# Infant social cognition: Psychological and sociomoral reasoning.

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**Abstract**

Infant social cognition depends on at least two evolved systems: the psychological- and sociomoral-reasoning systems. Each system has at its core a distinct explanatory framework of principles and concepts. The psychological-reasoning system enables infants to interpret agents' intentional actions and is constrained by a principle of rationality (with its corollaries of consistency and efficiency). When infants observe an agent act in a scene, the psychological-reasoning system infers the mental states that underlie the agent's actions; if the scene changes, infants use these mental states—together with the rationality principle—to predict the agent's likely actions. Recent evidence indicates that infants are already capable of sophisticated mentalistic reasoning and can attribute to agents not only motivational states (e.g., goals) and epistemic states (e.g., ignorance), but also counterfactual states (e.g., false beliefs). The sociomoral-reasoning system guides infants' expectations about how individuals should act toward others and is constrained by several principles, including reciprocity, fairness, and ingroup (with its corollaries of loyalty and support). When infants observe two or more individuals interact in a scene, the sociomoral-reasoning system determines what actions are obligatory, what actions are permissible, and what actions are impermissible. This chapter reviews key findings concerning each system in infancy.

**Introduction**

Beginning in the first year of life, infants attempt to make sense of the actions of others. At least two causal-reasoning systems contribute to this process: the *psychological*- and *sociomoral-reasoning* systems (for a comprehensive review, see Baillargeon et al., in press). Each system operates largely without explicit awareness and has at its core a distinct explanatory framework comprising key principles and concepts. The psychological-reasoning system infers agents' mental states (e.g., Leslie, 1994), and the sociomoral-reasoning system determines what is obligatory, permissible, and impermissible in social interactions (e.g., Dwyer, 2009).

To illustrate the purview of each system, imagine that infants are observing the following scene. Mary is stacking rings on a table; the last ring rolls to the floor, and Mary vainly attempts to reach it. At that point, Jane enters the scene; she observes Mary's efforts, walks over to the fallen ring, and picks it up. The psychological-reasoning system would enable infants to interpret Mary's and Jane's individual actions by inferring the mental states underlying these actions (e.g., Mary wants to stack all the rings, she noticed that the last one fell, and she is trying without success to reach it; Jane understands what Mary is trying to do, and she purposefully walks to the ring and picks it up). The sociomoral-reasoning system would allow infants to form expectations about what Jane should do next (e.g., is it obligatory for Jane to give the ring to Mary? is it permissible for Jane to drop the ring back to the floor? is it impermissible for Jane to steal the ring?) and about how Mary should respond to Jane's actions.

In this chapter, we review findings on psychological and sociomoral reasoning in infancy (i.e., before age 2). These findings are important not only for developmental psychology but also for cognitive science generally, because they inform and constrain theoretical models about the nature and causal etiology of human intuitive social cognition.

## Psychological Reasoning

### *Agents*

When infants encounter a novel entity, they gather evidence about its ontological status. If the entity is capable of autonomous motion (e.g., begins to move or reverses course on its own), infants categorize it as *self-propelled* and endow it with internal energy (e.g., Luo, Kaufman, & Baillargeon, 2009). If the entity has autonomous control over its actions (e.g., uses varied means to achieve the same goal or responds purposefully to changes in its environment), infants categorize it as *agentive* and endow it with mental states (e.g., Csibra, 2008; Johnson, Shimizu, & Ok, 2007). Finally, if the entity gives evidence that it is both self-propelled and agentive, infants categorize it as an *animal* and endow it with biological properties, such as filled insides (Setoh, Wu, Baillargeon, & Gelman, in press).

By 3 to 5 months of age, infants can already identify and reason about novel non-human agents (e.g., Hamlin & Wynn, 2011; Luo, 2011; Luo & Baillargeon, 2005). These findings make it unlikely that infants gradually construct (e.g., through their own experiences as agents) an abstract understanding of intentional action that is then extended to novel agents; rather, these findings support the view that psychological reasoning is an adaptation that emerges early in life and enables infants to interpret the actions of any entity they identify as an agent.

