

SOCIAL COGNITION AND THE SEEDS OF EDUCATION

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Social cognition and the seeds of education

He who thus considers things in their first growth and origin, whether a state or anything else, will obtain the clearest view of them. – Aristotle

Education, neuroplasticity, and developmental psychology have much in common: All are concerned with the original nature of humans and how it is transformed by experience.

In the modern world, the educator, neuroscientist, and developmental psychologist occupy separate disciplines, use different techniques, and publish in different venues for different audiences. But before this specialization, the three perspectives were intertwined as philosophers pondered questions about the roots of civilization and what distinguished humans from other animals. In the *Republic*, Plato considered the design of a just society, and immediately raised two issues about children, ‘What will their education be?’ and ‘You know, don’t you, the beginning of any process is the most important, especially for anything young and tender? It’s at that time that it is most malleable and takes on any pattern one wishes to impress on it’ (Book II).

In *Émile*, Rousseau contemplated education and espoused a revolutionary idea about childrearing: ‘Why should not his education begin before he can speak’ and ‘As I said before, man’s education begins at birth; before he can speak or understand he is learning. Experience precedes instruction’ (Book I).

These thinkers, of course, knew little about the brain and did not anticipate many of the empirical discoveries about child development, but they shared the conviction that education is the wet-nurse to civilization and childhood is a ‘sacred’ (Rousseau) and ‘most important’ (Plato) time.

Modern scientists have produced empirical data about the importance of childhood and have discovered physiological mechanisms conforming to some of the philosophers’ key intuitions. Neuroscientists introduced the concept of ‘neuroplasticity’ which echoes Plato’s musings about early malleability; and a Nobel Prize was awarded to D. Hubel and T. Wiesel for research on the ‘critical period’ which is akin to Plato’s imprinting on the young and tender. Modern educators seek to expand primary and secondary instruction, arguing that children deserve ‘P-12’ education (P = pre-school) and that parents are

a baby's first and best teacher – echoing Rousseau's previously revolutionary cry that education should begin at birth.

We can discern a coalescing of ancient and modern ideas, but there is not universal agreement about the best path forward. The contemporary scholar, John Bruer, wrote a provocative paper in 1997 entitled 'Education and the brain: A bridge too far'. He argued that there is a yawning chasm between brain science and the practice of education.

There may be a way of reconciling the dreams of Plato and Rousseau with the sobering reality of Bruer's arguments. Enter the third, sometimes forgotten discipline mentioned in the opening paragraph of this essay – child development. Even if we accept Bruer's metaphor of two landmasses (brain science and education) that are too far apart to be bridged, we should not ignore another landmass jutting out between them (child development). Perhaps we can build smaller connecting bridges. How the child's brain changes with experience (neuroscience) can be linked to the study of the child's developing thoughts, emotions, intentions, and actions (child psychology), which in turn can be connected to the study of designed learning environments made to facilitate learning and help all children achieve their full potential (education). The gaps are smaller if we bridge from neuroscience to child psychology to education than if we try to span from the first to the third directly.

The scientific study of child development is a relatively new discipline. Perhaps the first systematic investigation of child development was Darwin's (1877) 'A biographical sketch of an infant'. It was a meticulous record of the mental growth of his own child, Doddy, and published in the philosophical journal, *Mind*. Next came Jean Piaget who provided data that surpassed Darwin's observations. When Piaget wanted to know if infants believed in the reality of things they could not see, he did not simply wait and observe infants, he hid their favorite object under an occluder to test whether they would search for it. In an interesting historical twist, Piaget became the director of the Institut Jean-Jacques Rousseau in Rousseau's birthplace, Geneva, in 1921. Piaget transformed the field by moving beyond baby observational techniques, but he did not utilize the most valuable tools of experimental science – random assignment and control groups. The field of experimental infant psychology was born in the late 1950s and early 60s, and the first meeting of the International Conference on Infant Studies took place in 1978.

