen, 2006). To date, the importance of theory-of-mind competence for the development of moral judgment has primarily been discussed for explicit theory of mind and explicit moral judgment in early childhood (Astington, 2004). Recently, a longitudinal study demonstrated connections between theory-of-mind competence and prototypic moral judgments (e.g., hitting someone for no reason; Smetana, Jambon, Conry-Murray, & Sturge-Apple, 2012).

It has also been theorized that intentionality knowledge and moral knowledge reflect two distinct forms of reasoning (psychological and moral, respectively) that coexist in early development. Young children's failure to interpret others' intentional states correctly in morally relevant situations may often reflect a failure to coordinate moral judgment with mental state attribution when both forms of considerations are simultaneously presented in a multifaceted context (Killen et al., 2013; Smetana, Jambon, & Ball, 2014). For example, young children who understand that hitting is wrong (see Smetana, 2006) nonetheless often assign blame to a peer who commits a transgression when he or she did not mean to do it. In this case, children understand the wrongness of the act but make errors when inferring the intentions of the potential transgressor, thus showing an understanding of harm in terms of the intrinsic experiences of a victim but failing to apply mental state knowledge to the situation.

Systematic empirical investigations of the interrelationships between young children's theory of mind and moral judgment have shown both distinctions and interrelations between moral and psychological knowledge (Fu, Xiao, Killen, & Lee, 2014; Killen, Mulvey, Richardson, Jampol, & Woodward, 2011; Smetana et al., 2012; Wainryb & Brehl, 2006). In one of the first systematic investigations of the relation between false belief understanding in a moral context and moral judgment, Killen et al. (2011) studied young children's understanding of a transgression that was committed accidentally, that is, by an actor who was guided by positive intentions but did unintended damage based on a false belief.

Specifically, the scenario developed by Killen et al. (2011) involved a story about a classroom helper who threw out a paper bag when cleaning up the classroom that, unbeknownst to the classroom helper, contained another child's special cupcake (the cupcake owner was outside of the classroom when the classroom helper threw it away). Children found it more challenging to identify the accidental transgressor's false belief (knowledge about the contents of the paper bag) in the morally relevant context than a neutral agent's false belief in a standard false belief task (knowledge about the contents of a cracker box, e.g., the crayons in the cracker box task, see Wellman & Liu, 2004). Furthermore, false belief understanding was related to understanding the accidental transgressor's intentions. Children who failed to understand that the transgressor falsely believed that the paper bag was empty tended to mistakenly attribute negative intentions to the wrongdoer. But even many 5-year-olds who understood the accidental transgressor's false belief, answered that the transgressor intended to commit a "bad" act, indicating that it remains challenging for young children to understand an actor's intentions in a morally relevant situation even once they have acquired an understanding of false belief.

Thus, the accidental transgressor paradigm by Killen et al. (2011) assesses children's understanding of an actor's intention, depending on their understanding of the actor's false belief, which is critical for adequate moral judgment. We propose that developmental precursors of an understanding of intentional agency may be predictive of the development of moral understanding in a context requiring theory-of-mind competence. Theoretical considerations and previous findings relating infant action understanding to older children's theory of mind led us to examine whether infant action understanding is predictive of intentional reasoning necessary for moral judgment in early childhood.

On the basis of previous studies (Aschersleben et al., 2008; Thoermer et al., 2012; Wellman et al., 2008), we expected both goal encoding in the 1st year of life and implicit false belief understanding at 18 months to be predictive of morally relevant theory of mind (MoToM). These predictions were based on the proposition that infant psychological reasoning is developmentally linked to children's later explicit understanding of intentional states. Goal encoding is foundational for an understanding of intentional action and should therefore be related to later explicit reasoning about agents' intentions in general and moral intentions in particular.

Implicit false belief understanding should be predictive of later explicit reasoning about belief-based intentional states, in particular, the accidental transgressor's intentions.

An understanding of intentionality not only depends on the attribution of beliefs but also of desires to an agent. Although there is evidence for an implicit understanding of the subjectivity of desires in infancy (Repacholi & Gopnik, 1997), this has, surprisingly, not been related to later explicit theory of mind. Explicit desire reasoning at 3 years was shown to be predictive of belief reasoning at 4 years in a longitudinal study by Wellman, Fang, and Peterson (2011). To explore the predictive relations of implicit reasoning about desires in infancy and later explicit theory of mind, we included an assessment of subjective desire understanding at 24 months and predicted this measure to be related to later reasoning about beliefs and belief-based intentions. This is important not only for understanding the development of theory-of-mind competence but also may provide evidence for future research on links between subjective desires and moral judgments.