### *Mental States*

Infants who observe an agent act in a scene can attribute at least three kinds of mental states to the agent: *motivational* states, which capture the agent's motivation and include goals and attitudinal dispositions (e.g., Csibra, 2008; Woodward, 1998); *epistemic* states, which represent what the agent knows about the scene and include knowledge and ignorance states (e.g., Liszkowski, Carpenter, & Tomasello, 2008; Luo & Johnson, 2009); and *counterfactual* states, which correspond to reality-incongruent states such as false beliefs and pretense (e.g., Onishi & Baillargeon, 2005; Onishi, Baillargeon, & Leslie, 2007). A *decoupling* mechanism is recruited by the psychological-reasoning system to help represent counterfactual states (e.g., Baillargeon et al., in press; Leslie, 1994). For example, when the agent holds a false belief about the scene, the decoupling mechanism enables infants to temporarily put aside—or decouple from—their own perspective on the scene in order to adopt the agent's perspective

*Elicited- and non-elicited-response false-belief tasks*. Until recently, it was generally assumed that false-belief understanding does not emerge until about age 4 and constitutes a major milestone in the development of mentalistic reasoning (e.g., Wellman, Cross, & Watson 2001; Wimmer & Perner, 1983). This assumption was based on findings from *elicited-response* tasks. In these tasks, children are presented with a scene where an agent holds a false belief about some aspect of the scene, and they are asked a direct question about the agent's likely behavior. For example, children listen to a story enacted with props: Sally hides her toy in a basket and leaves; in her absence, Anne moves the toy to a box. Children are asked where Sally will look for her toy when she returns. At about age 4, children typically answer correctly, pointing to the basket; in contrast, most 3-year-olds point to the box, as though they do not yet understand that Sally will hold a false belief about her toy's location (e.g., Baron-Cohen, Leslie, & Frith, 1985).

The evidence that false-belief understanding is present long before age 4 comes from *non-elicited-response* tasks (e.g., Baillargeon, Scott, & He, 2010; Scott, He, Baillargeon, & Cummins, 2012). In these tasks, children are again presented with an agent who holds a false belief; instead of asking how the agent will act, however, investigators assess children's understanding of the agent's false belief using various indirect measures. For example, positive results have been obtained with infants in the second year of life using violation-of-expectation tasks (e.g., infants detect a violation when Sally searches for her toy in its current location; Onishi & Baillargeon, 2005), anticipatory-looking tasks (e.g., infants anticipate that Sally will approach the toy's original location; Senju, Southgate, Snape, Leonard, & Csibra 2011), anticipatory-pointing tasks (e.g., infants spontaneously point to inform Sally about her toy's new location; Knudsen & Liszkowski, 2012), and prompted-action tasks (e.g., infants respond appropriately to prompts to help Sally, such as "Go on, help her!"; Buttelmann, Carpenter, & Tomasello, 2009). Evidence of false-belief understanding has been obtained using similar tasks with infants as young as 7 months of age (e.g., Kovács, Téglás, & Endress, 2010).

*Processing-load account*. If children are capable of representing false beliefs at an early age, why do they fail at elicited-response tasks until about age 4? According to the *processing-load* account (e.g., Baillargeon et al., in press), these tasks have considerable executive-function demands (for alternative accounts, see Butterfill & Apperly, in press; Perner & Roessler, 2012). When children are asked the test question (e.g., "Where will Sally look for her toy?"), a *response-selection* process is activated (e.g., Mueller, Brass, Waszak, & Prinz, 2007) that inadvertently triggers a "reality bias": Because agents usually look for an object where it is located, the prepotent response is that Sally will look for her toy in its current location. Thus, instead of—or in addition to—tapping their representation of Sally's false belief, children tap their own knowledge about the toy's current location. As a result, children cannot succeed unless their *inhibition* skills are sufficiently mature to suppress the prepotent response generated by the reality bias (e.g., Birch & Bloom, 2003; Leslie & Polizzi, 1998).