In this essay I focus on scientific advances in childhood social cognition – what children know about themselves and other people. I do so for two reasons. First, the empirical discoveries about early social cognition are surprising. Piaget's (1954) theory held that infants are born 'solipsists' with no

initial connections to other people. The new work shows that newborns are anything but, and completely revises our views. Empirical evidence shows that young infants recognize the equivalence between self and other right from birth, and we are beginning to understand the psychological and neuroscience basis of these self-other mappings. Second, human education fundamentally depends on social cognition. Good teachers, like good parents, take the perspective of the learner and adjust their teaching so that it can be best absorbed; reciprocally, attentive learners are constantly trying to discern the tutor's intentions (Bruner, 1996). Both teacher and learner are engaged in acts of social cognition.

I explore the origins and early development of social cognition, but do not provide a full literature review. The essay offers a selective examination of studies from my laboratory illustrating the philosophy that education 'begins at birth'. I trace key changes in social cognition that occur from infancy to early childhood. The specific topics include: (i) learning through social imitation, (ii) children's dawning understanding of others as sentient beings like the self, and (iii) how the identity and academic interests of primary-school children are sculpted by the cultural context in which they grow up.

Childhood imitation

A distinctive characteristic of human beings is the capacity to learn from watching the actions of others and imitating them. I see another act, and I can immediately use this as a model for my own acts. I can duplicate other people's successes, avoid their failures, and learn about myself by watching them. Although many other animals learn from experience, they do not readily learn from watching *others'* experiences.

Imitation underlies human culture. It supplements biological evolution as a mechanism for transferring ingenious inventions and practices from one generation to the next. Without imitative learning the knowledge of how to build a fire, use a lever, or tie a knot would have had to be re-invented in each generation. Such skills are not innate; nor are they learned through trial and error or via explicit instruction. Rather, a child watches an expert in the culture and the child 'absorbs' the conduct. In cultures lacking formal schoolhouses, apprenticeship and imitation is a prominent form of 'education', and it has been so for millennia. Aristotle said it well: 'Imitation is natural to man from childhood, one of his advantages over the lower animals being this, that he is the most imitative creature in the world, and learns at first by imitation' (*Poetics*).

Aristotle is right so far as he goes, but that does not end the matter for the scientist who is interested in the mechanisms underlying imitation and its de-

velopment with age. The empirical work has revealed two surprising facts about childhood imitation: (i) its origins and (ii) how it is regulated by emotion.

The original state

Conceptual problem. If we are seeking origins, the imitation of facial expressions is a good place to start. Infants have the motor skills to move their faces, so copying others is not ruled out. There is a conceptual problem, however. Infants can see another person's face but they cannot see their own face. If they are young enough, they will never have seen their face in a mirror. Facial imitation poses a formidable challenge, because the infant must match a gesture he sees a person perform with a gesture of his own that is invisible to him and accessible only through tactile-proprioceptive feelings. Facial imitation can be thought of as posing the philosophical problem of Other Minds in action. The child knows himself from the inside and the other from the outside. How can he bring the two together?

In traditional developmental theory facial imitation was regarded as a landmark cognitive milestone. Piaget (1962) thought that young infants could not perform such 'invisible imitation', because they had no way to connect self and other. Infants were born 'solipsistic' (Piaget, 1954), or so he argued.

Empirical findings and inferences. My colleagues and I tested newborn infants in a hospital setting. The oldest infant was 36 hours old and the youngest was just 42 *minutes* old at the time of test. The newborns were shown simple facial gestures: poking out the tongue and opening and closing the mouth. In other studies neonates saw hand movements, lip pursing, and head movements. To the surprise of many, the empirical data revealed that young infants imitated all these acts (Meltzoff & Moore, 1977, 1997). This is remarkable because they are imitating actions they see other people perform with actions of their own that they cannot see themselves do. There is a basic human connection between self and other that is present at birth. Imitation is a congenital aspect of social behavior (see Figure 1).

The interpretive framework I put forward is that there is a basic body scheme that allows infants, even newborns, to see the acts of others as 'like me'. Imitation is a matching-to-target process. The goal or behavioral target is specified visually. Infants' self-produced movements provide proprioceptive feedback that can be compared to the visually specified target. According to the framework, the comparison is possible because human acts are represented within a common code, which we refer to as a 'supramodal' representation that transcends single modalities such as vision or touch and unites them in a common language (Meltzoff & Moore, 1997). We also proposed that infants' prenatal movements may prepare them for imitation.



Figure 1. Photographs of human neonates under 1-month-old imitating adult facial expressions. (From Meltzoff & Moore, *Science*, 1977).