A second aim of the present study was to contribute to the intense debate about the nature of early social cognition (e.g., Baillargeon et al., 2010; Ruffman, 2014; Sodian, 2011; Uithol & Paulus, 2014; Woodward, 2009) by investigating the interrelations among different components of psychological reasoning in infancy. If infants' responses to action understanding tasks reflect relatively rich psychological knowledge, then we should not only expect predictive long-term relations for later theory-of-mind reasoning but also interrelations among the infant measures. Because multimeasure and within-subjects longitudinal studies in infancy are quite rare, no prior study has examined the interrelations among goal understanding, belief understanding, and desire understanding in infancy. It is possible that key components of an implicit theory of mind develop independently in infancy, jointly supporting the acquisition of mentalistic action understanding and being integrated into a coherent set of mental state concepts only in early childhood, when an explicit theory of mind develops. Alternatively, it is also possible that core elements of infants' understanding of intentional action are developmentally interrelated even in the 2nd year of life and thus form an integrated system of action prediction and action explanation even in infancy.

To test for goal, belief, and desire understanding in infancy, we chose three tasks: goal encoding assessed in a habituation paradigm (Woodward,

1998) at the age of 7 months, false belief understanding assessed in an anticipatory looking task (Thoermer et al., 2012) at the age of 18 months, and an understanding of the subjectivity of desires (Repacholi & Gopnik, 1997) assessed at the age of 24 months. The age of 24 months was chosen because Carlson, Mandell, and Williams (2004) showed sufficient variability in this task at this age. These measures were taken from a larger longitudinal study of theory of mind in infancy and early childhood, which also comprised assessments of joint attentional and imitation skills in infancy (e.g., Kristen, Sodian, Thoermer, & Perst, 2011; Paulus et al., 2015; Sodian & Kristen-Antonow, 2015).

We chose looking-time measures of goal encoding and false belief understanding because these measures tap infants' encoding of intentional action independently of their engagement in social interaction. For desire reasoning at 24 months, we used a social-interactive measure because, to date, no looking-time measure of this concept has been developed. To test for the specificity of the predictive relations between infant social cognition and early childhood theory of mind, verbal IQ (Wechsler Preschool and Primary Scale of Intelligence [WPPSI]) measured at the age of 48 months was used as a control variable; a working memory measure assessed at the age of 7 months was used as a control variable in infancy. To test for the connections to moral judgment in early childhood, we administered the MoToM interview by Killen et al. (2011), which assessed understanding an accidental transgressor's false belief and his/her (positive) intention at the age of 5 years. In sum, the present study is the first investigation of the relations among three core components of theory of mind in infancy and the connections between these forms of intentional knowledge and attributions of moral intentions in early childhood.

Method

Participants

The full sample consisted of $N = 77$ (37 girls, 40 boys) healthy children who had participated in a longitudinal study of social-cognitive development from the age of 7 months, with at least one valid data point in infancy and who produced valid data at least one of the measurement points in early childhood. Children were recruited from public birth records and from middle-income backgrounds in Southern Germany. Ages at the measurement points were as follows: 7 months ($M = 6.96$,

$SD = 0.25$), 18 months ($M = 18.04$, $SD = 0.25$), 24 months ($M = 24.02$, $SD = 0.25$), 48 months ($M = 48.25$, $SD = 0.23$), and 60 months ($M = 60.82$, $SD = 0.73$). Data collection was carried out between December 2006 and October 2011.

The maternal education demographics were the following: one quarter or 24.7% of the mothers had attended secondary school up to grade 10 (not college-bound degree), 22.1% had attended secondary school up to grade 12 (college-bound degree), 44.2% had a bachelor or a master degree, and 9.1% had a PhD. Assessments were carried out in a university laboratory in Germany (in German), and all children were accompanied by a caretaker. Participation was voluntary. The university ethics committee approved the study.

