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8

"Like Me" as a Building Block for Understanding Other Minds: Bodily Acts, Attention, and Intention

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Wayne Gretzky was a genius. He could do things on the ice that seemed magical. When asked his secret to scoring goals, he said: "Hockey is simple. You just see the game, and then you skate to where the puck will be." Other hockey players often struggle over this advice and ask: "But how do you know where it *will* be?" Gretzky just shrugs at this. He doesn't have other help to give: "You just see it. It's obvious before it happens." He can't imagine a hockey player being restricted to seeing where the puck actually is. He thinks everyone ought to be able to see what the players will do next. What a disadvantage only to see the actual, and not the future movements of other players! He might call it hockeyblindness.

Children with autism are sometimes described as having a kind of mind-blindness. They can't predict what others will do. They can see what another person is doing, but it doesn't provide enough purchase to predict what will happen next. Through rote memorization and laborious learning they can participate in repetitive social routines, but it is never quite right. Even high-functioning people with autism are a step behind in the game of social interaction, having to think through what comes naturally to us.

The normal baby, on the other hand, is facile at skating to where the social puck will be. Part of the joy, the exhilaration of interacting with normal babies is that they get the gist of what you are doing. They can meet you where the interaction is leading, without your laboriously pulling them along. You can make mistakes, and they can read what you meant to do. This simplifies things. It "slows down" the interaction for them, just as the hockey game is running in slow motion for Wayne Gretzky. The typically developing child is to a child with autism as Gretzky is to the rest of us with

respect to hockey. Typically developing children are geniuses of social cognition in comparison to children with autism.

How do young children so readily understand our behaviors, interpret our intentions, and skate to where the interactive puck will be? You could say it is "natural" for them. But we think this can be analyzed further. What seems to come naturally to normal children is actually the product of innate foundations and much development. In this chapter we will analyze the contributions from both.

Origins of Understanding Others—God Only Knows?

If we take Piaget's (1952) starting state, the newborn is in a condition of "normal autism." The neonate has only a few reflexes to work with (e.g., sucking and grasping), and the behaviors of others are registered meaningfully only to the extent that they can be assimilated to these schemes. The child battles its way out of normal autism by 18 months. This is a very long road to understanding other minds. If we take Skinner's starting state, . . . well, never mind.

We now know there is a much richer innate state than Piaget, Skinner, and all previous learning theorists ever dreamed. In this sense the nativists have won the battle over the newborn's mind. But some of us think that there are also developmental changes that occur as a result of infants' using this innate state to interpret input from the rich social environment. We call this "starting-state nativism," as opposed to "final-state nativism" (e.g., Gopnik and Meltzoff 1997; Meltzoff and Gopnik 1993). On this view, evolution has provided the human newborn with "discovery procedures" for developing adult common-sense psychology, but the final state is not specified at birth or through maturation alone. Starting-state nativism is different from Piaget's and Skinner's views, but it is also different from Fodor's.

Chapter 1 of Fodor's (1987) rather slim guide to human development says:

> Here is what I would have done if I had been faced with this problem in designing *Homo sapiens*. I would have made a knowledge of commonsense *Homo sapiens* psychology *innate*; that way nobody would have to spend time learning it. . . . The empirical evidence that God did it the way I would have isn't, in fact, unimpressive. . . . Suffice it that: (1) Acceptance of some form of intentional explanation appears to be culturally universal. . . . (2) At least in our culture, much of the apparatus of mentalistic explanation is apparently operative quite early. . . . (3) I take the lack of a rival hypothesis [to nativism] to be a kind of empirical evidence; and there are, thus far, precisely no suggestions about how a child might acquire the apparatus of intentional explanation "from experience."

Fodor is not alone in invoking God. Galileo (1613) reasoned that God would have taken exactly the opposite approach regarding worldly experience:

> And who wants to set bounds to the human mind? . . . I do not think it is necessary to believe that the same God who has given us our senses, reason, and intelligence wished us to abandon their use, giving us by some other means the information that we could gain through them.

For Galileo, God would set few bounds and would maximize learning from experience. For Fodor, God would set many bounds and would not waste our time with learning. Does it all come down to who has God on his side? Developmental psychologists are not immune to such religious wars, but we take a different approach. We consult the newborns. It's our job to do the dirty (sometimes quite literally) work. We have learned quite a bit.

From Shared Acts to Shared Minds: A Developmental Hypothesis

Newborns do not do much in the way of intentional interaction, but one surprisingly "sophisticated" thing they can do is imitate bodily acts of other people (Meltzoff and Moore 1977, 1983, 1989). This sensitivity to human acts and ability to map equivalences between self and other provides leverage for understanding the beginnings of social cognition.