Films of infants in the womb document that they make hand, facial, and limb movements. This prenatal motor experience provides them with a proprioceptive memory about how the parts of the body move. The tongue is felt to move in very different ways than hinged joints. When infants see these movements postnatally they assimilate them to the felt motor patterns experienced prenatally (Meltzoff & Moore, 1997).

The essential point is that infants are born into a social world and can connect with others from their very first encounters with them. They perceive the acts of self and other as equivalent. In their very first encounters with mother, this is not an alien object, but someone who moves ‘like me’. This has far-reaching implications for theories of social cognition, and the neural correlates are being explored using infant brain measures such as electroencephalography (EEG) (Marshall & Meltzoff, 2011).

Regulating imitation: emotion and the roots of conscience

Conceptual problem. Human imitation extends beyond the duplication of simple movements and mannerisms in three ways. First, humans also learn how to use tools and manipulate culturally specific objects by watching how others do so. Second, humans do not only learn in one-to-one interaction, but also learn indirectly by eavesdropping on the interactions of others. Third, humans begin to assimilate ‘good’ or ‘bad’ from watching how

others respond. A child need not act and be scolded, but can learn from monitoring how the parent responds to the actions of a sibling. If it is a forbidden act, the child will regulate his natural tendency to imitate. We investigated these issues empirically.

Empirical findings and inferences. In these studies infants watched an adult perform novel actions on objects. For example, the adult (Model) brought out a black box and used a stick as a tool to push a button that activated the object. When infants are presented with the same box, they immediately imitate the act. Next, we tested whether emotion regulates imitation. We had 18-month-old infants watch the Model perform novel actions on objects but had a second adult (Emoter) react with an angry negative emotion, as if the Model was performing a forbidden act. Then the child was presented with the object. We found that the children regulated their conduct; they did not imitate the forbidden act (Repacholi, Meltzoff, & Olsen, 2008).

This is not ‘emotional contagion’, because the child’s motor acts were gated by whether the Emoter was or wasn’t looking at the child. If the Model and Emoter went through the same script, and the Emoter left the room, the baby performed the forbidden action. If the Emoter turned her back or closed her eyes, the child performed the forbidden act. The critical feature was whether the Emoter was visually monitoring the baby – in cases that the Emoter was watching the infant, the infant did not imitate.

The study establishes that even preverbal babies are not slavish imitators. Moreover, babies learn from second-hand experience. The child himself was not scolded – the child simply observed someone else being scolded, and that was sufficient to inhibit imitation.

There were individual differences. Some children were excellent self-regulators and some were not. We are interested in whether there are inborn differences in inhibitory control, and how such is cultivated through mother-infant interaction before children enter our laboratory at 18 months of age. We also want to assess whether our preverbal measure is predictive of children’s capacity to delay gratification and regulate their behavior when they are in primary school.

What about a sense of conscience? The preverbal babies refrain from replicating the forbidden acts only if they are watched. At older ages children refrain in a wider set of circumstances. Inasmuch as the origins of conscience can be investigated empirically, this research paradigm may offer a good start. Certainly, the change from regulating behavior when watched (infants) to regulating behavior based on internalized rules (older children and adults) is a momentous shift. This developmental change is of interest to scientists, philosophers, and religious leaders alike.

Recognizing other people as sentient beings

Human beings have mental states – thoughts, feelings, and perceptions – that we strive to understand by paying close attention to our fellow humans. One important contributor to ‘reading’ others’ internal states is paying attention to their eyes – the eyes are called a ‘window of the soul’.

If a person talking to you turns to look at something you tend to follow their gaze. Gaze following is a key component of learning and education inside and outside the classroom. Gaze following establishes common ground and indicates a shared topic. As children try to understand the meaning of words, they take into account the direction of parental gaze. Although words can refer to absent objects, parts of things, and hypotheticals (Quine, 1960), parents spend a lot of time labeling here-and-now whole objects for infants (Markman, 1989; Tomasello & Farrar, 1986). St. Augustine noted that children are assisted in language acquisition by paying attention to the gaze of adults: ‘I watched and remembered that they used that sound when they wanted to indicate that thing. Their intention was clear, for they used bodily gestures, those natural words which are common to all races, such as facial expressions or glances of the eyes...’ (Book I).

