Minnesota Symposia on Child Psychology

Meeting the Challenge of Translational Research in Child Psychology

Volume 35

Edited By

Dante Cicchetti

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WILEY

John Wiley & Sons, Inc.

2009

CHAPTER

2

Roots of Social Cognition: The *Like-Me* Framework

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ROOTS OF SOCIAL COGNITION: THE *LIKE-ME* FRAMEWORK

There are three chief reasons why people pursue child development. They want to: (a) help their own child, (b) help other people's children, or (c) understand the causes and mechanisms of child development. The first reason is grounded in a concern for an individual. The second is motivated by a class of people. The third is driven by the pursuit of abstract knowledge. The first two are based on practical concerns and the third on a quest for knowledge.

The parents I see in my laboratory are typically motivated by the first reason. Dr. Benjamin Spock devoted his professional life to the second. Piaget was impelled by the third. Of course, these motives are not mutually exclusive. A practitioner may start off wanting to help children and

This research was supported by NICHD (HD-22514), the National Science Foundation (SBE-0354453), and the Tamaki Foundation. The thoughts expressed in the paper are those of the author and do not necessarily reflect the views of these agencies. I thank R. Brooks, P. Kuhl, C. Harris, and C. Fisher for help on this chapter and A. Gopnik and K. Moore for useful conversations on the matters discussed here.

become captured by the purely abstract issues. A researcher may begin by pursuing abstract knowledge and then be touched by real-world concerns. Over the course of their careers some people such as Piaget (1970) and Bruner (1960), both of whom became interested in improving education, successfully span both theory and practice.

Can we weigh these motives or rank them in relation to each other? Leonardo da Vinci, no stranger to combining theory and practice, asserted:

> Those who are in love with practice without knowledge are like the sailor who gets into a ship without rudder or compass and who never can be certain whither he is going. Practice must always be founded on sound theory. (*Notebooks*, entry 19)

Or even more bluntly, "Science is the captain and practice the soldiers" (*Notebooks*, entry 1160). This fits with C. P. Snow's (1964) influential two-culture thesis that emerged from his experiences at Cambridge University:

> We prided ourselves that the science that we were doing could not, in any conceivable circumstances, have any practical use. The more firmly one could make the claim, the more superior one felt. (p. 32)

The modern view differs from this (Stokes, 1997). Funding agencies, universities, and philanthropists are pushing to close the gap between theory and practice. The goal is to inspire research that does not fit easily in the old basic/applied or captain/soldier dichotomies. The concept of *translational research* has emerged (Gunnar & Cicchetti, this volume). Translational research in child development is motivated by the dual desires to advance fundamental understanding of mind and to help children reach their full potential. Translational research addresses a fundamental intellectual puzzle and has a why-society-should-care component. Neither is the captain; both jointly steer the research.

All science occurs in a context (Kuhn, 1962), and the context for today's child development research is different from the one Piaget found himself in when he observed his own children in the 1920s. Piaget did not write for parents, and his discoveries were not streamed into headlines. There were no Swiss newspapers proclaiming: "Babies loose track of objects hidden under Piaget's beret!" Or "Baby memory: Jacqueline has tantrum one day after seeing neighbor boy throw a fit." Or "Are your baby's secondary circular reactions developing on time?"

Today is different. Parents are being assaulted with information about their role in child-rearing. Some headlines claim "parents don't matter." Others lead parents to feel guilty because they matter too much—early experience is destiny. Society is asking questions about the origins of thought, emotion, language, and personality. How should developmental scientists respond?

First, we should realize that the spotlight is on us. From the White House to the state house, there is interest in research on early learning. Discoveries reported in *Science*, *Developmental Psychology*, or *Child Development* are rapidly picked up by the media. Discoveries about the mental life of children no longer creep quietly into the professional literature.

Second, basic researchers do not have to give up their day jobs to respond to society's call (Shonkoff & Phillips, 2000). Our studies of child development need not promise to a cure teenage violence. There is plenty of room for those who want to stay close to the laboratory to uncover the basic mechanisms of learning and psychological development. Today's knowledge-driven research turns into tomorrow's applications, and conversely society's most pressing concerns often inspire careful science (e.g., NICHD Early Child Care Research Network, 2001, 2005). We need not insulate ourselves from the real world on the one hand or overpromise on the other.

Third, scientists can play a role in communicating the empirical discoveries to parents, health-care professionals, business leaders, and policy makers. Between pure discovery and the dissemination of programs there is a missing link. The missing link is the *translation* of the research findings. University scientists make discoveries; non-university groups disseminate the information to those who can use it. But there is a translation gap—the science often inadvertently misrepresented by nonprofessionals who are summarizing it. By ensuring that scientists are involved in the translation process, we can close this gap.

The sharing of scientific discoveries can assist parents in two ways. Learning that babies and young children think, want, intend, and even perform their own mini-experiments helps people see and enjoy babies in new ways. After all, if such discoveries keep scientists going late at night, why should it not do the same for parents? Also, communicating research and the scientific process can inoculate parents against pseudoscience. We may not be able to stop organizations from claiming to make better babies, but we can intrigue parents and policy makers with the value of genuine science. If academic astronomers can intelligently debate the origins of the universe in newspapers carrying astrological predictions, we can discuss the origins of the mind amidst the pseudoscience claiming to create super-babies with expanded IQs and pumped-up ethical sensitivities. In our own efforts to close the translation gap (Gopnik, Meltzoff, & Kuhl, 2001), we treat parents and other stakeholders as intelligent consumers of information who are interested in the philosophy, neuroscience, and the behavioral aspects of child development.