For newborns, *human acts* provide the most elementary parsing of the world into entities that bear on self-other relations and those that do not. Human acts are especially relevant to infants because they are visual manifestations of how the infant feels itself to be and because they are movements infants can intend. Of all the sights in a room—a stethoscope, clothes, a bed, a shimmering light—the human act is something interpretable: "That (seen) event is like this (felt) event." There is a cross-modal match between the acts seen in others and the acts done by the self. It is not simply the static features of the adults—eyes, hair, smell—that are special for infants; it is also the way the adult's body moves and its relation to the self. The fact that infants can re-create the acts with their own bodies allows infants to give them special meaning.

Infants' attention to and imitation of human acts has interesting developmental sequelae:

- The world of material objects is then divisible into those that perform human acts (people) and those that do not (things).

- Because human acts are seen in others and performed by the self, the infant can represent the other as "like me": I can act like the other and reciprocally the other acts like me. Persons are special entities, the only entities in the world with whom I can share behavioral states. *The cross-modal knowledge of what it feels like to perform observed acts provides a privileged access to people not afforded by things.* This sets the child down the pathway of ascribing psychological properties to people.

Three things give infants a jump start on common-sense psychology:

innate equipment Infants can recognize equivalences between perceived and executed acts. This is a starting state, as documented by imitation in newborns (Meltzoff and Moore 1997).

intra-personal experience When infants perform bodily acts themselves (when lying in their crib, in social interaction, etc.) they have certain mental experiences. For example, emotional expressions or effortful strivings considered merely bodily acts are systematically related to certain mental states.

inter-personal inference When infants see others acting "like me," they project that others have the same mental experience that goes with those behavioral states in the self. This gives infants some purchase on understanding others, establishing a kind of toehold until spoken language can be used.

Infants do not need to have adult common-sense psychology "preloaded" into the mind. It could develop, at least in a very elementary and schematic form, on the basis of the similarities between self and other at the level of acts. This is not Piagetian "natural autism." Nor is it Skinnerian learning

by shaping and reinforcement. Fodor's claim that these are nonstarters for the growth of common-sense psychology may be correct. Starting-state nativism embraces innate imitation and cross-modal mapping between self and other and suggests that infants can elaborate their understanding of others by processing them as "like me." Infants learn about others by analogy to the self, but this "analogy" is not based on years of thinking things through; it is, rather, the starting point.[1]

Infants' Earliest Construal of Bodily Acts

Twenty years of research has established that early facial imitation is innate and also goal directed and purposeful. This particular starting state was not imagined in the armchair. The empirical work takes some patience to get through but is worth the trouble; the data give teeth to the notion of an innately based "like me" mechanism.

Innateness

According to classical theory, young infants were incapable of imitating facial gestures. The problem was as follows: Although infants can see another person move, they have no visual access to their own faces. Similarly, they can feel their own faces, but have no access to the "feeling of movement" (an internal state) of the other. There seems to be a gulf between self and other. Self and other seem to be known in fundamentally different ways.

How can the infant connect the visible others with nonvisible aspects of self? Such links were thought to be forged through postnatal learning. To eliminate such learning we tested imitation in newborn babies, the youngest only 42 minutes old (Meltzoff and Moore 1983, 1989). The results demonstrated successful facial imitation. Apparently, facial imitation is innate.

Flexibility and Purposefulness

Some form of nativism is called for, but this by no means ends the discussion. The spectrum of choices now ranges from reflexive, wholly stimulus-driven behavior to a more goal-directed cross-modal matching of human acts. It makes a difference to our theories of mind to determine whether the newborn is simply a collection of reflexes or is capable of acting intentionally.

One relevant finding concerns the range of gestures that can be imitated—the generativity of the phenomenon. Numerous independent studies report tongue-protrusion and mouth-opening imitation in infants less than 2 months old. Early imitation has also been reported for components of emotional expressions and for a variety of other gestures, including head movements, brow and cheek movements, and hand gestures. (For a review, see Meltzoff and Moore 1997.)

Other research explored whether early imitation is rigidly time-bound and stimulus-driven in the manner of the classic reflexes. The evidence shows it is not. In one study infants were shown gestures while they had a pacifier in their mouths which engaged the sucking reflex. There was no attempt to imitate during the display. The adult then assumed a neutral face and removed the pacifier. Infants initiated imitation over the next several minutes while looking at the neutral face (Meltzoff and Moore 1977). In a more dramatic example, 6-week-olds imitated across a 24-hour delay. Infants saw a gesture on one day and returned the next day to see the adult with a neutral-face pose. Infants stared at the face and then imitated yesterday's act from long-term memory (Meltzoff and Moore 1994). It makes little sense to say that infants have a "reflex" that fires 24 hours after the target act has disappeared! They were imitating on the basis of their remembrance of things past. (See also Meltzoff and Moore 1992.)

Goal Directedness

A characteristic of goal-directed action is that it converges toward the goal along flexible routes (Heider 1958). Such goal directedness has been demonstrated in early imitation. Infants gradually correct their imitative attempts in order to achieve a more accurate match to the target. This systematic error correction occurs even when the adult gives no feedback to the child (Meltzoff and Moore 1994).