Procedure and Measures

Goal-Encoding Task at 7 Months

Infants sat in a tabletop seat or on the parent's lap in front of a stage on which a stuffed bear and a ball were placed on pedestals. In each trial, a curtain opened, and a human hand and arm moved in from the side and grasped one of the objects, remaining still until the trial ended and the curtain closed. A trial lasted until the baby had looked away from the stage for two consecutive seconds. For half ($n = 21$) of the infants, the toy on the right was the target (respectively, for the other half, it was the toy on the left). The habituation criterion was established by summing up looking times over the first three trials that summed up to at least 12 s. An infant reached the habituation criterion when three trials totaled less than half of the sum of these trials. If an infant did not reach this criterion, the test trials were begun after 14 trials. The mean number of habituation trials was $M = 9.49$ ($SD = 3.42$, range = 6–14). After habituation was complete, the toys' positions were switched and the baby saw one familiarization trial with the toys in their new positions.

After that, the baby saw two alternating test events with three trials of each type. In the old goal/new path event, the actor grasped the same toy as during habituation (the toy was in a new position, so the actor moved his arm through a new path to grasp the toy). In the new goal/old path event, the actor moved her arm through the same path as in habituation, grasping a new toy (Woodward, 1998). Twenty-one infants began with a new goal/old path trial, and 21 began with an old goal/new path trial. The infants' looking was

coded by an observer who pressed a key on a computer keyboard when the infant looked at the stage. From that, looking times and habituation criteria were calculated by a computer program (Pinto, 1994). To assess reliability, a second observer coded each video again from the videotaped record. Only infants for whom an interobserver correlation of 0.9 or more was achieved were included (see Licata et al., 2014, for details on inclusion criteria).

Working Memory at 7 Months

The infants sat on their caregiver’s lap facing a frame containing two openings that were side by side, 42 cm apart from center to center. Two curtains were attached to the back of the frame, designed to cover the windows. At the beginning of each trial, the experimenter pulled aside two curtains, put her face in one of the windows, and engaged the infant’s attention. Then, the experimenter withdrew her face, replaced the two curtains, and wiggled her fingers at the top center of the frame. As soon as the infant looked toward the fingers, the experimenter reopened the curtains, and after a 2- to 3-s pause, she reappeared in her previous location. The curtains were then closed again. After a short pause, the curtains were reopened to initiate the next trial. The experimenter’s location of appearance was counterbalanced across trials between the left and right windows, and the procedure lasted for six trials (in contrast to 12 trials in the original procedure, see Reznick, Morrow, Goldman, & Snyder, 2004).

Videotapes were coded by two independent coders who assessed the direction of the infant’s first gaze after the reopening of the curtain. Children were given a score of 1 if they looked toward the cued direction and a score of 0 if their gaze was directed toward some other location. Scores, thus, could range from 0 to 6. A random sample of 25%

children was coded by a second observer. Cohen’s kappa was .72.

Belief-Based Anticipatory Looking (Implicit False Belief) Task at 18 Months

Infants’ implicit false belief understanding was tested using a task adapted from Neumann, Thoermer, and Sodian (2008). Infants watched animated movies on screen with an integrated eye-tracking system (for a more detailed description, as well as inclusion criteria, see Thoermer et al., 2012). The movies showed a female agent watching a car moving from one garage to another (see Figure 1). During familiarization (two trials for each child, each lasting 32 s), once the actor had seen the car arrive at the second box, she disappeared behind a screen. Subsequently, two doors above each of the two boxes were illuminated (accompanied by a chime). This was followed by a freeze frame of 3 s during which anticipatory fixations at the two doors (areas of interest [AOI]) were assessed. Then the agent’s face appeared at one of the doors and she reached through this door for the car. Infants subsequently received one test trial. Test trials (lasting 41 s) differed from familiarization in that a phone ring distracted the actor from observing the car, while the car continued to move; after reaching the second garage, it went backward to the first garage and then went on driving through the garage, disappearing from the screen. Once the car exited the screen, the doors illuminated with an accompanying chime and infants’ fixations were recorded over a 3-s anticipatory period. Figure 1 shows the timeline for the test event of this belief-based anticipatory looking task (see Figure 1).

