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'Like me': a foundation for social cognition

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Abstract

Infants represent the acts of others and their own acts in commensurate terms. They can recognize cross-modal equivalences between acts they see others perform and their own felt bodily movements. This recognition of self–other equivalences in action gives rise to interpreting others as having similar psychological states such as perceptions and emotions. The 'like me' nature of others is the starting point for social cognition, not its culmination.

Introduction

According to Piaget, infants begin life as asocial creatures, in a state of 'solipsism' or 'radical egocentrism' (Piaget, 1952, 1954), only gradually coming to apprehend the similarities between the actions of self and other. An aim of genetic psychology was to investigate how an organism starting from solipsism could develop into the mature social adult.

In this paper, I will show that the initial state differs from this vision. The recognition of self–other equivalences is the foundation, not the outcome, of social cognition. The acts of the self and other are represented within a supramodal code. This provides infants with an interpretive framework for understanding the behavior they see. Input from social encounters is therefore more interpretable than classically supposed. Infants have a storehouse of knowledge on which to draw: They can use the self to understand the actions, goals, and psychological states of others and conversely can learn about their own powers and the possibilities and consequences of their acts by observing the behavior of others. The bedrock on which social cognition is built is the perception that others are 'like me'.

'Like me' in action

I designed studies to explore the power of the 'like me' notion at the basic level of action patterns. Do infants register when another person behaves like them? In one study, 14-month-old infants sat across the table from two adults who were side-by-side (a paired comparison, as in looking-time studies, save that they were live adults). Two TV monitors were placed behind the infant, one displaying the current infant and the other a record of the immediately preceding infant. Each adult mimicked one of the infants on TV. One of the adults imitated everything the live infant did; the other imitated what the previous infant had done. Although both adults were acting like perfect babies, and thus were good controls for one another, infants reacted differentially. Infants looked significantly longer and smiled more at the person who acted like them.

What is the basis for infants' preferences? Two candidates are temporal contingency and structural equivalences. The former relies on the fact that the behavior of the infant (X) and

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the adult (Y) are temporally linked, but does not require that the infant recognize that X and Y are structurally congruent acts.

I tested these alternatives in another study by having both adults initiate their responses contingent on the same infant behavior. When the infant produced a behavior from a predetermined list, both adults simultaneously sprang into action. One of the adults matched the infant; the other performed a controlled, mismatching response. For example, whenever an infant shook a toy, the imitating adult also shook his toy. The behavior of the mismatching adult was also triggered by the infant's behavior, but this adult performed a different action. Whenever the infant shook his toy, the control adult slid his matched toy on the table. This design achieves the goal of having both of the adults' acts contingent on the infant's. What differentiates the two adults is not the temporal contingency information, but the structural congruence of the adults' actions vis-à-vis the subject.

Infants looked significantly longer and smiled more at the imitator, suggesting that they can recognize the structural congruence between the acts they see others perform and their own behavior. They do not just recognize that another moves *when* they move (temporal contingency), but that another acts in the same *manner* as they do (structural congruence). Moreover, they actively prefer the social partner who is behaving 'like me' over the one who simply acts 'contemporaneous with me' as measured by preferential looking and heightened positive affect towards that person.

'Like me' in perception

Certain bodily movements are imbued with meaning for adults and older children. When adults see another person gazing at an object, it is not simply registered as a head-turn-to-the-side, but rather as an object-directed act picking out a target in the environment. Some developmental psychologists do not think that infants appreciate the latter (e.g. Butterworth & Jarrett, 1991; Corkum & Moore, 1995). A lean view is that in gaze-following situations the infant notices the adult's head as it rotates and by tracking this physical motion in space the infant's own head is pulled to the correct hemi-field. Once it is there, the distal object is encountered by happenstance. Infants turn in the direction of the adult's gaze, but they are simply processing salient physical movements in space caused by the adult's head. They are not gaze following, properly called, and don't appreciate the directedness/'aboutness' of adult gaze.

We tested this by having an adult turn to look at one of the two identical objects in a random order over four trials (Brooks & Meltzoff, 2002, 2005). For one group of infants, the adult turned to the target object with eyes open, and for the other, the adult turned with eyes closed. If infants relied simply on gross head motions, they should turn in both cases. If they relied solely on an abstract rule to look in the same direction as a 'contingent interactant' or 'agent' that turned (e.g. Johnson, Slaughter & Carey, 1998), they should also look regardless of whether the adult's eyes were open or closed, because it was the same agent, with the same history of interactive behavior turning in both groups. If, however, infants understand that the eyes are relevant for connecting viewer and object, then they should differentiate the two conditions, looking at the target object when the adult's eyes are open but not closed.