Infants also respond in "creative" ways. One study showed infants the novel gesture (not seen in their base-line activity) of poking out the tongue at 45° off midline (from the side of the mouth). Infants responded by doing straight tongue protrusions and simultaneously turning their heads to the side, which results in their own version of a kind of sideward tongue protrusion (Meltzoff and Moore 1997). Although the literal muscle movements differed, the *goal* of the act is similar. Tongue protrusion + head turn is a creative error.

Correction of imitative responses and creative errors suggest a common story. In the former, infants make repeated attempts, and their intention is not satisfied by the initial motor performance stemming from it. This suggests that there is a differentiation between the representation of the target act that was derived from the external world and the representation of the infant's own body acts. The goal is apparently to bring these two into congruence. Creative errors suggest that the response is not simply "released" in the manner of a classic reflex but is actively constructed.

Mechanism of Self-Other Mapping

Taken as a whole, the findings suggest that early imitation is based on active cross-modal mapping (Meltzoff and Moore 1994, 1995, 1997). Figure 1 provides a schematic of this hypothesis. The central notion is that imitation, even early imitation, is a matching-to-target process. The goal or behavioral target is specified visually. Infants' self-produced movements provide tactile-kinesthetic feedback that can be compared to the visually specified target. Meltzoff and Moore propose that such comparison is possible because both perceived and performed human acts are represented

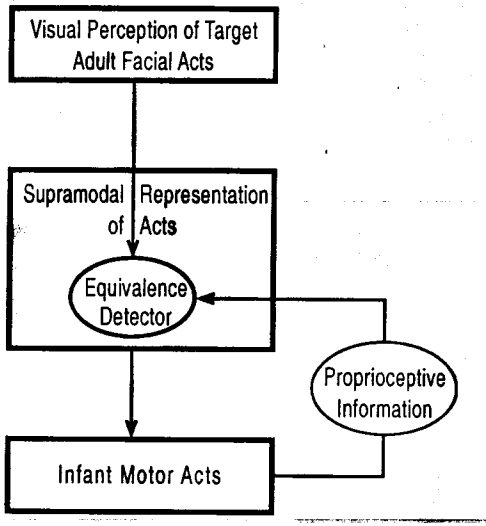

Figure 1
Facial imitation is based on cross-modal matching between self and other (reprinted from Meltzoff and Moore 1997).

within a common, "supramodal" framework. On this view, the infant's representation of bodily acts is not restricted to modality-specific terms. The bodily acts of self and other can be related by making visual-kinesthetic cross-modal comparisons. Other research has provided converging evidence for cross-modal equivalences of form (not simply timing) using both tactile-visual (Meltzoff and Borton 1979) and auditory-visual (Kuhl and Meltzoff 1982, 1984) tests; therefore, infants' matching of the *form* of the bodily acts fits with a larger body of research. A more detailed analysis of the cross-modal "metric of equivalence" thought to be used in facial imitation can be found in Meltzoff and Moore 1997.

We conclude that young infants engage in comparisons between themselves and others. This is a starting point for social cognition, not an endpoint reached after months of postnatal learning. Our intention for the remainder of the chapter is to show that further developments in social cognition may be grounded in the cross-modal equivalences between self and other that are first manifest in early imitation.

Infants' Construal of Shared Games

Let us assume a starting state of innate cross-modal mapping and imitation. What happens when we add social interaction and culture to the mix? Instead of thinking that social interaction molds a blank slate, we immediately see that the rich starting state allows the child to interpret interpersonal exchanges in special ways.

Adults across cultures play reciprocal imitative games with their babies. The social literature emphasizes the temporal turn taking of these games (Brazelton and Tronick 1980; Bruner 1975, 1983; Stern 1985). Timing and contingency detection are important, but we think these games are uniquely valuable because of the structural congruence between self and other. Physical objects may come under temporal control. Only people who are paying attention to you and acting intentionally can match the form of your acts in a generative fashion. Only people can act "like me."

Meltzoff tested whether infants recognize when another acts "like me" and the emotional consequences of this experience. A broad range of ages was used, from 6 weeks to 14 months. One experiment involved 14-month-olds and two adults. One of the adults imitated everything the baby did; the other adult imitated what the previous baby had done. Although both

adults were acting in perfectly infantile ways, and thus were good controls for one another, infants reacted differentially. Infants selectively looked longer at the person who was imitating them and also smiled more often at that person (Meltzoff 1990).

This selective looking and affect could be based on temporal contingency detection. We examined this in the next study by having both adults act at the same time. When the infant happened to produce a behavior from a predetermined list, both adults sprang into action. One of the adults matched the infant; the other performed a mismatching response. Thus, both of the adults acted contingently on the infant. Infants looked significantly longer and smiled more at the imitator. Evidently, infants recognize a deeper commonality between self and other than timing alone—they recognize an adult acting "just like me," not "just when I act."