Diverse Desire Reasoning at 24 Months

Desire reasoning was measured using a task based on Repacholi and Gopnik (1997). Children

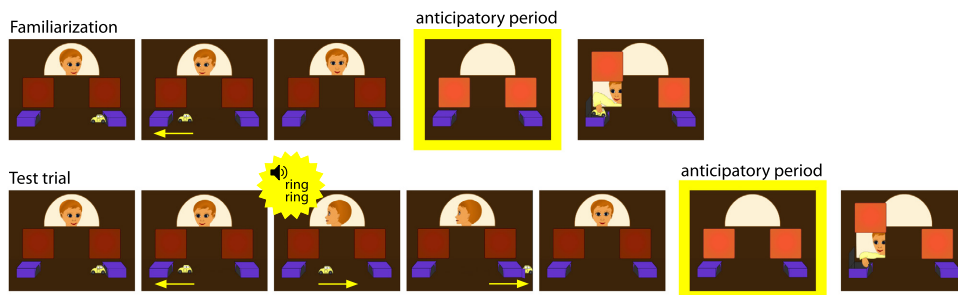


Figure 1. Timeline of the familiarization (a) and test (b) events. The solid frame marks the anticipatory scene. Note. Movies were presented in color; thus, the garages were clearly discriminable.

were seated at a table at the opposite side of the experimenter. In a warm-up phase, a give-and-take play with a block was played for about 30 s to check whether children were motivated to give an object to another person. After that, the child was presented a car and a block on a tray. The side of the object (i.e., whether the car or the block was presented on the right or on the left side) was randomized. The child had 45 s in which to explore the objects. Then, the objects were removed and the experimenter held the object in her hand, looked at it and said, using expressions of disgust for the object the child had preferred during the exploration phase, *Yuck a block/car. I played with the block/car. Ugh. I don't like blocks/cars. Yuck*, this statement lasted for 10 s. After that, the experimenter showed preference for the other object by showing facial expressions of happiness (*Ahhh a block/car, I played with the block/car! I love blocks/cars! Yay!*), again lasting for 10 s. Then the experimenter put both objects again into the bowls on a tray, moved the tray toward the child, put his hand in the middle of the two bowls with palms up, and asked, *Can you give me something?* Coding was done by two research assistants, one of them coding 100% of the sample and the other coding 30% of the sample. Children received a "1" if they gave the correct, that is, the item the experimenter had preferred, to the experimenter, and a "0" if they gave the item they preferred themselves to the experimenter. Cohen's kappa was $\kappa = .92$.

Verbal IQ at 48 Months

The verbal IQ at 48 months was assessed by administering two subtests of the German version of WPPSI (Petermann, 2009) verbal IQ scale, *Similarities* and *General Knowledge*. Both tasks were administered according to the testing manual. The subtest *Similarities* assesses verbal reasoning and concept formation. The child read an incomplete sentence containing two concepts that share a common characteristic, such as *Dogs and cats, both are . . . ?* The child's task was to complete the sentences by stating a shared property or superordinate concept. In the *General Knowledge* task, the child had to answer questions relating to general knowledge topics (e.g., "Which animals do you know?," "What is the opposite of south?").

MoToM Interview at 60 Months

Children's moral understanding was assessed using a task by Killen et al. (2011). For the purpose

of the present study, two assessments pertaining to the "MoToM" story were administered: (a) false belief (false contents) in a morally relevant context and (b) attributions of moral intentions of an accidental transgressor. In a short warm-up task, children were familiarized with the Likert-type scale (1 = *not a lot*; 4 = *a lot*) by asking them two short questions (how much they liked pizza and how much they liked playing outside) and asking them to show it on the child friendly (smiley faces) Likert-type scale.

Children were told a short story involving one child, a classroom helper, who cleaned up the room and accidentally threw away a paper bag on a table that had another child's cupcake inside (the owner of the cupcake was playing outside). Brightly illustrated pictures of the characters and objects (cupcake, trash can) were used during the interview for ease of following the story (see Killen et al., 2011). The exact story was the following (gender names matched the gender of the participant):

This is Max/Tina (pointing to Max/Tina) and this is Tom/Julia (pointing to Tom/Julia). Max has brought in a cupcake from home and is keeping it in this paper bag. Max puts the paper bag on the table then goes outside to play. Tim is helping the teacher clean up the classroom and sees the paper bag. Tim throws the paper bag in the trash.

The assessments were (a) false belief (false contents) of the accidental transgressor (*What did Tim, the boy who threw out the paper bag, think was in the bag?: cupcake or trash*) and (b) attributions of moral intentions of the accidental transgressor (*When Tim threw out the bag, did he think he was doing something that was all right or not all right?: Likert-type scale response*). Coding was done by two research assistants, one of them coding 100% of the sample, and the other coding 30% of the sample. Cohen's kappa was $\kappa = 1.0$ in the false belief question and $\kappa = .96$ in the question regarding the attributions of moral intentions of the actor.