Many discoveries from the modern science of early child development have captured the attention of the public, policy makers, and practitioners. This chapter is focused on discoveries concerning early *social cognition*—what infants know about people. Parents care about IQ, but parents and professionals alike now realize that children's understanding of other people has more impact on school readiness and success and happiness in life than previously thought (e.g., Collins & Laursen, 1999; Ladd, Birch, & Buhs, 1999). Policy makers and parents want to know when children become attuned to other people and come to identify with them. Are children born social, or are they born in a state of "normal autism," as claimed by psychiatrists Mahler, Pine, and Bergman (1975, p. 41), unable to differentiate people from things? Moreover, both parents and policy makers want to know whether children's social environment, beyond the extremes of neglect and abuse, makes a difference to their eventual outcome.

In this chapter I will discuss new research on imitation, joint visual attention, and emotion. I will show that infants are carefully watching our actions and imitating what they see. Parents matter because babies are learning from us. Young children, even infants, look to us for guidance.

I have found that this information makes a special difference to fathers and the male policy makers. While the fathers and grandfathers might have thought that their little ones were not learning before they were old enough to go fishing or hold up their end of a conversation, it alters the paternal worldview to learn that preverbal children are already watching and learning. It is not just that adults are role models for teenagers. The new research shows that we are role models for our young children, even our babies. It is basic science that matters to people in the real world.

Overturning the Myth of the Asocial Infant

Within our professional lifetimes, we have witnessed the overturning of one of the most pervasive myths in social science—the myth of the asocial infant. On classical views of human development offered by Freud, Piaget, and Skinner, the newborn is cut off from others. Freud and his followers made a distinction between a physical and psychological birth (Freud, 1911; Mahler et al., 1975). When the baby is born, there is a physical birth but not yet a psychological one. The baby is like an unhatched chick, incapable of interacting as a social being because a "stimulus barrier" or "protective shield" cuts the newborn off from external reality (Freud, 1920, pp. 25–30). Freud provided the following metaphor to describe the human newborn: "A neat example of a psychical system shut off from the stimuli of the external world . . . is afforded by a bird's egg with its food supply enclosed in its shell; for it, the care provided by its mother is limited to the provision of warmth" (Freud, 1911, p. 220). These and other related claims influenced generations of psychiatrists and their practices (Beebe, Rustin, Sorter, & Knoblauch, 2003; Beebe, Sorter, Rustin, & Knoblauch, 2003).

Piaget used a philosophical rather than biological metaphor to endorse a similar point about the asocial infant. He believed that the baby is "radically egocentric" or even "solipsistic" (Piaget, pp. 352–357). The neonate has only a few reflexes at his or her disposal (e.g., sucking, grasping), and people are registered only to the extent that they can be assimilated to these action schemes. The infant breaks free of the initial solipsism by 18 months. It is a long journey from solipsism to understanding of others' minds, emotions, and the rest of social cognition.

One cannot readily quote Skinner's view about how children crack the puzzle of social cognition, because in a sense he does not think they ever do. Even adults are conceptualized as reacting to behaviors but not knowing the minds of their interactive partners. Human beings have finely tuned contingency detectors, and that is all there is. To use Skinner's phrase, social cognition is largely a "matter of consequences" (Skinner, 1983), by which he means that people are not role models who are observed and internalized, but merely reinforcement agents who sculpt the child's behavior through administering rewards and punishments.

The *Like-Me* Theory

If the human infant is born neither a social isolate nor with an adult-like grasp of other people's thoughts, feelings, intentions, and desires, from whence comes such understanding? What gets social cognition off the ground? Skinnerian blank slates, Freudian isolated eggs, and Piagetian solipsism will not get us from the newborn to the adult because there is not enough innate structure to interpret and make good use of the experience received in social interaction. Based on modern empirical work in developmental science, Meltzoff (2007a, 2007b) proposed the *Like-Me* theory to describe the infant's initial state and early phases of social cognition.

The *Like-Me* theory has three developmental steps, depicted in Figure 2.1. It describes the infant's innate state (Step 1) and also provides a mechanism for developmental change (Steps 2 and 3). The older child and adult are not locked into the same understanding as the newborn. Their interpretation of others as intentional agents is modified by their own experiences.

Step 1: Innate equipment

Newborns detect and use equivalences between observed and executed acts. When newborns see adult biological motion, including hand and face movements, these acts are mapped onto the infant's body movements. This mapping is manifest by newborn imitation. Self and other are intrinsically bound through an innate coding of human acts that is abstract enough to unite the perception and production of behavior. My own felt acts and the acts I watch you make are registered by the

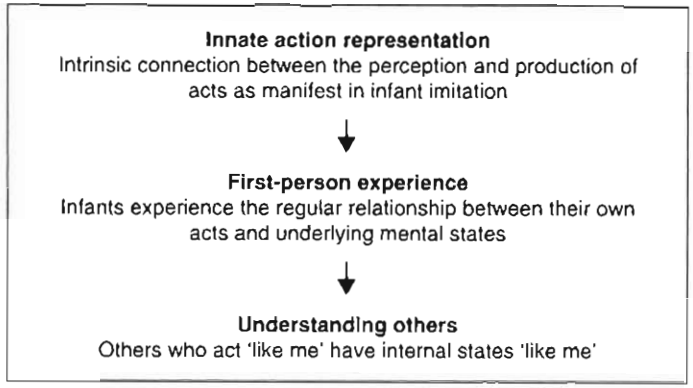

Figure 2.1 'Like Me' developmental theory. (Adapted from: Meltzoff, 2007b).