Infants also exhibited "testing behavior," which indicated that they were interested in working out the causal relations. When infants performed these tests, they made sudden and unexpected movements while staring at the adult, as if to check whether the adult was intentionally copying them. For example, the infant might slide the toy across the table as it stared at the adult's face, then modulate its act by going faster and faster as if to check if the experimenter was shadowing . . . or suddenly freeze all actions to see if the experimenter froze. (Infants acted much like Groucho Marx in front of a "mirror" in *Duck Soup* when he is trying to determine whether he is seeing a reflection of himself or merely someone acting like him.) Infants selectively directed this testing behavior to the adult who was acting "like me."

We found this pattern of behavior at all the ages we tested down to about 9 months. However, this is not an innate reaction. Infants in the first months of life are attentive to being imitated, but they don't switch to mismatching gestures to test if they will be copied. For example, if an adult systematically matches a young infant's mouth opening and closing, the infant's attention is attracted, and it generates more of this behavior, but it doesn't switch to tongue protrusion to test this relationship. Older infants go beyond this and treat the interaction as a generative matching game. Older, but not younger, infants seem to abstract the notion that the game is "you do as I do," where the particular behaviors are infinitely substitutable. Older infants do not simply register behavior-to-behavior links, as neonates do, but the abstraction of a "matching game" generalized across particular instances.

"Like Me" + Social Interaction as an Engine for Developing Intentionality

Once the social interaction is construed at this abstract level, it provides an occasion for infants to go beyond surface behaviors to the intentions that underlie them. Here are four things infants can abstract from mutual-imitation games:

- The adult's behavior matches the infant's.
- It is not a chance congruence but a systematic following of the infant's acts.
- The specific behaviors don't matter, because the game is "to match."
- From the infant's viewpoint, its own novel behaviors are intended acts.

Taken together, these four points provide the grounds for infants' enriching their construal of others on the basis of an analogy to the self: the infant purposely produces and systematically varies its own acts, the other systematically performs matching acts, perhaps the other also is acting purposively. This new construal would expand interpersonal understanding beyond that of the neonate. On the one hand, the infant now ascribes more to the other; the adult is a purposive other. On the other hand, the infant is construing self and other as equivalent agents—bearers of commensurate psychological properties, not just common body movements.

Infants' Construal of Intentional Acts

In adult common-sense psychology, people are agents just like me who have intentions like my own. What do we know about the infant's understanding of the intentions of others?

Gergely, Nádasdy, Csibra, and Bíró (1995), Wellman and Phillips (this volume), Woodward, Sommerville, and Guajardo (this volume), and other researchers have developed preferential-looking procedures to help get at this question. Meltzoff (1995) developed a more active procedure: a nonverbal procedure called the "behavioral reenactment technique." The procedure capitalizes on imitation, but it uses this proclivity in a new, more abstract way. It investigates infants' ability to read below the visible surface behavior to the underlying goals of the actor.

One study involved showing 18-month-olds an unsuccessful act, a failed effort (Meltzoff 1995). For example, the adult "accidentally" under- or overshot his target, or he tried to perform a behavior but his hand slipped several times; thus the goal state was not achieved. To an adult, it was easy to read the actor's intention even though he did not fulfill it. The experimental question was whether infants also read through the literal body movements to the underlying goal of the act. The measure of how they interpreted the event was what they chose to re-enact. In this case the "correct answer" was not to copy the literal movement that was actually seen, but to copy the actor's goal, which remained unfulfilled.

The study compared infants' tendency to perform the target act in several situations: after they saw the full target act demonstrated, after they saw the unsuccessful attempt to perform the act, and after it was neither shown nor attempted. The results showed that 18-month-olds can infer the unseen goals implied by unsuccessful attempts. Infants who saw the unsuccessful attempt and infants who saw the full target act both produced target acts at a significantly higher rate than controls. Evidently, young toddlers can understand our goals even if we fail to fulfill them.

In a recent extension, Meltzoff (1999) sought the earliest age at which infants inferred absent goals. The results suggest it is first manifest between 9 and 15 months. Fifteen-month-olds behaved much like the 18-month-olds in the original study. Nine-month-olds, however, did not respond above base-line levels to the "failed-attempt" demonstrations, although they could succeed if the adult demonstrated successful acts.

In further work, 18-month-olds were shown the standard failed attempt display, but they were handed a trick toy. The toy had been surreptitiously glued shut before the study began (Meltzoff 1996). When infants picked it up and attempted to pull it apart, their hands slipped off the ends of the cubes. This, of course, matched the surface behavior of the adult. The question was whether this imitation of the adults' behavior satisfied the infants. It did not. When infants matched the surface behavior of the adult, they did not terminate their behavior. They repeatedly grabbed the toy, yanked on it in different ways, and appealed to their mothers and the adult (cf.

