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## The Birth of Social Intelligence

Annette M. E. Henderson, Sarah Gerson, and Amanda L. Woodward

University of Maryland, College Park

### Abstract

The ability to make sense out of the actions of others is critical to people's daily functioning. Adults are social experts: They understand that people's actions are directed at goals and are driven by intentions. In this article, the authors highlight key findings from studies examining infants' understanding of human action. These findings suggest that infants come to understand that intentions and attention guide human action within the first few months of their lives. By 13 months, infants understand that intentions are specific to individuals, yet there are some actions that are shared by all individuals within a group. Taken together, the evidence suggests that infants are well on their way to becoming social experts by their second birthdays.

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As adults, human beings [are socially smart: Adults understand other people's thoughts, desires, beliefs, and goals and reason that people's actions are guided by these mental states. Adults do not view simple action sequences, such as a woman grasping and raising a glass of water to her mouth, as disconnected patterns of movements. Instead, they see these events as structured in terms of obtaining a goal (of quenching her thirst) and intentionally driven by desire (for a beverage). Understanding others' intentions is important to people's daily functioning and fundamental to the process of learning from others. For these reasons, social intelligence is critical to social, cognitive, and language development.

To illustrate, consider the following situations involving two 18-month-olds at a park. Brandon and his father are playing near a basketball net. Brandon's father reaches into a bag, pulls out a ball, and walks toward the net while bouncing the ball. As Brandon's father gets closer to the hoop he raises his arm, and as he is about to release the ball, he trips. The ball flies out of his hands and bounces out of bounds. Another toddler, Sadie, is playing in the sandbox with a toy airplane and her mom is playing with a train; both objects are unfamiliar to Sadie. While Sadie's mom is playing, a truck with a shovel on it catches her eye and she proclaims, "Look! A backhoe!"

How might Brandon and Sadie interpret their caregivers' actions? In both situations, these actions are somewhat ambiguous. Brandon might think that his dad meant to drop the ball out of bounds or that his father meant to throw the ball into the hoop, but that tripping interfered with this goal. Because Sadie does not know the names of any of the objects in the sandbox, there are many possible referents of the new word that her mother has provided. What will Sadie think her mom was calling a "backhoe"? Will Sadie expect that other people will share knowledge of the meaning of the new word?

Recent research demonstrates that 18-month-olds are "socially smart" in these situations. For example, if Brandon's dad said, "Now you try," current scientific evidence suggests that

Brandon would imitate the action that his father intended to do. Brandon would not imitate his father's accidental action and throw the ball out of bounds, but would instead attempt to toss the ball in the hoop. Evidence suggests that Sadie would use her understanding of intentions to pick out cues of her mother's attentional focus to identify which object her mom was referring to with the new word. Thus, despite the ambiguities inherent in these situations, Brandon can learn what to do with the ball and Sadie can identify which object is the backhoe.

These scenarios illustrate the social cognitive skills that are within the repertoires of most 18-month-olds (e.g., Baldwin, 2000; Carpenter, Akhtar, & Tomasello, 1998; Meltzoff, 1995). To appropriately interpret these situations, Brandon and Sadie need to understand the following features of action: (a) actions are structured by goals and intentions, (b) actions are informed by a person's attention, and (c) intentions belong to individual people, but some ways of acting are shared among all members of a group. The inferences made by Brandon and Sadie are the kinds of interpretations that toddlers make on a daily basis. These demonstrations of "social smarts" indicate that toddlers apply their understanding of intentions to many different situations. A growing body of evidence suggests that this understanding does not come online as an epiphany at 18 months of age. Instead, the groundwork is laid much earlier in development. As we illustrate next, infants begin to make sense of others' actions in socially smart ways within the first 6 months of life.

The primary focus of this article is to review evidence surrounding the development of an understanding of intentions. However, we begin by describing two ways in which researchers study this development. In the sections that follow we highlight what infants understand about the intentional nature of human action. First, we review evidence that 6-month-old infants know that actions are driven by intentions and directed at obtaining goals. We also show that, by 9 to 12 months, infants know that a person's actions are guided by their attention. Finally, we demonstrate that 13-month-olds understand that, although intentions belong to individuals, there are some actions that are shared by many individuals. Taken together, evidence suggests that these abilities are present prior to 18 months and serve as precursors to the rich social knowledge possessed by children like Brandon and Sadie.