If young children's difficulties were entirely due to their inability to inhibit prepotent responses, we would expect them to succeed at elicited-response tasks that circumvent the reality bias. One such task is the "undisclosed-location" task: Instead of moving Sally's toy from the basket to the box, Anne takes it away to an undisclosed location. As children do not know where the toy is, the reality bias should have little effect, leaving them free to answer the test question by tapping their representation of Sally's false belief. However, young children typically perform at chance in undisclosed-location tasks (Wellman et al., 2001). According to the processing-load account, the joint demands of the false-belief-representation and response-selection processes overwhelm young children's limited *working-memory* resources, leading to chance performance. This account predicts that young children should succeed at undisclosed-location tasks when response-selection demands are reduced through practice trials, and recent results confirm this prediction (Setoh, Scott, & Baillargeon, 2011).

### *The Rationality Principle*

Adults' expectations about agents' actions are guided by a *rationality* principle: All other things being equal, adults expect agents to act rationally—indeed, this is what makes it possible to predict their actions (e.g., Dennett, 1987; Fodor, 1987). Corollaries of the rationality principle include expectations of *consistency* (agents should act in a manner consistent with their mental states) and *efficiency* (agents should expend as little effort as possible to achieve their goals) (e.g., Baillargeon et al., in press; Gergely, Nádasdy, Csibra, & Bíró, 1995). Like adults, infants expect agents to adhere to the rationality principle. When infants observe an agent act in a scene, the psychological-reasoning system attempts to build a psychological explanation for the agent's actions, by positing a causally coherent set of mental states that portrays these actions as rational. If infants succeed in building such an explanation, they can then use it (along with the rationality principle) to predict how the agent will behave when the scene changes.

*Consistency*. In a well-known consistency task (e.g., Woodward, 1998), infants first receive familiarization trials in which an agent faces two objects, object-A and object-B, and repeatedly reaches for object-A. In the test trials, the objects' locations are switched, and the agent reaches for either object-A (*old-object* event) or object-B (*new-object* event). In another version of the task (e.g., Robson & Kuhlmeier, 2013), object-B is replaced with new object-C in the test trials, and the agent reaches for either object-A (*old-object* event) or object-C (*new-object* event). In either case, infants typically look longer at the new- than at the old-object event. This result suggests that during the familiarization trials, infants notice that the agent continually chooses object-A over object-B, and, based on this systematic choice information, they attribute to the agent a particular disposition, a liking or preference for object-A. During the test trials, infants expect the agent to continue acting on this preference, and they detect a consistency violation when the agent reaches for the other object instead.

Additional findings support this interpretation. First, infants do not attribute a preference to the agent during the familiarization trials if object-A is the only object present (e.g., Luo & Baillargeon, 2005), or if the agent does not know that object-B is present (e.g., Luo & Johnson, 2009); in either case, there is no longer choice information signaling the agent's disposition toward object-A. Second, infants attribute a preference to the agent during the familiarization trials even if object-A is the only object present, as long as the agent expends effort to obtain object-A (e.g., in each familiarization trial, the agent must open a container in order to retrieve object-A; Bíró, Verschoor, & Coenen, 2011). Third, infants view preferences as attributes of individual agents: If Mary prefers object-A over object-B, infants do not expect Jane to share the same preference (e.g., Buresh & Woodward, 2007; see Egyed, Király, & Gergely, 2013, for an interesting exception involving pedagogical cues). Finally, infants attribute preferences whenever agents' choices systematically deviate from random sampling (e.g., when an agent chooses only ducks from a box containing mainly frogs; Kushnir, Xu, & Wellman, 2010).

*Efficiency***.** In a well-known efficiency task (e.g., Csibra, 2008), infants first receive familiarization trials in which an agent detours around an obstacle in order to reach a target. In the test trials, the obstacle is removed, and the agent either moves to the target in a straight line (*short-path* event) or detours as before when approaching the target (*long-path* event). Infants typically look longer at the long- than at the short-path event. This result suggests that during the familiarization trials, infants attribute to the agent the goal of reaching the target. During the test trials, infants expect the agent to maintain this goal and to pursue it efficiently: With the obstacle removed, a more efficient path to the target becomes possible, and infants detect an efficiency violation when the agent ignores this path and follows the familiar, less efficient path instead.