Baldwin, Markman, and Melartin 1993). Interestingly, 90 percent of the infants looked up at an adult immediately after failing to pull the trick toy apart. They did so with a mean latency of less than 2 seconds, and they vocalized while staring directly at the adult. Why were they appealing for help? They had matched the adult's surface behavior, but evidently they were striving toward something else: the adult's goals, not his literal behavior. This eliminates the possibility that infants in the original study had merely tried to imitate the surface behavior of the adult (hands slipping off the cubes) and had pulled the toy apart by mistake.

If infants are picking up the underlying goal or intention of the human act they should be able to achieve the act using a variety of means. This was tested in a study using a dumbbell-shaped object that was too big for the infants' hands (Meltzoff 1996). The infants did not attempt to imitate the surface behavior of the adult. Instead they used novel ways to struggle to get the gigantic toy apart. They might put one end of the dumbbell between their knees and use both hands to pull it upward, or put their hands on inside faces of the cubes and push outward, and so on. They used *different means* than the experimenter, but toward the *same end.* This fits with Meltzoff's (1995) hypothesis that infants had inferred the goal of the act, differentiating it from the literal surface behavior that was observed.

Another study investigated how 18-month-olds responded to a mechanical device that mimicked the movements made by the actor in the failed-attempt condition. A device was constructed that had poles for arms and mechanical pincers for hands. It did not look human, but it traced the same spatiotemporal path that the human actor traced and manipulated the object much as the human actor did. The results showed that infants did not attribute a goal or an intention to the movements of the inanimate device when its pincers slipped off the ends of the dumbbell just as the actor's hands did. Although infants looked at it as long as at the human display, they simply did not see the sequence of actions as implying a goal. Infants were no more (or less) likely to pull the toy apart after seeing the failed attempt of the inanimate device than they were in base-line levels when they saw nothing.

In a final study (Meltzoff 1996), the inanimate device succeeded in pulling the dumbbell apart. After witnessing this display, infants were given

the dumbbell. They too pulled it apart. Evidently, infants can pick up certain information from the inanimate device, but not other information: They can understand successes, but not failures. This makes sense because successes lead to a change in the object, whereas failures leave the object intact and therefore must be interpreted at a deeper level.

In summary, the infants distinguished between what the adult meant to do and what he actually did. They ascribed goals to human acts; indeed, they inferred the goal of a sequence of behaviors even when the goal was not attained. This differentiation lies at the core of our common-sense psychology. It underlies fluid communication as well as our moral judgments (Baldwin and Moses 1994; Bruner 1999; Chandler, Sokol, and Hallett, this volume; Kaplan, this volume; Tomasello and Barton 1994). The infants in these experiments already exhibit a fundamental aspect of our common-sense psychology: the acts of persons (but not the motions of unambiguously mechanical devices) are understood within a framework involving goals and intentions.

Infants' Construal of Attentional Acts

Other people not only intentionally manipulate objects; they also attend to objects from afar. They direct their perceptual systems toward objects and thereby pick up information about them despite the spatial gap. In common-sense adult psychology, we ascribe intentionality to the gazer. How do infants interpret the bodily act of an adult turning her head and eyes to look at an object? When do they begin to interpret this act as indicating that the adult is psychologically connected to the object of their gaze?

A great deal of research has been aimed at dissecting what is going on when an infant follows the gaze of another person (Baron-Cohen 1995; Baldwin and Moses 1994; Butterworth 1991; Moore 1999; Moore and Dunham 1995; Scaife and Bruner 1975). One debate concerns whether gaze following indicates anything more than the infants' being attracted to the spatial hemi-field toward which the adult's head is turning. At the most elementary level, a young infant might simply track the adult's head movement and thereby swing its own head to the correct half of space, without any notion of the adult's "attention to an object" or even the object directedness of the adult's gaze (Butterworth and Cochran 1980; Corkum and Moore

1998; Hood, Willen, and Driver 1998; Moore and Corkum 1994). This kind of lean interpretation has garnered support from experiments showing various types of errors infants make before about 18 months (Butterworth and Jarrett 1991; Corkum and Moore 1995, 1998; Morissette, Ricard, and Décarie 1995; Moore and Corkum 1998).