Results

Descriptive Statistics

Goal-Encoding Task

Infants looked, on average, for 20.3 s at the new goal ($SD = 11.42$, range = 2.5–64.5), whereas they looked for 17.4 s at the new path ($SD = 17.9$,

range = 3.3–117). A weighted test differentiation score (Brune & Woodward, 2007) was derived by dividing the total amount of looking time at the new goal event by the sum of the looking times at the new goal event plus the new path event (see Table 1).

Implicit False Belief Task

A proportion score of looking at the correct (i.e., belief based) door AOI (i.e., the door in the wall at which the agent would be expected to search based on his belief about the car’s location) was calculated by dividing the time an infant spent looking at the correct AOI by the sum of looking at the correct door AOI and the incorrect door AOI, and multiplying the quotient by 100. Results showed that infants spent *M* = 57% of the time looking at the belief-based door.

Diverse Desires Task

Half of the children (*M* = 46%) were competent in the diverse desires task.

MoToM Interview

In the moral story task assessed at 60 months, 58% of the children answered the false belief (false contents) question correctly and 35.5% responded correctly to the attributions of moral intentions of the act assessment, answering that the protagonist

thought that what he was doing was “very good” (24.2%) or “good” (11.3%), while 64.6% answered that he thought it was “bad” (6.5%) or “very bad” (58.1%; *M* = 2.02), and on a Likert-type scale from 1% to 4. 23% of the children answered both the false belief and the attributions of moral intentions questions correctly. Thereby, attributing moral intentions was significantly more difficult than false belief understanding, McNemar test (*p* = .008, *n* = 62).

Inferential Analyses

We first report bivariate correlations among the focal variables (see Table 2), followed by nonparametric analyses. In a second step, we test for the specificity of the hypothesized longitudinal relations by means of partial correlations.

We predicted measures of infant psychological reasoning to be significantly correlated with both intention and false belief understanding in the moral theory-of-mind (MoToM) interview. Confirming our hypotheses, infants’ goal-encoding ability at 7 months (differentiation between test trials) was positively related to children’s moral intention understanding at 60 months. Moreover, implicit false belief understanding assessed at 18 months was also positively related to children’s attributions of moral intentions at 60 months. Desire understanding at 24 months was not correlated with moral intention understanding, but it was positively related to children’s understanding of the accidental transgressor’s false belief. Contrary to expectations, neither goal encoding nor implicit false belief understanding was correlated with the MoToM false belief question. Child gender was related to performance on the MoToM interview, with girls outperforming boys. Furthermore, verbal IQ was positively correlated with almost all the assessed variables (see Table 2).

We further aimed at investigating the interrelations among different measures of infant psychological reasoning. There was a marginally significant correlation between infants’ goal-encoding ability at 7 months and their implicit false belief competence 11 months later (see Table 2).

The findings on predictive relations between infant social understanding and later understanding of moral intentions were confirmed by nonparametric analyses using one-tailed significance tests. Although none of the six infants who reached a score of 0.50 or less in the goal-encoding task mastered the attributions of moral intentions question, 10 of the 28 competent infants did, $\chi^2(1,$

Table 1
Descriptive Statistics of Performance on All Measures

Task	Measurement point (months)	N	M (SD)	Range
Goal-encoding looking time	7	42	56% (13%)	20%–86%
Working memory	7	70	3.21 (1.14)	1.00–6.00
Implicit false belief	18	44	57% (43%)	0%–100%
Diverse desires	24	71	46% (50%)	0%–100%
Verbal IQ	48	68	106.90 (12.48)	67–137
MoToM false belief	60	64	58% (50%)	0%–100%
MoToM intention of the actor	60	62	2.02 (1.30)	1–4

Note. *N* = 19 children contributed valid data at all measurement points. MoToM = moral theory of mind.

Table 2
Intercorrelations Among the Study Variables

	1	2	3	4	5	6	7	8
(1) Goal-encoding LT 7 months	1							
(2) Implicit FB 18 months	.37 (25) [^]	1						
(3) Working memory 7 months	.16 (39)	-.17 (42)	1					
(4) Diverse desires 24 months	.23 (40)	-.09 (49)	.19 (67)	1				
(5) Verbal IQ 48 months	.30 (38) [^]	.41 (40)**	-.09 (63)	.18 (63)	1			
(6) MoToM FB 60 months	.10 (34)	.05 (37)	-.01 (57)	.31 (60)*	.52 (55)**	1		
(7) MoToM intention 60 months	.36 (34)*	.44 (37)**	-.12 (56)	.01 (58)	.34 (55)**	.09 (62)	1	
(8) Gender	.07 (42)	-.07 (44)	.31 (70)**	.07 (71)	-.04 (68)	-.01 (64)	-.26 (62)*	1

Note. LT = looking time; MoToM = moral theory of mind; FB = false belief.
[^] $p < .10$. * $p < .05$. ** $p < .01$. two-tailed Pearson correlations, phi coefficient for dichotomous variables, with N in parentheses.