Additional findings support this interpretation. First, similar results have been obtained with various detour tasks, including an agent reaching over an obstacle to grasp an object (e.g., Phillips & Wellman, 2005). Second, when considering physical effort, infants evaluate not only the shortest path possible for reaching a target, but also the shortest action sequence possible for obtaining an object: Infants expect an agent who has access to two identical objects to choose the one that can be retrieved with fewer actions (Scott & Baillargeon, 2013). Third, infants consider mental as well as physical effort when reasoning about efficiency: If an agent is presented with two identical objects, one under a transparent cover and one under an opaque cover, infants expect the agent to choose the visible object, which can be retrieved with less mental effort (Scott & Baillargeon, 2013).

*Irrational agents*. The preceding results indicate that when infants are able to build a well-formed psychological explanation for an agent's actions, they use this explanation to predict how the agent will act when the scene changes. As might be expected, when infants are *unable* to build a well-formed explanation for an agent's actions, they hold no expectations about the agent's subsequent behavior. Such negative results have been obtained (1) when it is unclear why the agent is pursuing a particular goal (e.g., the agent is attempting to steal an undesirable object; Scott, Richman, & Baillargeon, 2013) or why the agent is *refraining* from pursuing a particular goal (e.g., the agent is staring at an accessible object but does not reach for it; Luo, 2010); (2) when the agent's actions are inconsistent with her knowledge about the scene (e.g., the agent expresses excitement over an empty container; Chow & Poulin-Dubois, 2009); and (3) when the agent's actions are inefficient and involve either an unnecessary action (e.g., the agent opens a container before grasping an object that stands next to the container; Bíró et al., 2011) or an unnecessary detour (e.g., the agent jumps, for no apparent reason, while approaching a target; Gergely et al., 1995).

When presented with an inefficient action on a novel object, infants occasionally give the agent the benefit of the doubt: They assume that a rational agent would not perform this action unless there was a reason for doing so. Thus, after watching a model activate a light-box by touching it with her forehead, while her hands lay idle on either side of the light-box, infants tend to imitate the model's inefficient head action (Meltzoff, 1988). Infants use their hands to activate the light-box, however, if the model's hands are occupied while she demonstrates the (now merely expedient) head action (Gergely, Bekkering, & Király, 2002).

**Sociomoral Reasoning**

As it became clear that infants can make sense, at least in simple situations, of the actions of a single agent, researchers were naturally led to ask whether infants also possess expectations about social interactions among two or more agents, bringing about a new focus on sociomoral reasoning.

***Values***

Because many sociomoral expectations presuppose an ability to assess the *values* of social actions, initial investigations explored this ability in infants. In general, the value of a social action is determined by its *valence* (positive, negative, or neutral) and *magnitude* (more or less) (e.g., Jackendoff, 2007; Premack, 1990). As might be expected, positive actions are those that have a beneficial effect on others, whereas negative actions are those that have a detrimental effect.

Research with infants age 10 months and older indicates that: (1) they can assess the valence of both positive (e.g., helping, sharing) and negative (e.g., hindering, hitting) actions (e.g., Behne, Carpenter, Call, & Tomasello 2005; Premack & Premack, 1997); (2) they show an affiliative preference for individuals who produce positive actions over individuals who produce negative actions (e.g., Hamlin et al., 2007); (3) through evaluative contagion, they show affiliative preferences for individuals who behave positively toward individuals who have produced positive actions and for individuals who behave negatively toward individuals who have produced negative actions (e.g., Hamlin, Wynn, Bloom, & Mahajan 2011); and (4) they expect others to have similar affiliative preferences (e.g., Fawcett & Liszkowski, 2012; Hamlin et al., 2007).

***The Reciprocity Principle***

Adults expect individuals to act in accordance with a *reciprocity* principle: If A acts in some way toward B, who chooses to respond, then B’s reciprocal action should match A’s initial action in *value*, though it need not match in *form* (e.g., Jackendoff, 2007; Premack, 1990). Recent evidence indicates that by the second year of life, infants already possess an expectation of reciprocity (e.g., Dunfield & Kuhlmeier, 2010; He, Jin, Baillargeon, & Premack, 2013).