We recently reexamined gaze following by infants. We began by investigating a specific question: whether infants are restricted to using gross cues such as head movements. We set up a standard gaze-following test in which an adult looked at one of two objects. The infants were 12, 14, and 18 months of age. Two identical objects were used, so toy preferences were controlled, and the adult turned in silence with no verbal or emotional cues. The interesting manipulation was that the adult turned to the target object with eyes *open* for half the infants and with eyes *closed* for the other half (Brooks and Meltzoff 2000). In both cases infants saw a person who had been interacting contingently and talking with the infant before the trial. If infants relied on gross head motions, they should turn indiscriminately. If they relied on a general top-down rule and looked in the same direction as a "contingent interactant with a face," they should also look whether the adult's eyes were open or closed.[2]

The findings were that both 14-month-olds and 18-month-olds turned selectively—they turned significantly more often toward the target object in the eyes-open condition than in the eyes-closed condition ($p < 0.01$). The 12-month-olds showed a trend toward this selectivity, and we are currently conducting further tests to clarify the effects at this transitional age. One interpretation of these findings is that 14-month-olds have begun to realize that attending/looking is not a fixed property of animate agents. The same person may either be a perceiver/looker or not, depending on the status of his or her perceptual systems.

Taken in isolation, studies of gaze following are open to several interpretations. (See, e.g., Baldwin 1993a, 1995; Baldwin and Moses 1994; Carpenter, Nagell, and Tomasello 1998; Flavell 1999; Johnson 2000; Moore and Corkum 1994; Taylor 1996.) Therefore, Brooks and colleagues used converging methods (Brooks 1999; Brooks, Caron, and Butler 1998). They modified Woodward's (1998, 1999) procedure for investigating goal-directed reaching and used it to examine whether infants coded the link between the adult and the physical target of the adult's gaze.

In the Brooks work, 15-month-olds and 18-month-olds saw a videotape of a person who silently turned and oriented toward one of two toys (figure 2). After familiarization with this scene, the toy positions were laterally switched and infants saw two test events. In one, the person made the same head motion to the same location as in the familiarization trials. Thus, the head motions remained identical, but the adult was now oriented toward a new toy (new target/old side). In the other test event, the person made a head movement in a new direction; thus, she was oriented toward the old toy (old target/new side). The importance of eyes was tested in both conditions, with half of the infants presented with head turns with the adult's eyes-open and half with the adult's eyes closed.

If infants are coding the familiarization event in terms of the person-object link, they should look longer at the new target/old side event (figure 2, left panel). It does not maintain the original link between the person and the toy. If infants are coding the familiarization event in terms of the physical movements of the head, they should look longer at the old target/new side event. The person makes a novel head movement (figure 2, right panel). This logic

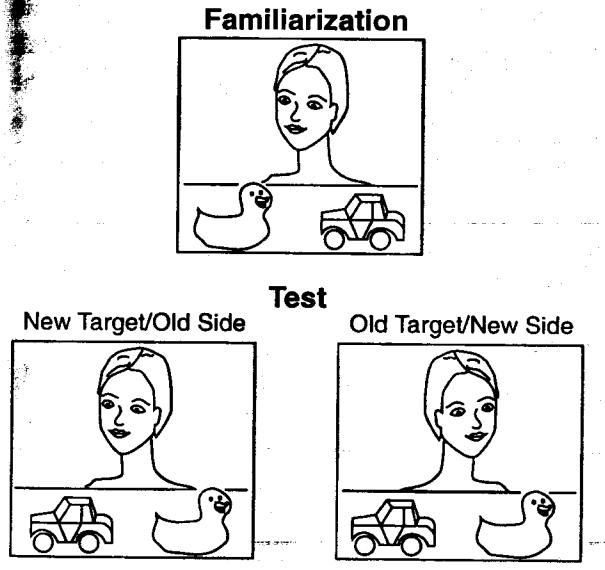

Figure 2
Preferential-looking procedure used to test infants' construal of adult gaze toward objects (adapted from Brooks 1999).

is identical to Woodward's studies of manual grasping movements.[3] The study extends the work on manual grasping in that the adult is not physically interacting with the toy but has a distal relation to it and in that the adult's eyes are either open or closed. The eye open–eyes closed manipulation allows for a stringent test of whether infants are coding the link between the gazer and the target. If so, they should look longer when the adult orients to the new object *only* when the adult's eyes are open and not when they are closed.

The results (figure 3) fit with this prediction. In the eyes-open condition, infants looked longer when the adult turned to look at the new toy (new target/old side) than when she turned to look at the old toy (old target/new side event), $F(1, 23) = 7.26$, $p < 0.05$. In the closed-eyes condition, they did the reverse and responded purely on the basis of the gross physical movements involved. Infants looked longer when the adult turned to the new side ($F(1, 23) = 4.68$, $p < 0.05$). This distinction between closed and open eyes remained significant at each age.