$N = 34$) = 3.04, $p = .041$. Similarly, only 2 of the 17 infants who had failed the implicit false belief task mastered the attributions of moral intentions question, whereas 10 of the 20 competent participants did, $\chi^2(1, N = 37) = 6.13, p = .007$.

When the correlations between infant measures and the MoToM moral intentions question were controlled for gender and verbal IQ, they proved to be stable, using one-tailed significance tests. Implicit false belief and moral intention understanding were significantly correlated, $r_{\text{par}}(33) = .35, p = .021$, and so were goal encoding and moral intention understanding, $r_{\text{par}}(30) = .32, p = .038$. For the dichotomous scores on the diverse desires and MoToM false belief tasks, no partial correlation could be computed. Instead, a binary logistic regression analysis using the forward (Wald) option yielded a significant effect of both children's competence in the diverse desires task at 24 months ($B = 1.86$, Wald = 5.68, $df = 1, p = .009$) and of verbal IQ ($B = 0.14$, Wald = 8.76, $df = 1, p = .002$) on false belief understanding, indicating that the effect of the diverse desires task remained significant when IQ was taken into account. With regard to the correlations among the infancy measures, the relation between infants' goal-encoding ability and implicit false belief remained stable when controlling for working memory and gender, $r_{\text{par}}(21) = .41, p = .027$.

Discussion

The findings of the present longitudinal study demonstrated, for the first time, a predictive relation between infants' understanding of intentional agency and 5-year-old children's explicit reasoning about actors' moral intentions, necessary for moral

judgment. While previous studies have shown goal encoding and false belief understanding in infancy to be predictive of later explicit false belief understanding, no prior research has demonstrated connections to moral judgments in a context requiring theory-of-mind competence. Infants who encoded an agent's actions in terms of their goals at the age of 7 months, and who correctly anticipated an agent's belief-based goal-directed actions at 18 months, were more likely than infants who failed these tasks to evaluate an accidental transgressor's intentions as positive at the age of 5 years. Furthermore, 2-year-olds who understood the subjectivity of desires were more likely than those who failed this task to understand the accidental transgressor's false belief at the age of 5 years. The correlations between infants' and children's reasoning about agents' intentions and beliefs were independent of gender and general cognitive abilities as assessed by verbal IQ.

This pattern of findings was largely consistent with our hypotheses which were based on previous longitudinal studies of the relation between infant psychological reasoning and preschool theory of mind. Note, however, that we did not find significant correlations between goal-encoding and implicit false belief understanding on one hand, and the explicit false belief measure in the morally relevant context on the other hand. This may be due to the difficulty of the MoToM false belief task which may involve additional task demands (see Killen et al., 2011). Further research is necessary to determine the relation between the standard false belief assessment and false belief understanding in a morally relevant context.

Our main predictions, concerning the relation between infant understanding of intentional action and later *intentional* understanding in a moral

context were confirmed by the present findings. Inferring an agent's intention independently of the outcome of his or her actions is a key component of moral judgment and psychological understanding in general. The types of errors that children make when they do not have MoToM contribute to peer conflict and social tension in social development, blaming an accidental transgressor for wrong-doing is one of the most frequent sources of conflict in social encounters, and particularly in early childhood (Killen & Smetana, 2015). The present findings indicate that these core aspects of real-world social understanding in early childhood have their roots in infant action understanding.

One interpretation of the present findings is that infants' understanding of intentional action is conceptually linked to later developing mental state knowledge required for explicit moral intention attribution. This emphasizes the relationship between theory of mind and morality, and indicates that an understanding of intentional agency is central for moral judgments. A next step would be to investigate relationships between goal encoding in infancy and competencies that reflect an early awareness of fair or just treatment of others (morality) in infancy, such as response to others' distress (Hastings, Miller, Kahle, & Zahn-Waxler, 2014) or preferences for prosocial acts over harmful acts (Hamlin, 2013). It should also be noted that the conclusions to be drawn from the present study are limited due to design and sample size. The present findings justify a next step which would be a project with a larger scope, designed to model patterns of developmental change.