## How Researchers Study What Infants Understand

Infants' behavior in everyday social setting seems socially smart—infants follow the gaze of others, direct the attention of others, respond appropriately to others' emotional expressions, imitate the actions of others, and are active participants in social interactions. However, precise scientific tools are needed to get a detailed account of what infants truly understand. One tool used to examine what infants know is the visual habituation paradigm, which uses infants' looking time to measure their understanding of observed events (see Box 1). This paradigm relies on the fact that humans tend to look at things that are novel. Infants are shown one event repeatedly until they become bored. Then, two different test events are presented, and longer looking to one event suggests that infants view the event as novel relative to the habituation event. In imitation paradigms, infants' selective imitation of particular parts of actions tells us what they view as the important aspects of demonstrated

actions (see Box 2). Converging evidence from these paradigms suggests that, by 18 months, infants are well on their way to becoming social experts.

## Understanding Actions, Goals, and Intentions

When adults view intentional actions, they encode them according to their relation to a goal (she is reaching for the glass of water) rather than according to their physical properties (she extends her arm and closes her hand around an object). This helps them extract the most important part of an action—the goal. A study conducted by our group (Woodward, 1998, see Box 1) provided the first evidence that 6-month-old infants selectively attend to the goal of a simple grasping action. In this study, infants looked longer when a person's goal changed but not when she changed the direction of her reach, demonstrating that they saw the relation between the person and the object as the critical aspect of the grasping action during habituation. Critically, infants did not look longer when they saw a mechanical claw “grasp” the new object. Thus, infants, like adults, view actions as goal directed, and distinguish between goal-directed actions and other kinds of movements. Recent imitation findings provide converging evidence for this conclusion: By 7 months of age, infants selectively imitate action goals, but only when they view clearly goal-directed movements (Hamlin, Hallinan, & Woodward, in press).

### Goals Often Occur With a Series of Actions

Very often, a person's intentions play out not in a single action but through a series of actions. For example, when someone is reaching toward a glass in a cabinet, this action is performed as part of a sequence of events with the final goal of having a drink. Evidence suggests that, by 12 months, infants are sensitive to the goal structure of a sequence of two actions (Sommerville, Hildebrand, & Crane, in press; Sommerville & Woodward, 2005; Woodward & Sommerville, 2000). In one study, infants were repeatedly shown an event in which an experimenter pulled on one cloth in order to attain an out-of-reach toy (the goal toy) at the end of that cloth (Sommerville & Woodward, 2005). After habituation, the sides of the toys were switched so that the goal toy was on a different cloth and the experimenter reached toward the old cloth (for a new toy) or a new cloth (for the old toy). Twelve-month-olds looked longer when the experimenter reached for the old cloth, suggesting that they understood the reach for the cloth as a means to achieve the ultimate goal, the toy.

Understanding the goal of a sequence of actions is useful because it can help infants track the abstract goals that organize sequences of actions and understand indirect actions like tool use.

### Goals Are Independent of Actions

An important element of understanding intentions is the realization that a person's intentions are independent of his or her particular actions. This allows individuals to extract meaning from a person's actions even when the intended action is not successfully completed.

Evidence from imitation studies (see Box 2) demonstrates that, by 18 months, infants infer and imitate the intended actions of others (Hamlin et al., in press; Meltzoff, 1995).

Understanding that actions are guided by intentions also allows individuals to differentiate between accidental and purposeful actions. Consider our example of Brandon and the

basketball. If Brandon's father had ducked to avoid being hit by another ball thrown in his direction, rather than accidentally tripping, Brandon might infer that his father's action was intentional. Evidence suggests that, by 14 months, infants understand the difference between accidental and purposeful actions and selectively imitate only those actions they interpret as intentional (Carpenter et al., 1998). Further evidence suggests that 9-month-olds interpret actions differently depending on the context in which they occur (Behne, Carpenter, Call, & Tomasello, 1995; Gergely, Nadasdy, Csibra, & Biro, 1995).