The results showed that 12-, 14-, and 18-month-old infants turned selectively, seeking out the target significantly more often when the adult turned with eyes open than with eyes closed. We also scored other behaviors –such as looking duration and pointing – beyond the traditional frequency of looking measure. We found that the average length of a look to the correct target was longer when infants followed the adult's open eyes versus closed eyes. Inanimate objects thus become 'marked' or 'distally touched' by the adult's looking at them, and infants inspected the marked object as if searching for the aspect of interest. The infants also pointed to the object more when the adult looked at it with open than with closed eyes. This behavior is striking because it is clearly ostensive – infants point more often when the social partner can see the object than when the partner cannot (see also Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004, on the development of pointing). How have infants come to know about the meaning of another person's eye closure? According to the 'Like Me' framework, they may have learned this through their experience with their own eye closures.

Of course, eye closure is only one way to block a person's line of sight. Another way is to use an inanimate object. From an adult perspective, blindfolds have the same effect as closed eyes – both prevent visual access –whereas a headband does not obscure the adult's vision. We tested 12-, 14- and 18-month-old infants using the same paradigm with a blindfold versus a headband. The results were different than the eye-closure case. The 14-and 18-month-olds looked at the adult's target significantly more often in the headband than the blindfold condition. In contrast, the 12-month-old infants did not distinguish between the two conditions. They looked at the indicated target just as often when the adult turned wearing the blindfold as the headband.

This is not a matter of blindfolds causing some general suppression of activity. Quite the contrary; the young infants make the mistake of following the 'gaze' of the adult wearing the blindfold as much as they do when there is no blindfold involved. It is as if they do not yet understand that blindfolds block perception, even though they understand that eye closure does. Perhaps they understand eye closure earlier than blindfolds because their own experience teaches them that vision is obscured when their eyes are closed.

A training study

We provided 12-month-olds first-person experience with the effects of blindfolds (Meltzoff & Brooks, 2004). Infants were randomly assigned to one of three groups: (a) blindfold experience, (b) experience with a blindfold with a window cut out of it, and (c) a baseline condition in which they merely became familiarized with the opaque blindfold as an object on the table.

Infants in the opaque-blindfold and windowed-blindfold groups were provided with various interesting objects to play with on the table; when they looked down to visually inspect an object, the experimenter held the 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. Infants in the windowed-blindfold group received exactly the same treatment, thus controlling for the experience of an adult repeatedly inserting a cloth between them and the objects; however, they could peer through the windowed blindfold. Infants in the baseline group were simply familiarized with the blindfold as an object. It rested flat on the table with the infant and experimenter taking turns sliding it back and forth, but it was not used to block their view of distal events.

At the end of the training period all three groups were given our standard gaze-following test. This was the first time the 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-blindfold experience and the baseline infants who received no training still mistakenly followed the blindfolded adult's 'gaze' to the distal object when she wore the blindfold. This is in line with the Brooks and Meltzoff (2002) report that 12-month-olds without special training do not seem to treat blindfolds as objects that block the adult's view.

In a second study we tested 18-month-olds. Recall that infants of this age do not turn when the adult is blindfolded. They seem to understand that blindfolds block vision. We wanted to see if first-person experience with a trick see-through blindfold would change their minds and reverse what they had learned.

Infants were randomly assigned to one of three groups: (a) first-person experience with an opaque blindfold, (b) first-person experience with a trick blindfold that looked identical to the opaque one but was made of sheer material that could be seen through when held close to the eyes, and (c) baseline in which they simply played with the blindfold as an object while it lay flat on the table. As in the previous study, infants in the two treatment groups were allowed to play with toys and the blindfold was interposed between their eyes and the toys during the training period. However, in this case, the opaque blindfold blocked their view, and the trick blindfold allowed infants the experience that this particular (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 training group refrained from following the adult's head turns when the adult wore the blindfold (in line with Brooks and Meltzoff's, 2002, results with this age). 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. We believe that first-person experience with blindfolds changes infants' understanding of the other's situation.