In one violation-of-expectation experiment, for example, 15-month-olds watched live events involving two unfamiliar women who sat at windows in the right wall (E1) and back wall (E2) of a puppet-stage apparatus (He et al., 2013). During the familiarization trials, E1 either gave a cookie to E2 (*give-cookie* condition) or stole E2's cookie (*steal-cookie* condition). During the test trial, while E2 watched, E1 stored stickers one by one in a colorful box; as she was about to store her last sticker, a bell rang, and E1 exited, leaving her last sticker on the apparatus floor. Next, either E2 stored the sticker in the box, thus helping E1 by completing her actions (*store-sticker* event), or E2 tore the sticker into four pieces and dropped them on the apparatus floor (*tear-sticker* event). In either case, after finishing her actions, E2 looked down and paused until infants looked away and the trial ended.

In the give-cookie condition, infants looked reliably longer at the final paused scene if shown the tear-sticker as opposed to the store-sticker event; in the steal-cookie condition, the opposite looking pattern was found. These results suggested two conclusions. First, infants expected E2 to follow the reciprocity principle: When E1 had acted positively toward E2, infants detected a reciprocity violation if E2 acted negatively toward E1; conversely, when E1 had acted negatively toward E2, infants detected a reciprocity violation if E2 acted positively toward E1. Second, infants could detect these violations even though E2's reciprocal actions toward E1 differed in form from E1's initial actions toward E2, pointing to an abstract expectation of reciprocity. These conclusions were supported by a second experiment identical to the first except that in the test trial E2 entered the apparatus only *after* E1 had exited. E2 found the sticker on the apparatus floor and, as before, either stored it or tore it up. Infants in both conditions looked about equally at the store-sticker and tear-sticker events. Because E2 did not know to whom the sticker belonged, her actions were not *wittingly* directed at E1. Therefore, the reciprocity principle did not apply, and infants held no expectations about E2's actions.

### ***The Fairness Principle***

According to the *fairness* principle, all other things being equal, individuals should treat others fairly when allocating windfall resources, dispensing rewards for effort or merit, and so on (e.g., Haidt & Joseph, 2007; Premack, 2007). Traditionally, investigations of fairness in 3- to 5-year-olds have used *first-party* tasks, where the children tested are potential recipients, and *third-party* tasks, where they are not. Perhaps not surprisingly given young children's pervasive difficulty in curbing their self-interest, a concern for fairness has typically been observed only in third-party tasks (e.g., Baumard, Mascaro, & Chevallier, 2012; Olson & Spelke, 2008). Extending these results, recent investigations using third-party tasks have revealed that infants in the second year of life already possess an expectation of fairness (e.g., Geraci & Surian, 2011; Schmidt & Sommerville, 2011; Sloane, Baillargeon, & Premack, 2012).

In one violation-of-expectation experiment, for example, 19-month-olds watched live events in which an experimenter divided two objects between two identical animated puppet giraffes (Sloane et al., 2012). At the start of each trial, the two giraffes protruded from openings in the back wall of the apparatus; in front of each giraffe was a small placemat. The giraffes "danced" until the experimenter entered the apparatus carrying two identical objects (e.g., edible cookies), and announced, "I have cookies!"; the giraffes then responded excitedly, "Yay, yay!" (in two distinct voices). Next, the experimenter placed either one object in front of each giraffe (*equal* event) or both objects in front of the same giraffe (*unequal* event). Finally, the experimenter left, and the two giraffes looked down at their placemats and paused until the trial ended.

Infants looked reliably longer at the final paused scene in the unequal than in the equal event, suggesting that, by 19 months, infants expect a distributor to divide resources fairly between two similar recipients. This conclusion was supported by two control conditions. In one, the giraffes were inanimate (they never moved or talked), and infants looked about equally at the two test events. In the other, instead of bringing in and distributing the two objects in each trial, the experimenter removed covers resting over the giraffes' placemats to reveal the objects; infants again looked equally at the two test events, suggesting that they did not merely expect similar individuals to have similar numbers of items.