same abstract code. Meltzoff and Moore (1977, 1997) called this a *supramodal representation* because it cuts across particular modalities. It is because of the infant's action represention—the supramodal code—that the movements of people are special to young babies. The child, even the newborn, can watch the movements of other people and immediately recognize that "those acts are like these acts" or "that looks the way this feels." The supramodal representation of human action provides the lingua franca for connecting self and other.

Step 2: First-person experience

Through everyday experience infants map the relation between their own bodily states and mental experiences. For example, there is an intimate relation between striving to achieve a goal and the concomitant facial expression of concentration and effortful bodily acts. Infants experience their own unfulfilled desires and their own matching facial/postural/vocal reactions. They experience their own inner feelings and behavioral facial expressions and construct a detailed bidirectional map linking mental experiences and behavior (Kuhl & Meltzoff, 1982; Meltzoff & Brooks, 2008; Meltzoff & Moore, 1997).

Step 3: Attributions to others

When infants see others acting in a way that is similar to how they have acted in the past—acting *like me*—they make an attribution. They ascribe

the internal feelings that regularly go with those behaviors, based on their self-experience. This gives infants leverage for grasping other minds before language can be used. Infants integrate the ability to relate self–other at the level of action (Step 1) with their own self-experience (Step 2) to yield a deeper understanding of what lays behind the behavior of others. As children's own experiences expand they have an enriched understanding of what another might be feeling, desiring, and perceiving when he or she acts in certain tell-tale ways.

This is not Fodorian nativism (Fodor, 1983). Newborns do not possess the adult theory. Nor is the adult conception of others simply triggered by particular cues or due to the maturation of modules. Rather, infants' initial grasp that the actions of others are *like me*, coupled with their own experiences and observations, provides them with a developmental mechanism for coming to understand the mind others in a new way (Meltzoff & Brooks, 2008).

Action Representation and Imitation

Preverbal infants imbue the acts of others with felt meaning not through a formal process of analytic reasoning, but because the other is processed as *like me*. This is underwritten by the way infants represent action. There is now evidence that young infants parse human action into a common code that links acts they see others perform and ones they themselves produce. Perhaps the best evidence comes from infant imitation. Imitation demonstrates that, at some level of processing, infants use the seen behavior of others as a basis for forming a corresponding action plan. Through imitation, infants make manifest the connection between self and other at the level of shared actions.

When in development does imitation and this coding of action begin? Meltzoff and Moore (1977) reported that 12- to 21-day-old infants imitate facial expressions. Because early imitation ran afoul of the myth of the asocial infant, the report at first engendered surprise; but the finding has now been replicated in more than 24 studies from around the world (for a review see Meltzoff & Moore, 1997). The neonatal imitative response is quite specific; it is not a global or a general arousal reaction. Infants respond differentially to two types of lip movements (mouth opening versus lip protrusion) and two types of protrusion actions (lip protrusion versus tongue protrusion). Infants also differentiate two different types of tongue movements from one another (Meltzoff & Moore, 1994). Early imitation cannot be reduced to simple mimicry or instant resonance. The response can be displaced in time and space from the demonstration. In one study, a pacifier was put in infants' mouths as they watched the display. After the pacifier was removed, the infants imitated the earlier displays (Meltzoff & Moore, 1977). In another study, an adult showed 6-week-old infants a gesture, and then the infants were taken home for a 24-hour memory delay. The next day they were presented with the same adult sitting with a neutral facial expression. If the adult had shown mouth opening the day before, the infants initiated that gesture from memory; if the adult had shown tongue protrusion, infants responded with that gesture (Meltzoff & Moore, 1994). The imitative response is not rigidly fixed in the form of a fixed-action pattern. Infants *correct* their imitative attempts so that they more and more closely converge on the model demonstrated (Meltzoff & Moore, 1997). They are actively matching the target.

Meltzoff and Moore (1983, 1989) tested newborns in a hospital setting. The youngest infant was only 42-minutes old. The results showed that the newborns imitate adult gestures. Nativist claims are commonplace in the philosophical and psychological literatures, but few tests have been conducted on newborns. *Homo sapiens* have an innate capacity to imitate.

Meltzoff and Moore (1997) proposed that facial imitation is based on *active intermodal mapping*—the AIM account. On this view infants can, at some primitive level, recognize equivalence between the acts they see others do and the acts they do themselves. This is not a complex mechanism that requires cognitive machinations by the infant. Rather, there appears to be a very primitive and foundational body scheme that allows infants to unify the seen acts of others and their own felt acts into one common framework. The infants' own facial gestures are invisible to them, but they are not unperceived. They are monitored by proprioception. Conversely, the adult's acts are not felt by proprioception, but they can be seen. Infants can link perception and production through what AIM terms a common *supramodal* coding of human acts. This is why they can correct their imitative movements. And it is why they can

imitate from memory: Infants store a representation of the adult's act and it is the target against which they compare their own acts. A more detailed description of the metric of equivalence between self and other is provided elsewhere (Meltzoff & Moore, 1997).