Regarding the implications of the present findings for moral judgment, the finding that early cognitive intentionality is predictive of intentionality attributions related to moral judgment in childhood has significant implications for theories about social-cognitive development. From infancy to childhood, children are constructing judgments that reflect moral and psychological knowledge (Smetana et al., 2014). In fact, both types of knowledge, moral and psychological, have their origins early in development and may be interrelated, beginning in infancy.

Regarding the implications for theory-of-mind development, the present study is the first one to demonstrate a link between goal encoding and implicit false belief understanding in infancy, and later explicit understanding of *intentions*. Both goal encoding and implicit false belief understanding predicted children's understanding of the accidental transgressor's intentions which required them to

take his epistemic state into account. Moreover, the study demonstrated a predictive relation between desire understanding in a nonverbal task at 24 months, and explicit false belief understanding at the age of 5 years. This finding is consistent with longitudinal relations from desire to belief reasoning shown between 3 and 4 years by Wellman et al. (2011). Thus, the present pattern of findings goes beyond previous studies in demonstrating a network of relations between different components of psychological reasoning in infancy and theory of mind in early childhood.

Furthermore, the present study demonstrated a correlation between goal encoding at 7 months and implicit false belief understanding at 18 months which was independent of working memory. This finding is consistent with the idea that infants' early ability to analyze actions in terms of goals is foundational for their later developing ability to take epistemic states into account when predicting agents' goal-directed action, and tentatively supports the view of conceptual coherence in infants' mentalistic action understanding rather than the idea of independent core knowledge components (Carey, 2009).

Taken together, the present findings lend some first support to a conceptual interpretation of infants' agent and action representations which are interrelated in infancy, and linked to later mental state attributions. While previous findings on the relation between implicit and explicit false belief understanding (Thoermer et al., 2012) were interpretable in terms of task features, the present findings are clearly not due to similarity in task features, and go beyond the level of relations between analogous concepts. Rather, goal understanding predicted later (implicit) belief understanding and both were predictive of explicit moral intention understanding in a task that required the child to take an agent's epistemic state into account. Moreover, early desire understanding predicted later belief understanding, adding to the picture of conceptual coherence between earlier and later developing components of psychological reasoning. Note that these findings speak against low-level interpretations of infant theory-of-mind competencies in terms of responses to perceptual novelty (Heyes, 2014).

A conceptual interpretation of infants' understanding of intentional agency does not, however, necessarily imply that infants have an understanding of intentional states in the sense of a representational theory of mind (Sodian, 2011). Rather, the ability to keep track of what an agent perceived (experiential record, Perner & Roessler, 2012), and

to integrate this information with a representation of the agent's goals may be sufficient to arrive at belief-consistent action predictions. Thus, a preferential sensitivity in infants to an agent's attention focus and goal in the face of conflicting or salient irrelevant information may be related to later explicit attention to an agent's mental state even when this mental state conflicts with the overt outcome of his action. Goal encoding in infancy requires a specific deployment of attention to an agent's goals and attention focus over and above a novel spatiotemporal feature of the action (for discussions see Paulus, 2012; Thoermer, Woodward, Sodian, Perst, & Kristen, 2013). In the anticipatory looking task, as well, infants have to pay attention to and draw inferences from a change in an agent's attention focus in the context of a goal-directed action (the protagonist is distracted from observing the critical event by a phone ringing). And finally, the intention question in the MoToM task requires children to take the transgressor's epistemic state into account when drawing an inference about his intention, independently of the negative valence of the outcome of his action.

Understanding intentional agency in infancy is related to intentionality necessary for making accurate moral judgments in a complex situation in childhood, one that requires attributions of intentional agents for making a moral judgment. When intentionality judgments are correct then children do not blame a potential transgressor for a misdeed; when intentionality judgments are mistaken (an error of theory of mind) then blame is assigned to accidental transgressors (Killen et al., 2011). These data support the viewpoint that intentionality attributions determine the moral status of the transgression. Thus, the developmental relationship between intention understanding in infancy and later intentionality required for moral judgment highlights the central role of intentional agency to social interactions, social relationships, and the components necessary for the healthy functioning of children's cognitive, social, and moral development.

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