In summary, the evidence suggests that, between 6 and 18 months, infants see others' actions as driven by intentions. With this foundation, infants can make sense of many of the actions produced by the people in their social worlds.

## **Actions Are Informed by Perception and Attention**

To this point, we have highlighted studies in which the actions have involved a direct physical relation between the action and goal-object (e.g., a person grasping an object). A second critical component to understanding intentions is the appreciation that a person's attention is linked to their actions. To illustrate, Sadie's mom was not referring to the object that she was holding, nor was it the object that Sadie was holding—it was the object at which she was looking. If Sadie only understood intentions in terms of physical relations between actions and goals, she would have assigned the new word to the object her mom was holding. However, Sadie, being like most 18-month-olds, was able to use her mom's eye gaze as an index of her attention and correctly determine that she was referring to the truck. In doing this, it is evident that Sadie understands that people's actions are guided by their attention. This knowledge about others' attentional states has its roots in the first year of life.

### **Action Is guided by Attention**

Gaze direction is perhaps the most prevalent and useful index of an individual's attentional focus. As adults, when a person turns his or her head and looks in a different direction, it is assumed that this individual is doing so in order to look at something. Evidence suggests that infants as young as 6 months use their eyes to follow gaze (Butterworth & Jarrett, 1991; D'Entremont, Hains, & Muir, 1997; Scaife & Bruner, 1975). Although infants' early gaze following may not truly reflect the understanding that changes in gaze result in changes in what people are attending to (Moore & Corkum, 1994), evidence from our laboratory and others suggests that this understanding emerges before infants' first birthdays.

In a series of visual habituation studies, our group set out to clarify whether infants understand the invisible connection between an individual's attention and his or her goal (Brune & Woodward, 2007; Woodward, 2003; Woodward & Guajardo, 2002). For example, infants were repeatedly shown an event in which an actor turned her head and looked at an object (Brune & Woodward, 2007; Woodward, 2003). For the test trials, the locations of the objects were switched and for each trial, the actor looked to the same object as before (new direction) or at a different object (same direction). Although the 7-, 9- and 12-month-old infants all followed the actor's gaze (i.e., looked at the same object as the experimenter), only the 12-month-olds looked longer at the test events in which the person was looking at

the different object. These findings offered the first direct evidence that, by 12 months, infants understand that people look at things in the world. Recently, Johnson, Ok, and Luo (2007) showed that infants as young as 9 months view gaze as goal directed in certain contexts.

### **Actions Are Guided by Attention**

As adults, if a man is seen looking toward a coffee cup, one might make a number of inferences about his intentions (e.g., he might be thirsty or want to clean up) or about what he might do with the cup (e.g., raise it to his mouth or put it in the recycling bin). Evidence suggests that infants come to appreciate the relation between attention and action soon after they realize that a person's attention is directed at things in the world (e.g., Phillips, Wellman, & Spelke, 2002; Sodian & Thoermer, 2004). To illustrate, Phillips et al. examined whether 8- and 12-month-olds could use an actor's gaze to predict her subsequent actions. Infants were habituated to two scenes. In the first scene, an actor looked and smiled at an object. In the second scene, the actor held and looked at the same object. For the test trials, infants saw the actor gaze at one object and then hold either the same object that she had previously gazed toward (consistent) or the other object (inconsistent). The 12-month-olds showed increased attention when the actor's attention was directed at a different object than the one she picked up. Eight-month-olds did not show this pattern, suggesting that they were unable to detect the oddity of looking at one object but acting on another. Thus, by 12 months, infants appreciate that information about a person's attention can be useful in predicting their subsequent actions.

### **Action Is Guided by Perceptual Experience**

To fully interpret a person's intentions, it is important to determine whether a person is actually able to see something and realize that her perceptions may differ from another person's. To illustrate, recall that Sadie's mom was looking at a truck when she produced the new label. Consider how Sadie's interpretation of her mom's intentions would be affected if she could see two unfamiliar objects in the general direction of her mom's focus of attention, but one of the objects was on the ground outside of the sandbox (out of her mom's sight). In this case, to determine the correct word-object pairing, Sadie would have to realize that her mom could not see the object that was on the ground and, thus, infer that the word was referring to the object that her mom could see.