We thus have two studies that manipulated eyes open versus eyes closed using different techniques. The results suggest the same story—a comforting situation when comparing preferential-looking measures and action measures (and one that does not always obtain; see Meltzoff and Moore 1998). The findings do not prove that infants ascribe to the adult an "internal experience of attending," but they certainly move beyond the

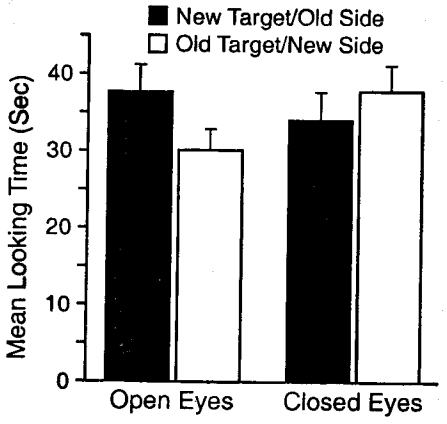

Figure 3
Mean looking time for infants ($n = 25$ per condition) viewing the stimuli portrayed in figure 2.

leanest interpretations of gaze following. Taken together they suggest that 14–15-month-olds represent the "object directedness" of adult gaze. (See also Wellman and Phillips, this volume.) In the adult framework, it is not enough to face the right way; you have to be looking in order to see. Not all people are visual perceivers; only those with open eyes are. As every parent of a teenager knows, "Face me" is not the same as "Look at me!" Fourteen-month-olds are beginning to make this critical distinction in common-sense psychology.

Conclusions: The "Like Me" Analogy

The foregoing research invites speculation about infants' construal of human acts as goal directed and about the "like me" analogy as a foundation for social cognition.

Goal Directedness of Acts

In Piagetian theory, infants acting in goal-directed ways and interpreting the goal directedness of others were slow to emerge (e.g., means-ends development, Piaget 1952, 1954). The research discussed in this chapter and elsewhere (e.g., Baird and Baldwin, this volume; Meltzoff and Moore 1995, 1997; Woodward et al., this volume) indicates that seeing human acts as goal directed is far more basic.

Three examples suffice to make this point:

- Woodward's (1998, 1999) work shows that young infants construe a reach-and-grasp event in a goal-directed manner.

- Experiments on infant understanding of adult gaze by Brooks and Meltzoff and many others (e.g., Wellman and Phillips, this volume; Woodward 2000) indicate that infants understand the object directedness of an adult act even when the adult has only a distal relationship with the object. The perceptual act is directed toward an external target or goal.

- Meltzoff's (1995, 1996) studies demonstrate that toddlers can infer unseen goals on the basis of an adult's failed attempts. They attribute invisible goals to human acts.

Evidently, infants construe human acts in goal-directed ways. But when does this start? We favor the hypothesis that it begins at birth. The relevant data come from the studies of how neonates code and imitate human acts. Of course, neonates are focused on elementary problems. They are concerned with understanding human acts themselves, not adults' physical manipulations of objects or adults' attention to distal objects. However, the available data show that infants first parse human acts in terms of goals rather than physical motions in space, specific muscle movements, and the like.

Consider, for example, the neonates' reaction to seeing the novel gesture of sideward tongue protrusion. Their responses provide critical clues to their representation of human acts. Infants produced a straight tongue protrusion coupled with a simultaneous head turn. It is only at the level of *goals* that the infant's head turn is relevant to the adult's act. Although the literal muscle movements were very different, the *goal* of the perceived act and the executed act was the same.[4]

The hypothesis is *not* that neonates represent goal directedness in the same way that adults do. In fact, neonates probably begin by coding the goals of pure body acts and only later enrich the notion of goals to encompass object-directed acts. The claim here is simply that infants begin by interpreting human behavior in terms of acts and goals, not muscle movements or physical motions. This seems to be the starting state.

The "Like Me" Analogy as Foundational

Let us return to the religious wars mentioned at the beginning of this chapter. There are two chief worldviews concerning the roots of common-sense psychology. Fodor's is that infants innately assign adult common-sense psychology to people, without having to waste time learning it. Variants of this view propose that the assignment may first be made to a broader class than people—to "self-propelled objects" (Premack 1990) or "entities with eyespots" (Baron-Cohen 1995)—but the core idea is the same. The opposing school of thought (advocated by those too numerous to cite) is that newborns are devoid of common-sense psychological attributions. Advocates of this school begrudgingly grant that newborns may be attracted to facedness and biological movement, but these are seen simply as perceptual attractors. Infants learn the adult common-sense psychology through social interaction with adults.

Starting-state nativism offers the beginnings of a third way—which means it can be attacked by both factions! It grants far more to the newborn than the second view, while stopping short of the first. In particular, we suggest that coding the "like me" analogy between self and other is a starting point of social cognition. The "like me" analogy is a discovery procedure infants use to learn about people, but it is not itself a product of learning. Newborns bring it to their very first interactions with people, and it provides an interpretive framework for understanding the behavior they see.

It has long been appealing to think that "like me" is involved in our common-sense psychology (Goldman, this volume). Empathy, role taking, and all manner of putting oneself in someone else's shoes emotionally and cognitively seem to rest on the equivalence between self and other. The problem was that the self-other equivalence was thought to be late developing and therefore could not be playing a formative role.