This study shows that infants use first-person experience about a mental state such as 'seeing' to make interpretations about another person. We think these training effects are a case of 'like me' projection, with far-reaching implications for how infants use self-experience as leverage for understanding the behavior of others who act 'like me' (e.g. Meltzoff, 2006; Sommerville & Woodward, 2005a, 2005b), as will be elaborated in the conclusions.

Applicable to me

In the work described so far infants were engaged in dyadic interaction. However, much can be learned by observing interactions between others, even though these interactions do not directly involve the self. There has been surprisingly little work done on infants' learning from eavesdropping on other people's social interactions. Repacholi and Meltzoff (in press) explored whether infants understand that emotional information in interactions between others (who are like me) is also 'applicable to me'.

We investigated what we called 'emotional eavesdropping'. An adult demonstrated how to manipulate novel objects in certain ways. We knew from previous work that infants would tend to imitate these actions. However, there were two new twists. First, an adult 'Emoter' expressed anger (or a neutral expression) when the first adult performed the action. The infants were subsequently given the object to manipulate to see whether their imitation varied as a function of what emotion the adult had expressed (the Emoter now had a neutral face). The second twist was that we systematically varied whether or not the Emoter could see the infant's imitative performance. We predicted that infants would not imitate the action if the previously angry adult could see them manipulating the object (and thus might become angry at them for performing the forbidden act), but would imitate if they were out of the Emoter's sight.

Eighteen-month-old infants were randomly assigned to one of three treatment groups: Anger-present (the previously angry Emoter faced the infant with a neutral expression during the response period), Neutral-present (the previously neutral Emoter faced the infant during the response period), or Anger-absent (the previously angry Emoter left the room for the response period). The results showed that infants in the latter two groups had significantly higher imitation scores than did infants in the first group. In a further study the Emoter stayed in the room in all conditions (Repacholi & Meltzoff, in press, Experiment 2). After her emotional display, the Emoter adopted a passive expression and either: (a) turned around so that she was not looking at the infant (Anger-back), or (b) directly faced the infant with a neutral expression (Anger-face). The infant was then given the object to manipulate. We predicted that infants in the Anger-back group would display higher levels of imitation relative to those infants in the Anger-face group, and the results confirmed this prediction.

These effects cannot be explained by the raw physical presence of the previously angry Emoter during the time that infants had access to the object. The child and Emoter were in the same room both in the Anger-back and Anger-face groups, but infants responded to them differentially. Nor can emotional contagion account for the results, because the infant had the chance to 'catch' the adult's emotion equally well in both groups, which were matched during the emotional outburst phase of the experiment (they only differed in where the adult was facing during the response period). In addition, we scored infants' own emotional responses during the adults' emotional interaction. In both experiments, we found that infants in the Anger conditions did not exhibit more negative affect than those infants in the Neutral conditions. Thus, the behavioral regulation reported here is not reducible to emotional contagion.

In sum, infants' actions were influenced by their memory of past emotions and their behavior varied as a function of whether the Emoter was currently looking at them. If the previously angry person was absent (Experiment 1) or turned her back (Experiment 2) in the response period, infants imitated.

One unanswered question is whether infants were interpreting the Emoter's anger as being about the performance of a 'forbidden act' (the act is bad) or about the object itself (that's a bad object). Our working hypothesis is that infants interpret the Emoter's anger to be about the act, inasmuch as infants rarely refused to touch the object, but they significantly refrained from imitating the act even though they picked up the object and had it in hand.

This research provides evidence that infants regulate their actions based on watching the emotional exchanges between two other people – 'emotional eavesdropping'. By 18 months of age, infants are not restricted to gleaning information from dyadic interactions that directly involve them, but are also capable of learning from eavesdropping on others. We think that after observing the Emoter express anger at the adult's actions, infants are concerned that the Emoter will become angry if she sees the infants themselves perform the target act. This would explain the conditions under which they do imitate (Neutral-present, Anger-absent, Anger-back) as well as those in which they do not (Anger-face). Evidently infants regulate their behavior based on whether or not the previously angry person now has *visual access* to their own actions: 'She won't get angry if she doesn't see me do it.'

Payoff of the 'like me' framework

The 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. 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 much like ours. Philosophers seek criteria that justify the inference that the moving mounds of flesh we observe are animated by psychological states (e.g. Russell, 1948; Ryle, 1949; Strawson, 1959). Developmental psychologists ask different questions. We inquire how such a view takes hold in the typical human mind (regardless of whether it is logically justified). Is it innately specified? Does the child's understanding of agents transform with age and social experience?