The idea of a supramodal representation of action that we used to explain early imitation 30 years ago fits well with neuroscience discoveries about the mirror neuron system (MNS) and shared neural circuits (Iacoboni et al., 1999; Rizzolatti, Fogassi, & Gallese, 2001). An important task for the future is to analyze the commonalities and differences in these mechanisms, which are proposed at different levels, the neural/sub-personal and the psychological/personal. For example, the MNS is better suited to explain fast, automatic, non-effortful resonance than to explain deferred imitation, response correction, and the imitation of novel acts. Careful analyses are beginning to emerge (e.g., Jackson, Meltzoff, & Decety, 2006; Meltzoff & Decety, 2003; Rizzolatti, Fadiga, Fogassi & Gallese, 2002).

The unique contribution from the human developmental literature is that newborn imitation demonstrates that self–other connectedness is functional at birth.[1] Importantly, I do not argue that the human imitative capacity has reached adult-like levels at birth and have described several interesting developments in imitation in later infancy and early childhood (e.g., Gleissner, Meltzoff, & Bekkering, 2000; Meltzoff, 1995; Repacholi & Meltzoff, 2007; Williamson, Meltzoff, & Markman, 2008). However, the behavioral discoveries do establish that human infants are born learning from their social environment. The idea of a solipsistic newborn—a social isolate—is a myth.

People As Perceivers: Infant Gaze Following

Interpersonal imitation does not exhaust infant social cognition. Another important aspect of social cognition is the realization that people are sources of information about external objects. For adults, particular body movements have special meanings—they are *about* something. If a person looks up into the sky, bystanders follow his or her gaze. This is not

[1]Here it is worth noting that MNS data are lacking using neural measures; the crucial newborn studies remain to be done with monkeys or humans using neuroscience measures. Single cell recordings with newborn monkeys would be useful to evaluate the functionality of mirror neurons at birth in the monkey brain; mu rhythm studies with human newborns may soon become possible.

imitation; the adult is not trying to copy the movement but rather trying to see what the person is looking at. Adults realize that people acquire information from afar, despite the spatial gap between viewer and object. Visual perception is a kind of psychological contact at a distance.

When do infants begin to ascribe visual perception to others? Is there a stage when head turns are interpreted as purely physical motions with no notion that they are *directed toward* the external object, no notion of a perceiver? In fact, children with autism may regard adults' looking behavior in this way. Children with autism have gaze-following deficits, and it can be speculated that they process adults' looking behavior more as a physical movement in space than as a psychological act that connects the perceiver and world (Hobson & Meyer, 2005; Mundy, this volume; Mundy & Sigman, 2006; Mundy, Sigman, & Kasari, 1990; Toth, Munson, Meltzoff, & Dawson, 2006).

The onset of gaze following in typically developing children has profound implications both for language and for emotions. It is relevant for understanding the meaning of an emotional display because people's emotions are often engendered by what they see in the external world (e.g., *that* object is dangerous, appealing, or disgusting). By following a person's gaze you can grasp the cause of his or her emotional display (Moses, Baldwin, Rosicky, & Tidball, 2001; Repacholi & Meltzoff, 2007).

Language acquisition is similarly facilitated by understanding another's line of regard (Baldwin, 1995; Brooks & Meltzoff, 2008; Mundy, Fox, & Card, 2003; Carpenter, Nagell, & Tomasello, 1998). Bruner's (1983) account of early language acquisition gives pride of place to joint visual attention in initial word learning. In the prototypical case, if you want to know what mom is verbally labeling, follow her eyes. She is probably not labeling what is behind her back or on the next page of the book. Infants learn language best from live, socially engaged tutors who engage in joint attention as they are labeling objects (e.g., Conboy, Brooks, Taylor, Meltzoff, & Kuhl, 2008; Kuhl & Rivera-Gaxiola, 2008; Kuhl, Tsao, & Liu, 2003).

There is a debate about the mechanisms underlying infant gaze following and whether it shows that infants have a primitive grasp of *seeing* and *visual contact* in others (Flom, Lee, & Muir, 2007; Mundy & Newell, 2007; Moore & Dunham, 1995). One view is that young infants initially treat others' looking behaviors as mere movements. In the leanest

version, young infants visually track the adult's head movement in space and are pulled into the correct hemifield where they catch sight of the salient target object by happenstance (Butterworth & Jarrett, 1991). Over time, infants then learn that the adult's head turn is a reliable cue indicating where an object can be seen (Moore, 1999, 2006). Conversely, others have offered a nativist view suggesting that infants have a built-in module that takes eye gaze as input and automatically makes attributions about seeing and visual experience in others (Baron-Cohen, 1995). A third, developmental view is that infants' understanding of others' vision emerges from more primitive beginnings. Meltzoff & Brooks (2008) propose that a mechanism of change is infants' experience with *their own vision*: Infants develop an understanding of the vision of others, in part through their own acts of turning-in-order-to-see and opening/shutting of their eyes to cut off and reinstate visual experience.