### ***The Ingroup Principle***

According to the *ingroup* principle, members of a social group should act in ways that sustain the group (e.g., Baillargeon et al., in press; Brewer, 1999). The ingroup principle has two corollaries, *loyalty* and *support*, each of which carries a rich set of expectations. Ingroup loyalty dictates that in situations involving ingroup and outgroup individuals, one should (1) *prefer* and *align with* ingroup as opposed to outgroup individuals, (2) *protect* ingroup individuals who are threatened by outgroup aggressors, and (3) display *favoritism* toward ingroup over outgroup individuals (e.g., when allocating resources). Ingroup support dictates that when interacting with ingroup individuals, one should (1) engage in prosocial actions such as *helping* ingroup members in need of assistance and *comforting* ingroup members in distress, and (2) limit negative interactions within the ingroup by *refraining* from unprovoked negative actions, *curbing* retaliatory actions, and engaging in *social acting*, the well-intentioned deception adults routinely practice (e.g., white lies) to support ingroup members (Baillargeon et al., 2013; Yang & Baillargeon, 2013). Although all of these expectations are being explored with infants (see Baillargeon et al., in press), due to space constraints we focus on the first expectation in each set.

*Ingroup loyalty*. Infants align their toy and food choices with those endorsed by speakers of their native language (e.g., Kinzler, Dupoux, & Spelke, 2012; Shutts, Kinzler, McKee, & Spelke, 2009). In one preferential-reaching experiment, for example, 10-month-olds from English-speaking families sat at a table in front of a computer monitor and received four test trials (Kinzler et al., 2012). Each trial had a speech phase in which infants heard, in alternation, a woman who spoke English and a woman who spoke French, followed by a toy-modeling phase, in which the two women stood side by side, each silent, smiling, and holding a different toy animal; real-life replicas of the toys rested on the table below the monitor. Following the toy-modeling phase, infants were wheeled closer to the table to select one of the toys. Across trials, infants reliably chose the toy held by the English speaker. These results suggest that when infants face two unfamiliar women, one from their speech community and one from a different speech community, they extend ingroup status to the woman from their speech community and align their choices with hers, in accordance with the ingroup principle.

*Ingroup support*. Infants *help* an experimenter in need of assistance (e.g., Warneken & Tomasello, 2006, 2007), as long as they extend ingroup status to the experimenter through either an appropriate familiarization phase (e.g., Barragan & Dweck, 2012) or affiliative primes (e.g., Over & Carpenter, 2009). For example, Warneken and Tomasello (2007) presented 14-month-olds with three out-of-reach scenarios in which a familiarized experimenter required help (e.g., he accidentally dropped a marker on the floor and unsuccessfully reached for it). Most infants helped the experimenter in at least one scenario. Infants are less likely to *comfort* a familiarized experimenter in distress, perhaps because appropriate interventions are harder to identify (e.g., Svetlova, Nichols, & Brownell, 2010). In third-party tasks, however, infants do expect an adult to comfort a crying baby (e.g., Jin et al., 2013; Johnson et al., 2010). In one violation-of-expectation experiment, for example, 12-month-olds watched videotaped *responsive* and *unresponsive* test events (Jin et al., 2012). In the responsive event, a woman folded towels on the left side of a room; at the back of the room were a chair with additional towels and a large stroller (one could not see whether there was a baby inside the stroller). Next, a baby began to cry; the woman walked to the stroller and bent over it, as though attempting to comfort the crying baby. The unresponsive event was similar except that it involved a different woman, who walked to the chair to pick up more towels, ignoring the crying baby. Infants looked reliably longer at the unresponsive than at the responsive event; this effect was eliminated when the baby laughed in the recorded soundtrack.

**Conclusion**

The evidence reviewed in this chapter suggests that infant social cognition involves at least two evolved systems that work together seamlessly, beginning in the first year of life. The psychological-reasoning system enables infants to interpret the intentional actions of agents and is constrained by a principle of rationality (with its corollaries of consistency and efficiency). The sociomoral-reasoning system guides infants' expectations about social interactions and is constrained by several principles, including reciprocity, fairness, and ingroup (with its corollaries of loyalty and support). Although much research is needed to understand each system and its neurological basis, the present review makes clear that key components of adult social cognition are already in place in infancy.

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