The starting state

Imitation indicates that infants, at some level of processing no matter how primitive, can map actions of other people onto actions of their own body – they process the acts of others as ‘like me’.[1] Facial imitation is especially informative because infants cannot see their own faces. If infants are young enough they will never have seen their own face in a mirror. The fact that young infants can imitate facial gestures shows that the perception and production of human acts are intrinsically intertwined.

We hypothesized that infants can represent human movement patterns they see and ones they perform using the same mental code (Meltzoff & Moore, 1977, 1997). There is thus something like an act space or primitive body scheme that allows the infant to unify the visual and motor/proprioceptive information into one common ‘supramodal’ framework. This supramodal act space is not restricted to modality-specific information (visual, tactile, motor, etc.). A more detailed analysis of the metric of equivalence used by infants to solve the correspondence problem, and the possible role of intrauterine motor experience, is provided elsewhere (Meltzoff & Moore, 1997).

Neuroscience and cognitive science

This hypothesis of a supramodal act space that emerged from developmental science is compatible with discoveries in neuroscience concerning mirror neurons (e.g. Gallese, 2003; Iacoboni, 2005; Rizzolatti, 2005) and proposals in cognitive science about action coding (e.g. Prinz, 2002). An important task for the future is to examine the commonalities and differences among these different perspectives and levels of analysis; such papers are beginning to emerge (Brass & Heyes, 2005; Meltzoff & Decety, 2003; Rizzolatti, Fadiga, Fogassi & Gallese, 2002; Wilson, 2001).

In all of these approaches there is an emphasis on the commonality between observation and execution. But as soon as one focuses on commonality, it immediately raises the question about differentiation. Perhaps the supramodal code means that there are no grounds for distinguishing self from other. Thought of in this way, the supramodal system would simply be a translation device for turning visual perceptions into motor output, a perception-production transducer: A Gibsonian tuning fork.

There are three reasons to think that we need a more nuanced notion than this to account for the empirical phenomena. First, the infant does not always produce what is given to perception. In one study of facial imitation we used a pacifier to stop the infant from imitating in an immediate, resonance-like way (Meltzoff & Moore, 1977). The adult assumed a passive-face pose before removing the pacifier. Infants imitated from memory when the actual stimulus now was a passive face. This same effect was shown more strongly in the Meltzoff and Moore (1994) study demonstrating that infants imitated yesterday’s gesture after a 24-hour delay when they re-encountered the adult with a passive face. Thus, the information picked up by vision can be accessed at a later time. This seems to require a stored representation of the adult’s act and not simply a direct resonance system. Second, infants self-correct their imitative acts to achieve a more faithful match (Meltzoff & Moore, 1994, 1997). In order to correct their performance, information about their own acts has to be available for comparison to the representation of the adult’s act. Third, infants show special interest in being imitated,

[1]The use of the English word ‘me’, is not meant to suggest that the young infant has an adult sense of self. I think that the adult notions of ‘I’, ‘me’, and ‘self’ develop. The ‘like me’ notion could be rephrased by purging the theoretically laden word, ‘me’, and saying that the infant recognizes: ‘*that* looks like *this* feels’. Similarly, I emphasize the *bi-directionality* of the effects supported by the framework. The tight relation between perception and production allows young infants to move in two directions – from self to other (as manifest in our training study, see text) and from other to self (as manifest by the imitation of novel acts that infants have not previously performed; Meltzoff, 1988). See Meltzoff (2006) for further analysis of this bi-directionality.

indicating the capacity to recognize when their unseen facial behavior is being copied. Such recognition implies that there is a representation of their own bodies.

These three facts go beyond the simple resonance account. They suggest that, at minimum, the infant's representational system performs three functions: (a) preserving information about the movements in the external world, (b) preserving information about one's own body movements, and (c) providing a means of comparison. This indicates a differentiation in the supramodal system such that the representation of the other's body is separate from the representation of one's own body. They are not confused. The cognitive act is to compare these two representations – in one case to match one's own acts to the other (imitative correction), and in the other case to detect being matched oneself (recognizing being imitated). Thus exteroception (perception of the acts of others) and proprioception (perception of one's own acts) are not one undifferentiated whole. Cognitive neuroscience work is now being directed at examining the neural underpinnings of self–other equivalence mappings that preserve a differentiation between self and other (Decety, Chaminade, Grèzes & Meltzoff, 2002; Jackson, Meltzoff & Decety, 2006; Jackson, Brunet, Meltzoff & Decety, 2006).