The first issue is to determine whether infants are, as the lean view suggests, simply processing the salient physical movements in space caused by the head. Brooks and Meltzoff (2002, 2005) developed a protocol that zeroed in on the importance of eyes in infant gaze following. In this procedure, an adult turned to look at one of two targets. The manipulation was that the adult turned to the target with eyes open for one group and with eyes closed for the other group. If infants relied simply on head motions, they should turn in both cases. If, infants appreciate that the eyes are relevant for connecting a perceiver and object, they should differentiate the two conditions and turn to look at the target in one case and not the other. The reason such a manipulation is crucial is that we do, in fact, see with our eyes and not with our head. It is an important step forward in social cognition for infants to put special emphasis on eyes (something children with autism may not do; see Mundy, this volume). It is, after all, the eyes that are the *window to the soul*—the head is not such a portal.

Brooks and Meltzoff (2002) used the Gaze Following: Eyes Open/Closed test to assess 12-, 14-, and 18-month-old infants. Each infant at each age was randomly assigned to a condition in which the adult turned to the target with either open or closed eyes. Infants at all three ages followed the adult significantly more often when the adult turned with

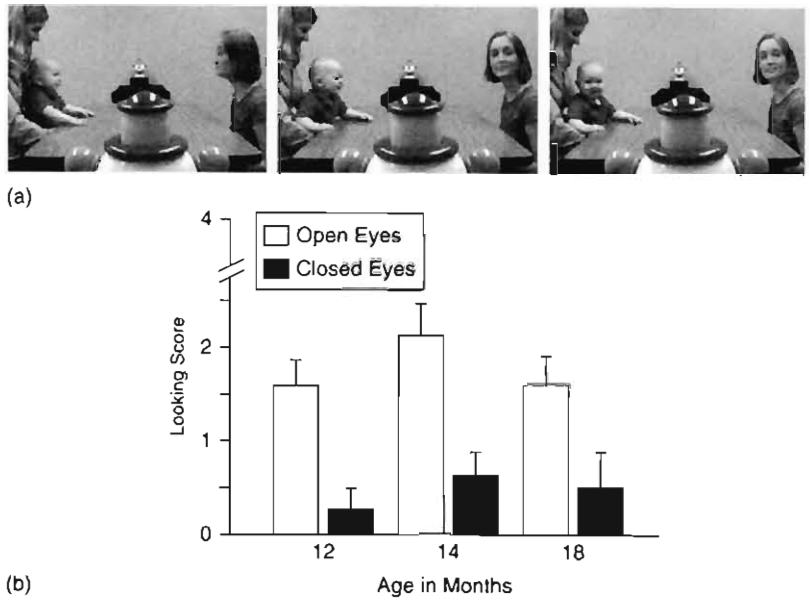

Figure 2.2 (a) Three-panel sequence showing a 12-month-old infant successfully gaze-following. The adult turns in silence and does not point to the target. (b) Infants selectively gaze follow (mean +*SE*) when the adult's eyes are open rather than closed. There were four gaze-following trials, and thus the maximum score if an infant correctly followed the adult's gaze on all trials is 4. (Adapted from: Brooks & Meltzoff, 2002).

open versus closed eyes (Fig. 2.2). At the ages tested, our current findings disprove the leanest interpretation, because head movement was controlled, and infants were more likely to look at the correct target when the social partner could see it.

Eye closure is only one way to block a person's line of sight. Another way is to use an inanimate object. For an adult, an opaque physical barrier has the same function as closed eyes—both prevent visual access. Importantly, this is not the case for 12-month-olds. As shown in the next study, these infants understand that vision is cut off by the biological motion of eye closure in advance of understanding that an inanimate barrier does so.

In the study of inanimate occluders, the person turned toward a target wearing either a headband or a blindfold (Brooks & Meltzoff, 2002).

In both instances, the same cloth covered part of the experimenter's face, but in one situation the adult could see and in the other she could not. We found that 14- and 18-month-old infants looked at the adult's target significantly more often in the headband than in the blindfold condition. In contrast, the 12-month-old infants did not distinguish between the two conditions. They systematically looked at the indicated target whether the adult turned wearing the blindfold or the headband. This is not just a matter of blindfolds causing a general suppression of activity. Rather, 12-month-old infants make the mistake of following the "gaze" of the adult wearing the blindfold. Evidently, they recognize that the human act of eye closure blocks contact with external objects, but they do not yet understand the same about inanimate occluders.

An Intervention Study: Self-Experience Changes Infants' Understanding of Other Minds

Infants understand eye closure in advance of view-blockage by inanimate barriers, but the adult's line of sight is blocked in both cases. Why is there a developmental difference? Eye closure is a biological motion with which infants have extensive first-person experience: Infants can control their own vision by closing their eyes when they do not want to look at something. The experience of turning off and on visual access to the world by eye closing/opening might serve as a framework for understanding such behavior in others. Perhaps if infants are given systematic, novel experience that blindfolds block their *own* view, they might make different attributions to others. To test this we designed an experimental intervention that provided blindfold experience to infants (Meltzoff & Brooks, 2008).

In one study, infants were randomly assigned to one of three groups. Infants in the treatment group were provided with various interesting objects to play with on the table; when they looked down to visually inspect an object, the experimenter held an opaque blindfold in between the object and the child's eyes. Thus, the infants experienced that their own view was blocked when the opaque blindfold was held in front of their eyes and was restored again when the blindfold was removed. This experience had nothing to do with the experimenter's viewpoint; it was a first-person experience. Two control groups were used. One involved

a specially constructed windowed-cloth, which was made from the same material as the blindfold but had a window cut out of the center. Infants in the window group received the same protocol as just described, thus controlling for the experience of an adult inserting a cloth between them and the objects; however, they could peer through the windowed cloth. Infants in the baseline control group were simply familiarized with the opaque cloth while it was laying flat on the table, so they could see and touch it, but did not receive a tutorial on its view-blocking properties.