Adults can quickly determine whether a person has perceptual access to some information and what the person is likely to know. Evidence suggests that infants between 12 and 18 months of age can identify situations in which a person's perceptual access is limited (Brooks & Meltzoff, 2002; Moll & Tomasello, 2004). Particularly impressive are the findings that infants can do this even when they have experienced something that the actor has not (Luo & Baillargeon, 2007; Onishi & Baillargeon, 2005; Tomasello & Haberl, 2003). To illustrate, Luo and Baillargeon showed that 12½-month-olds consider whether, or not, an actor had previously seen an object when they are inferring the actor's intentions. Infants watched an actor repeatedly reach toward one of two objects. The critical manipulation was whether the actor could see both objects during this phase (the infant could always see both objects). For half of the infants, the actor could not see one of the objects because it was

hidden behind an opaque barrier. At test, the actor reached toward either the same object or a new object. The findings revealed that infants took into account the perceptual experience of the actor; infants looked longer at test events in which the actor grasped the new object, but only when the actor had previously seen both objects. Thus, when the actor could see only one object in the introduction phase, infants seemed to appreciate that they had no basis to predict which object she would want at test (when both were available). Thus, by 13 months, infants can identify when a person's perceptual access might be limited and use this information to predict their future actions.

### **Summary: Intentions, Attention, and Action**

The findings reviewed thus far offer converging evidence that, by their first birthdays, infants understand quite a bit about intentions, attention, and action. By 6 months, infants understand that actions are directed at goals. Between 9 and 12 months, infants come to appreciate that attention is directed at things in the world. By 14 months, infants have a good grasp (no pun intended) of when actions are intentional and use this information in a number of important ways. With these pieces of intention understanding in place, infants can make sense of others' intentions in a multitude of contexts. However, a complete understanding of intentions requires the appreciation that, although intentions belong to specific individuals, there are some ways of acting that are shared by all individuals within a group. Existing evidence suggests that 13-month-olds make such distinctions.

### **Intentions Belong to Individuals**

Consider a situation in which an infant sees his father enter the kitchen looking frazzled. His father, who has misplaced his keys, proceeds to open and look in all of the cupboards and drawers. Seconds later, mom enters to make some lunch. She proceeds to open the refrigerator. Although his parents are both completing similar actions within a similar time frame, the infant should not assume that they share the same goal. This is because the actions of one parent do not provide information about the intentions of the other. This example highlights a critical feature of intentions: Intentions reside within individuals. As this is the case, paying attention to the person carrying out an action is critical for a complete representation of intentional action. Understanding the important link between an individual and his or her intentions helps infants learn how to extract important information as actions are occurring (e.g., who did what when). Furthermore, understanding that intentions belong to particular individuals may be a precursor to understanding intentions as internal, mental states.

Recent findings from our group suggest that infants as young as 9 months appreciate the individual and specific nature of intentions (Buresh & Woodward, 2007). In this study, 9- and 13-month-olds repeatedly saw an event in which a male actor reached toward one of two objects, in a habituation paradigm similar to the one described in Box 1. One group of infants participated in habituation and test events with the same actor throughout the study. Another group of infants saw a different actor in test trials than they had seen in habituation. If infants appreciate that intentions reside within individuals, they should not assume that a different actor would grasp the same object that the habituation actor grasped. In this experiment, infants who saw the same actor throughout looked longer when he grasped a

new object. In contrast, infants who saw a different actor at test did not look longer on either of the test trials. Thus, by 9 months, infants do not expect different individuals to have the same goal. These findings converge with those from other groups, suggesting that, by the age of 2, infants track the intentions of individuals (Moll & Tomasello, 2007; Onishi & Baillargeon, 2005; Tomasello & Haberl, 2003) and understand that it is inappropriate to extend one person's intentions to another (e.g., Graham, Stock, & Henderson, 2006; Henderson & Graham, 2005).