The representation of action we have postulated has implications for the development of social cognition. Human behavior is especially relevant to infants because the actions they see others perform look similar to the infant's own behavior and because these acts are events infants can intend themselves. When a human act is shown to a young infant, even a newborn, it may provide a salient recognition experience: 'That seen event is like this felt event.' Because human acts are seen in others and performed by the self, the infant can grasp that the other is at some level 'like me'. The other acts like me and I can act like the other. The cross-modal knowledge of what it feels like to do the act that was seen provides a privileged access to people not afforded by things.

'Like me' as leverage for developmental change

That young infants can interpret the acts of others in terms of their own acts and experiences provides them with a mechanism for development. For example, the infant knows that when she wants something she reaches out and grasps it. The infant experiences her own internal desires and the concomitant bodily movements (hand extension, finger movements, etc.). The experience of grasping to satisfy desires gives infants leverage for making sense of the grasping behavior they see others perform. When the child sees another person reaching for an object, she sees the person extending his hand in the same way, complete with finger curling. Object-directed, grasping movements can be imbued with goal-directedness, because of the child's own experience with these acts.

One reason that such experienced-based 'projection to others' has not typically been ascribed to young infants is that classical theories argue that they are incapable of mapping their own manual movements to those they see others perform. But the research on imitation shows this is wrong. Infants in the first half-year of life imitate manual gestures (Meltzoff & Moore, 1977, 1997; Vinter, 1986). Such imitation shows that infants detect the similarity between their own manual movements and those they see adults perform. This basic 'like me' analogy can then be put to work in their understanding the acts of others. For example, it may be the avenue by which the infants' own reaching experience changes their understanding of the reaching behavior of others (Sommerville, Woodward & Needham, 2005; Woodward, Sommerville & Guajardo, 2001): My goal-directed acts help me interpret the similar acts of others – 'like me' in action.

A similar argument applies to infants' understanding of goal-directed 'striving' in intention-reading studies (Meltzoff, 1995; see also Tomasello, Carpenter, Call, Behne & Moll, 2005). For example, the Meltzoff (1995) study showed 18-month-old infants an unsuccessful act that did not fulfill the actor's intentions. The study compared infants' tendency to perform the target act in several situations: (a) after they saw the full-target act demonstrated, (b) after they saw the unsuccessful attempt to perform the act, and (c) after it was neither shown nor attempted. Infants who saw the unsuccessful attempt and the full-target act produced target acts at a significantly higher rate than controls. Evidently, toddlers can understand our goals even if we fail to fulfill them, but what is the developmental mechanism by which they come to make this sort of interpretation?

The 'Like Me' framework provides leverage for understanding these results, by highlighting children's previous first-person experience. Infants have goals and act intentionally. They have experienced their own failed plans and unfulfilled intentions. Indeed in the second half-year of life they become obsessed with the success and failure of their plans. They begin to mark such self-failures with special labels ('uh-oh'; see Gopnik, 1982; Gopnik & Meltzoff, 1986); and they actively experiment with their own failed efforts (Gopnik & Meltzoff, 1997; Moore & Meltzoff, 2004). When an infant sees another act in this same way, the infant's self-experience could suggest that there is a goal, plan, or intention beyond the surface behavior. Thus infants would come to read the adult's failed attempts, and the behavioral envelope in which they occur, as a pattern of 'strivings' rather than ends in themselves. (For brain imaging work exploring the neural correlates of goal attribution, see Blakemore, Boyer, Pachot-Clouard, Meltzoff, Segebarth & Decety, 2003; Chaminade, Meltzoff & Decety, 2002; Cheng, Meltzoff & Decety, 2006.)

The understanding of another's looking behavior could also benefit from first-person experience – in this case, experience of oneself as a looker/perceiver. Infants can imitate head movements (Meltzoff, 1988; Meltzoff & Moore, 1989; Piaget, 1962). This indicates that infants can map between the head movements they see others perform and their own head movements. 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, infants experience that eye closure cuts off their own perceptual access. Inasmuch as infants can map the eye closures of others onto their own eye closures (as manifest in imitating blinking; Fontaine, 1984; Piaget, 1962), this would provide input for developing inferences about perception in others who have their eyes closed.