Twenty years of research on infant imitation revises the time frame. It indicates that young infants can represent the acts of others and their own acts in commensurate terms (Meltzoff and Moore 1995, 1997). They can recognize cross-modal equivalences between the acts they see others perform and their own tactile-kinesthetic sense of self. Moreover, the cross-modal comparisons run in both directions—infants can imitate (mapping from other to self) and can recognize being imitated (mapping from self to other).

In view of this facile self-other mapping, input from social encounters is more interpretable than is supposed by "blank-slate" theories. Infants have a storehouse of knowledge on which to draw: they can use the self as a framework for understanding of the other. Having performed an act, the infant has subjective, experiential knowledge of that act.

Armed with a cross-modal representational system, the infant can interpret a seen act in terms of its own subjective experience. For example, the infant knows that when it wants something it reaches out and grasps it. It experiences its own internal desires and its bodily hand extension and finger curling. When it sees another person reaching for an object, it sees the person extending his hand in the same way, complete with finger curlings and facial expressions matching the infant's own. We know that infants can detect the similarity between their own manual movements and those they see adults perform—for example, they imitate manual movements (Meltzoff

and Moore 1977, 1997; Piaget 1962). The experience of grasping to satisfy desires gives infants leverage for making sense of the grasping behavior of others. Thus, a basic "like me" analogy may underlie the behavior that Woodward (1998, 1999) reports.

A similar argument applies to the goal-directed "striving" and "try and try again" behavior used in Meltzoff's (1995, 1996) studies. Infants have experienced their own desires and acts of "try and try again." When an infant sees another act in this same way, the infant's self-experience could suggest that there is a goal beyond the surface behavior itself; the surface behavior would be seen as a familiar "type" indicating effortfulness or striving, rather an end in itself.[5]

Finally, even making sense of others' visual perception could benefit from experience of oneself as a looker/perceiver. Infants in the first year of life can imitate head movements and eye blinking (Meltzoff 1988; Meltzoff and Moore 1989; Piaget 1962). As unlikely as it seems at first blush, these data indicate that infants can map between the head movements they see others perform and their own head movements, and between adults' eyelid closures and their own eye closures. Infants' subjective experiences gained from "turning in order to see" could be used to make sense of the head movements of others who are orienting toward an object. Moreover, the infant's experience is that "closed eyes" cuts off the infant's own perceptual access. If an infant can map the eye closures of others onto its own eye closures (something infants manifest in imitating blinking), these mappings may provide data for developing inferences about perception in others.[6]

Starting-state nativism does not deny development; it embraces it. The innate equipment undergirds development through interaction with others who are perceived as "like me." What an infant learns about itself is used to interpret others, and what it learns from watching others changes the infant. Normal infants are Wayne Gretzkys of common-sense psychology: they have innate gifts not possessed by everyone (autistic children? nonhuman animals?), and they exercise these gifts all day long, for years on end, as long as they can find friends to play with. This results in an adult who seems to understand the game naturally and effortlessly.

Without an initial grasp of others as "like me," common-sense psychology would never get off the ground; however, without social interaction, common-sense psychology would not take the form it does.

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Notes

1. The onset of language provides a more efficient means of probing others' mental states (but even language is not fail-safe: my "red" may not be the same as your "red"). The claim is not that language is unimportant. The idea is that the "like me" analogy plays a powerful role in understanding others during the first two years before linguistic exchanges are of use. Two caveats: (1) "Like me" is more useful in interpreting emotions, desires, and purposiveness, rather than beliefs, because the former have relatively more visible indicators. (2) "Like me" more easily contributes to understanding congruences than it contributes to divergences in the mental states of self and other. Adults and older children have clearly outgrown such limitations, but they fit well with the empirical findings from preverbal infants (Gopnik, Meltzoff, and Kuhl 1999; Meltzoff, Gopnik, and Repacholi 1999; Repacholi and Gopnik 1997).

2. The results of Johnson, Slaughter, and Carey (1998) raise the latter possibility.

3. Woodward (2000) also recently tested looking.

4. For further discussions of the coding of humans acts in terms of goals, see Meltzoff and Moore 1997 and Gleissner, Meltzoff, and Bekkering 2000.

5. The similarity between self and other does not specify the content of the adult's goal unless that goal is familiar to the child. In cases of novel goals, "like me" simply indicates to the child that there is a goal beyond the surface behavior. It indicates effortfulness—that the adult is striving for something beyond what they are doing. An additional inferential process comes into play to determine the nature of the invisible goal. Thus, the "like me" analogy is supplemented by an inferential system (Gopnik and Meltzoff 1997).

6. In the case of understanding others' visual experiences, there is an obvious need for an additional inferential process beyond the basic self-other mappings. Multitiered systems of this sort have been suggested in social cognition and other domains (Baird and Baldwin, this volume; Gopnik and Meltzoff 1997; Meltzoff and Moore 1998; Povinelli, this volume).