At the end of training all three groups were given a standard gaze-following test: Infants were presented with the blindfolded adult who turned toward the distal objects. The results showed that infants who had received first-person training on the opaque blindfold now interpreted the adult's blindfolded turning correctly. They did not turn when the adult wore the blindfold. Importantly, infants who had the windowed-cloth experience and the baseline infants mistakenly followed the blindfolded adult's "gaze" to the distal object when she wore the blindfold (replicating Brooks & Meltzoff, 2002).

In the natural course of development, infants change their understanding of visual perception. By 18 months of age, infants do not act as though adults can see through opaque barriers (Brooks & Meltzoff, 2002; Butler, Caron, & Brooks, 2000; Dunphy-Lelii & Wellman, 2004). Meltzoff and Brooks (2008, Experiment 2) capitalized on this by providing 18-month-olds with a completely *novel* self-experience—one they would not have encountered outside of the laboratory. We constructed a trick blindfold that looked opaque from the outside but was made of special material that could be seen through when held close to the eyes. Infants were randomly assigned to one of three groups: (a) experience with the trick blindfold, (b) experience with the opaque blindfold, and (c) baseline experience in which they simply played with the trick blindfold as an object while it lay flat on the table. As in the previous study, for infants in the first two groups the blindfold was interposed between their eyes and the toys during the training period. The opaque blindfold blocked their view, and the trick blindfold provided infants the experience that the (apparently opaque) blindfold could be seen through.

After training, infants in all three groups saw the adult wear the blindfold in our standard test. As expected, infants in the baseline group and

the opaque-blindfold groups refrained from following the adult's head turns when the adult wore the blindfold. The new finding is that infants who had first-person experience with the trick see-through blindfold *followed* the adult's head turns significantly more often than did infants in the two other groups.

This underscores the power of infant self-experience. Infants were given a particular novel experience under experimental control. They immediately used the novel self-experience to change their construal of the behavior of others. They assume the other can see through the blindfold, despite the fact that the adult's eyes were covered and it looked, from the outside, like she could not.

This is the first study showing that infants use first-person experience about a psychological state such as *seeing* to make interpretations about another person. We think these training effects are a case of *like-me* projection with implications for how infants' self-experience transforms their understanding of mind of others who act *like me*, as will be elaborated on later in this chapter.

Integrating Emotion, Gaze, and imitation

Social cognition can be learned by observing third-party interactions not involving the self. Children learn by watching how siblings interact and observe their parental relationship. There has been surprisingly little laboratory research on infants' learning from watching two people interact. Repacholi and I investigated this in what we call *emotional eavesdropping* (Repacholi & Meltzoff, 2007; Repacholi, Meltzoff, & Olsen, 2008). This work examined whether toddlers regulate their imitation as a function of the emotional responses that they witness *others* receive for performing the same action. If others respond negatively, do they refrain from imitating the act?

Toddlers sat at the table much like a dinner table and watched two adults interact. When one adult performed a seemingly innocent act, the second adult became angry (saying, "*that* is so irritating!"). We manipulated the emotional response of the adult and whether or not that adult was looking when the child subsequently played with the objects. Our hypothesis was that children would be loathe to imitate the act that

caused the adult's anger (perhaps recognizing it was a *forbidden act*) if the previously angry adult was currently watching the child. If the angry adult had left the room or could no longer see the child's response, the child would imitate.

In more detail, the experimental set up was as follows. Eighteen-month-olds were randomly assigned to three groups. In all three groups an adult demonstrator performed a specific action on a novel object. What varied was the emotional reaction that another adult expressed. For one control, the Emoter became angry at the adult demonstrator as she performed the target action. The Emoter then assumed a neutral face and looked in the child's direction while the child was handed the object to see if he or she would imitate. For a second control, the Emoter also became angry but then left the room while the child was handed the toy for imitation, so she could not monitor the child's imitation. In the third group, the Emoter did not become angry and simply commented neutrally on the adult's demonstration (saying, "*that* is so entertaining") and watched as the child was handed the object. The results showed that toddlers in the latter two groups had significantly higher imitation scores than those in the first group (Repacholi & Meltzoff, 2007). infants

Repacholi et al. (2008) next zeroed in on the role of the adult watching the child. This work followed the same general procedure, but the previously angry Emoter assumed a neutral face and either: (a) stayed facing the child, (b) stayed facing the child but picked up a magazine to read (so not looking at the infant), or (c) stayed facing the child but closed her eyes (so not looking at the child). Children were significantly more likely to imitate the demonstrator's act in these latter two non-looking conditions than when the previously angry Emoter monitored the child's response.

This research shows that toddlers use *emotional eavesdropping*. Toddlers are not restricted to gleaning information from interactions that directly involve them but are also capable of learning from emotional exchanges between others. Interestingly, children regulated their behavior based on whether or not the previously angry person had *visual access* to their own actions. Children inhibited their imitative performances when the previously angry adult was looking at them; but when she was not, they

reproduced the forbidden actions. The work is significant because it shows that children do not blindly and automatically imitate (see also Williamson et al., 2008). Children self-regulated: They chose whether or not to duplicate the acts they saw.