This also makes sense of the fact that young infants have a more advanced understanding of eye closure than of blockage by an inanimate object (Brooks & Meltzoff, 2002). One-year-olds have had months of practice with voluntary looking away and eye closing to cut off unwanted stimuli. However, it is only around 12 to 14 months old that infants begin actively experimenting with removing and replacing inanimate occluders, such as when they uncover and re-hide objects from themselves (Gopnik & Meltzoff, 1997; Moore & Meltzoff, 2004). Our intervention experiment provided systematic first-person experience with the fact that the blindfold could block their own view, and infants were immediately able to use this to understand the blindfold-wearing adult in a new way (Meltzoff & Brooks, 2004). I argue that the infant is using first-person experience to interpret others.

Finally, Repacholi and I have found the 'Like Me' framework useful in understanding the imitation and emotion studies. In this case, infants are bringing to bear three converging 'like me' inferences: (a) that they and the other person can both perform the same actions, (b) if they perform the matching act, that the Emoter is likely to become as angry at them as she did at the other person, and (c) when the Emoter has her back turned to the infant, the Emoter cannot see what action is being performed, just as the child's own perceptual access is blocked when she has her own back turned to a scene. Repacholi and I plan to use infant confederates in the study. What will happen if an age-matched peer is scolded for performing the action? We expect that as the recipient of the anger becomes increasingly 'like me', the infants will be increasingly loathe to imitate the act that is scorned by the Emoter. Related work has already established infants' sensitivity to age-matched peers in an imitation setting (Hanna & Meltzoff, 1993).

Conclusions and new directions

It has long been thought that the commonality between self and other is integral to our commonsense psychology and is a basis for feeling empathy for others and 'mentally standing in their shoes' (Baldwin, 1906; Hume, 1739/1978; Husserl, 1950/1960; Smith, 1759/1976). The stumbling block for classical philosophy was that the self–other equivalence was postulated to be late developing and therefore could not play a formative role (Gallagher & Meltzoff, 1996). Nearly a quarter century of infancy research serves to revise this view, and contemporary philosophers have begun to take note (Campbell, 1994; Goldman, 2005; Gordon, 2005).

The findings from developmental science suggest that young infants already register the equivalence between acts of self and other. They do so before the use of language or comparisons of self and other in a mirror. This basic equivalence colors infants' first interpretations of the social world and allows them to imbue the behavior of others with felt meaning.

The 'Like Me' framework is useful for generating predictions and tests in autism, robotics, and neuroscience. For example, deficiencies in the 'like me' comparison may help us understand the pattern of impairments exhibited by children with autism; they have deficits in imitation, gaze following, and emotion understanding – all of which are underwritten by a 'like me' understanding (Dapretto, Davies, Pfeifer, Scott, Sigman, Bookheimer & Iacoboni, 2006; Dawson, Meltzoff, Osterling & Rinaldi, 1998; Dawson, Meltzoff, Osterling, Rinaldi & Brown, 1998; Meltzoff & Gopnik, 1993; Hobson & Lee, 1999; Hobson & Meyer, 2005; Rogers, 1999; Toth, Munson, Meltzoff & Dawson, in press).

In computer science, researchers are designing algorithms that enable artificial agents to learn from observing the behavior of others and to imitate – a key step towards constructing socially intelligent robots (Buchsbaum, Blumberg, Breazeal & Meltzoff, 2005; Demiris & Hayes, 2002; Demiris & Meltzoff, in press; Hoffman, Grimes, Shon & Rao, 2006; Rao, Shon & Meltzoff, 2007).

In cognitive neuroscience, work on human empathy shows that adults react differently to the injury of an entity as a function of the like-me-ness of that entity (Jackson, Brunet, Meltzoff & Decety, 2006). Brain imaging studies of imitation reveal that observing actions from a first- versus third-person perspective leads to different neural processing and speed of imitation (Jackson, Meltzoff & Decety, 2006). Evidently the human brain registers the like-me-ness of stimuli. Tracing the development of the relevant neural architecture is a goal for future studies. Such work will contribute to creating a field of developmental *social* neuroscience to complement the burgeoning field of developmental cognitive neuroscience.

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