## Shared Actions Within a Group

Many actions that infants observe on a daily basis are driven by the intentions of individuals, but there are other actions for which it is acceptable (and actually expected) to extend actions to a group. To illustrate, we return to Sadie, whose mom provided a label for an unfamiliar object. Although her mom may have her own intentions as to why she labeled that particular object, the form of her action (the labeling utterance) can and should be extended to other individuals. This is because words are conventional—the members within a given linguistic community share knowledge of what words mean and how they are used (Clark, 1983, 1993). If Sadie appreciates that labeling actions should be shared by others, she would generalize the word-object pairing across individuals (and use this label when talking to others; see Sabbagh & Henderson, 2007).

There is a growing body of evidence suggesting that very young children appreciate that word meanings can be extended to other individuals (Buresh & Woodward, 2007; Graham et al., 2006; Henderson & Graham, 2005). For example, Buresh and Woodward examined whether 9- and 12-month-olds appreciate that object labels are extended across individuals. In these studies, infants were habituated to an event in which an actor provided a novel label (i.e., “A modi. A modi.”) before grasping one of two objects. The test events were performed by either a different actor or the same actor from habituation. If infants appreciate that object labels are shared among individuals within the same language group, it was predicted that infants would look longer when the actor used the same word to refer to a different object, regardless of which actor completed the test events. Twelve-month-olds, but not 9-month-olds, looked longer when the test actor grasped the new object after producing the object label, regardless of the actor. Thus, by 12 months, infants distinguish between actions that reside within an individual and actions that are shared. These findings are particularly compelling because they suggest that infants do not see all intentional action in the same way.

In addition to implications for language development, infants' ability to identify actions that are shared by members of a group is important for social learning, one of the primary engines of cultural transmission (Csibra & Gergely, 2006). For instance, infants' ability to identify actions that are shared might play an important role in infants' acquisition of tool use and social rituals. Because the form of shared actions is critical, infants might attend to the form of the action being carried out rather than to the person completing the action if they know it is conventional. Infants' ability to identify actions that are shared demonstrates that infants' social intelligence provides the basis for acquiring social knowledge that is appropriate for the diverse communities in which infants live.

## Conclusion

We have offered a significant amount of evidence that the origins of human social intelligence can be traced to the first 12 months of life. By their first birthdays, infants come to understand three key aspects of human action (see Box 3 for ideas about how this understanding might develop).

1. Infants understand that human action is intentional and goal directed.
2. Infants appreciate that a person's attention is an important piece to identifying their intentions.
3. Infants appreciate that intentions are characteristics of individuals, but that certain actions are shared or are conventional forms of behavior.

These basic insights into human actions provide a foundation for toddlers' robust ability to learn from social partners. With an understanding of intentions, toddlers can apply their skills to learn about the meanings of new words (Akhtar & Tomasello, 2000; Baldwin, 1993; Bloom, 2000; Tomasello & Haberl, 2003), identify the referent of a person's emotional expression (e.g., Baldwin & Moses, 1996; Moses, Baldwin, Rosicky, & Tidball, 2001), and interpret others' behavior in increasingly complicated contexts (e.g., comprehension of sarcasm). Thus, within the first 2 years of their lives, infants develop a fairly sophisticated understanding of human action from which they can acquire the skills that are necessary to become functional members of their communities and species.

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## Biographies

**Annette Henderson**, PhD, is a postdoctorate research fellow at the University of Maryland. Her research investigates the development of children’s understanding of shared goals, such as linguistic conventions, and the role that this understanding plays in language development.

**Sarah Gerson**, is a graduate student at the University of Maryland. Her research investigates the origins of infants’ understanding of intentions in human goal-directed action. She is particularly interested in the mechanisms underlying infants’ understanding of intentions and how experience affects this development.

**Amanda Woodward**, PhD, is professor of psychology at the University of Maryland. She investigates infant social cognition and early language development. Her work has been recognized by several awards including the John Merck Fund Young Scholars Award (1994), the American Psychological Association (APA) Boyd McCandless Award (2000), and a James McKeen Cattell Sabbatical Fellowship (2003–2004). She is a fellow in Division 7 of the APA and of the Association for Psychological Science.