The work is relevant to the child clinical literature on family emotional climate. Children from families in which there are high levels of interparental anger are at risk for behavior problems (Hudson, 2005). It is sobering to contemplate that children's eavesdropping on a brief anger display in the laboratory inhibits their imitation. If infants eavesdrop on repeated events of interparental anger, it might more generally reduce their imitative learning. Repacholi and I are interested in the individual differences we observed in our studies. A small number of children not only did not imitate but refrained from even touching the test object in one or more trials; conversely, there were some who imitated on every trial, whether or not the previously angry Emoter was watching. One wonders whether these observations have predictive value—do they predict aspects of later executive functioning? Are these differences themselves the outcome of identifiable biological factors or family variables (e.g., interparental anger)? We are currently pursuing such questions.

Scope and Implications of the *Like-Me* Theory

The fundamental puzzle of social cognition stems from the fact that persons are more than physical objects. Enumerating a person's height, weight, and eye color does not exhaust our description of that person. We have skipped over their psychological makeup. If a self-mobile, human-looking body was devoid of psychological characteristics it would not be a person at all, but a robot or, to use the philosopher's favorite, a zombie. A fundamental issue is how we come to know others as persons like ourselves. Each of us has the phenomenological experience that we are not alone in the world, not the unique bearer of psychological properties. We know that we perceive, feel, and intend, and we believe others have psychological states just like ours.

Philosophers seek to justify the inference that the dynamic sacks of skin we see are animated by psychological states. They contemplate whether this is a fiction and assemble criteria for knowing whether it is or is not (Russell, 1948; Ryle, 1949; Strawson, 1959). Developmental

psychologists ask different questions. We inquire how such a view takes hold regardless of whether it is logically justified. Is it innately specified? Does it differ in children with autism?

Fodor (1987) thinks that infants innately assign adult commonsense psychology to people:

> 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 no one would have to spend time learning it. . . . The empirical evidence that God did it the way I would have isn't, in fact, unimpressive. (p. 132)

The opposing school is that newborns lack any inkling that other humans have psychological properties. It is claimed, for example, that the child is born a solipsist (Piaget, 1954) or is in a state of so-called normal autism (Mahler et al., 1975), treating people the same as things. It is a long way—I would say an impossible path—to get from there to commonsense psychology.

Modern developmental scientists, including myself, have been trying to develop a third way. It grants far more to the newborn than the second view, while stopping short of the first. In my view, infant imitation and the neural representations that underlie it provide an innate foundation for building the adult understanding of people, but infants do not possess the adult framework. Infants imitate at birth, but they do not infer intentions or fully understand visual perception as a mental state in others (Brooks & Meltzoff, 2005; Meltzoff, 1999). This is hardly grounds for Fodorian nativism. It is equally true that young infants outstrip Piagetian theory. What we need is a new theory of social development that includes a rich initial understanding and a mechanism of change that can transform this into the adult state based on structured interpersonal experience.

Infants' action representation and imitation demonstrate that they map other people's behavior onto their own bodies. Because human acts are seen in others and performed by the self, the infant can grasp the social connection: You can act *like me* and I can act *like you*—this interpersonal bridge based on shared action provides the initial state of social cognition.

This construal of certain movements in the environment as *me relevant* then has cascading developmental effects. First, the world of material objects can be divided into those entities that perform these acts (people) and those that do not (things). Second, the lingua franca of human acts provides access to other people that are not afforded by things. The ability of young infants to interpret the bodily acts of others in terms of their own acts and experiences provides an engine for social development.

The *Like-Me* theory depicted in Figure 2.1 can helps explain several findings in the developmental literature. Consider infants' growing understanding of the meaning of other peoples' reaching behavior (Sommerville, Woodward, & Needham, 2005). The infant wants something he or she reaches out and grasps it. The infant experiences his or her own internal desires and the concomitant bodily movements. According to *Like-Me* theory the experience of grasping to satisfy desires gives infants leverage for *feeling with* the other who grasps for things. When the child sees another person reaching for an object, these movements are imbued with meaning, in part because of the child's own experience. This may be the avenue by which the infants' reaching experience modifies their understanding of the reaching of others (e.g., Sommerville et al., 2005): The infants' own goal-directed acts help them interpret the similar acts of others—*like me* in action.

A similar argument applies to the studies on intention reading. The Meltzoff (1995) study showed 18-month-old infants an unsuccessful act that did not fulfill the actor's intentions. Infants who saw the unsuccessful attempts completed the target acts at a significantly higher rate than controls. This and other research (e.g., Tomasello, Carpenter, Call, Behne, & Moll, 2005) suggests that toddlers can understand our goals even if we fail to fulfill them. *Like-Me* theory holds that one key element is the infant's own self-experiences. Infants have subjective desires and act intentionally. They have experienced their own thwarted desires, failed plans, and unfulfilled intentions. Indeed in the second half-year of life infants are obsessed with the success and failure of their plans. They mark such self-failures with special labels (e.g., "uh-oh," Gopnik, 1982; Gopnik & Meltzoff, 1986); and they actively experiment with or is not (Russell, 1940; Ryle, 1949; Strawson, 1959). Developmental

their own failed efforts (Gopnik & Meltzoff, 1997; Moore & Meltzoff, 2004), varying their strategies and try-and-try-again behavior. According to the *Like-Me* view, this *intra*subjective exploration deepens their *inter*subjective grasp about the motivation and meaning of others' behaviors. When an infant sees another act in this way, the infant's self-experience suggests that there is a purpose, desire, or intention beyond the surface behavior. Thus, infants now interpret the behavioral envelope of adults' failed attempts as a pattern of strivings rather than ends in themselves. (For brain-imaging work on neural correlates of goal attribution, see Blakemore et al., 2003; Chaminade, Meltzoff, & Decety, 2002).

Gaze following admits to a similar theoretical analysis. The understanding of another's looking behavior is modified by intrasubjective experience—in this case, experience of oneself as a perceiver. One-year-olds are well-versed with voluntary looking away and eye closing to cut off unwanted stimuli. This bodily act is well–mastered, and they seem to understand that others with their eyes closed cannot see either. They have more difficulty understanding blindfolds. The Meltzoff and Brooks (2008) intervention experiment provided infants first-person experience with blindfolds, and infants were immediately able to use this to understand the blindfold-wearing other in a new way. This shows the power of using first-person experience and provides evidence for Steps 2 and 3 in Figure 2.1.

Finally, Repacholi and I found *Like-Me* theory useful in explaining the imitation and emotion studies. In this case infants are simultaneously coordinating three converging *like-me* comparisons: (a) they and the other person can both perform the same actions, (b) if they perform the act, that the Emoter is likely to become as angry at them just as she did at the other person, and (c) when the Emoter has her back turned or eyes closed, the Emoter cannot see what action is being performed—just as the child's own perceptual access is blocked in a similar case. It is interesting to speculate what would happen if an age-matched peer is scolded for performing the action. We expect that as the target of the anger becomes increasingly *like me*, the infants will be increasingly reluctant to imitate the act. Our previous work has already established infants' sensitivity to age-matched peers in an imitation setting (Hanna & Meltzoff, 1993).

The Like-Me framework has shown itself to be useful for understanding the development of social cognition and the role that self-experience plays in enriching children's understanding of other minds. It accounts not only for existing findings in the literature, but has been the source of novel empirical work, for example the blind-fold training study (Meltzoff & Brooks, 2008).

WHAT IS NEW AND WHAT IS NEXT?

It has long been thought that the commonality between self and other is integral to our understanding of other minds (e.g., Hume, 1739/1969; Smith, 1759/1976). The place that the philosophers went wrong is that the self–other equivalence was postulated to be late developing—emerging from language or complex cognitive analyses. The last quarter century of research stands this proposition on its head. The recognition of self–other equivalences is the starting point for social cognition—a precondition for infant social development, not the outcome of it. Contemporary philosophers of the mind are being influenced by these developmental findings (Goldman, 2005; Gordon, 2005).

Like-Me theory is proving to be useful for generating interdisciplinary predictions and tests in autism, robotics, and neuroscience. For example, deficiencies in the like-me comparison may help illuminate the puzzling pattern of impairments exhibited by children with autism. They have specific deficits in imitation, gaze following, and emotion understanding (e.g., Dapretto et al., 2006; Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Meyer & Hobson, 2005; Mundy, this volume; Mundy & Newell, 2007; Nadel, 2006; Rogers, 1999, 2006)—all of which are underwritten by a like-me understanding.

In computer science, researchers are beginning to design algorithms that enable artificial agents to learn from observing the behavior of others. Instead of laboriously programming a fixed number of skills, the robot can be given imitative skills so that it can learn flexibly from watching humans. Developmental science is translating its theories and findings to computer science and engineering in the quest to construct socially intelligent robots (e.g., Buchsbaum, Blumberg, Breazeal, & Meltzoff, 2005; Demiris & Hayes, 2002; Demiris & Meltzoff, 2008; Rao, Shon, & Meltzoff, 2007; Shon, Storz, Meltzoff, & Rao, 2007).

Work in developmental psychology is also impacting adult social neuroscience. Brain-imaging studies reveal that observing body actions from a first- versus third-person perspective (me versus not-me) leads to different neural processing and speed of imitation (Jackson, Meltzoff, & Decety, 2006). Studies of human empathy shows that adults' neural signatures to injuries vary as a function of the like-me-ness of that entity (Jackson, Brunet, Meltzoff, & Decety, 2006; Lamm, Nusbaum, Meltzoff, & Decety, 2007).

Fodor is correct that solipsism and blank-slate empiricism are too impoverished to characterize the human starting state. However, this does not mean that adult theory of mind is implanted in the mind at birth or matures independent of social experience. I here propose a developmental alternative to Fodor's creation myth. Nature designed a baby with an imitative brain. Culture immerses the child in social play with psychological agents perceived to be *like me*. The adult understanding of mind and empathy for others is the outcome.

Some of the most interesting advances in the next decade will come from developmental social neuroscience. This will allow us to explore the mechanisms and development of imitation, empathy, gaze following, and intersubjectivity in the context of discoveries about the mirror neuron system and shared neural representations. The goal will be to crack one of the most urgent and ancient cries for human meaning: Am I alone? Do others feel what I am feeling? Is there anybody out there like me? The importance of these questions for developmental science, clinical science, and neuroscience will not be lost in translation.

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