Scientists seek to uncover the mechanisms by which infants come to understand the meaning of another’s gaze. When the child sees an adult turn to face an object do they process this simply a physical movement or do they ascribe mental states to the act?

Infant gaze following

Conceptual problem. Common observation reveals that babies look where another is looking, but observation alone does not reveal the mechanism. One theory attributes very little to the child: The head is a large moving orb infants visually track as it rotates, and they accidentally catch sight of the target object in the periphery. What looks like gaze following is nothing more than tracking a physical motion – physics not psychology. A richer interpretation is that infants desire to see what another is seeing. Infants attribute psychological contact or mental experience to the one who gazes. Experiments are needed to discover the mechanisms underlying gaze following.

Empirical findings and inferences. In one study an adult turned to look at distal objects on a random schedule (see Figure 2). The trick was that in some cases the adult turned with eyes open and in other cases with eyes closed. The head movements were identical in both cases. If infants are simply tracking the head movements, they should perform equally. The results show that 1-year-olds are significantly more likely to follow the adult who turned with eyes open, suggesting that they know something about visual contact (Brooks

& Meltzoff, 2002). However, another study reveals that this knowledge is limited. If the adult has her vision blocked by a blindfold, 1-year-olds mistakenly follow her 'gaze'. It seems that 1-year-olds know that eye closure blocks the adult's vision but not that an inanimate occluder does so. Why?

One idea is that infants are using their own self-experience to give special meaning to the eye closures of others. Infants have agency over opening and closing their eyes. When they do not want to see something they close their eyes. They have complete control and a lot of practice with closing their eyes to make the world go black. I believe that they use this to interpret the eye closures of other people. We sought to test this idea.



Figure 2. A 12-month-old boy follows the gaze of an adult. Infants learn about people and things by looking where other people look. (From Meltzoff *et al.*, *Science*, 2009).

Others 'like me': using self-experience to understand others

Conceptual problem. Infants understand biological occluders (eye closures) before they understand inanimate occluders (blindfolds). My idea is that they are using their own phenomenological experience gained by performing bodily acts (eye closing/opening) to give meaning to the matching acts of others. If this is true, then providing infants self-experience with blindfolds should allow them to understand, for the first time, what it is like for another person who is wearing a blindfold.

Empirical findings and inferences. Meltzoff and Brooks (2008) did the relevant experiment. Infants sat at a table, which had an interesting object on it. When they turned to look at the object, the experimenter gently raised a blindfold to block their vision. The blindfold was subsequently lowered and infants were allowed to play with it. Then another interesting object was put on the table, the infants looked, and the adult again raised the blindfold to block their line of regard. This was repeated for almost ten minutes. The training was restricted to infants' own vision rather than anyone else wearing blindfolds. Then, for the first time, the adult wore the blindfold and the standard gaze-following test was administered.

The experience completely changed infants' interpretation of the adult. Now they did not follow the blindfolded adult's 'gaze' to the object (Meltzoff & Brooks, 2008). They generalized from their own experience to that of another person. Since they could not see (self-experience) when a blindfold was in front of their eyes, they inferred that the other could not see when in a similar situation. Control conditions gave infants equal amounts of time to familiarize themselves with the black cloth while it lay on the table and did not have this effect.

Infants imbue the actions of others with felt meaning based on their own experience. This opens up a new way of thinking about infant's understanding other mental states, beyond visual perception. Consider intention. Meltzoff (1995) showed that 18-month-olds can infer the simple intentions of other people. An adult tried to pull apart a barbell-shaped toy, but his hands slipped off, and the goal was not achieved. He tried again in a new way and was also not successful. The infant only saw the efforts but not the successful act. Nonetheless, when infants were given the object they carefully wrapped their hands around the ends of the object and firmly pulled it apart. Preverbal infants understand our goals and re-enact what we intend to do, not what we did do.

The gaze following work provides theoretical leverage for understanding infants' attribution of goals and intentions to others. One reason infants can make sense of the purposeful behavioral of others is that they have intentions themselves. They have tried unsuccessfully to pull apart objects. I believe infants use their own self-experiences to understand the similar behaviors in others. Others who act 'like me' have similar mental states like me. I infuse the behavior of others with my own phenomenological experience. Doing so provides a first step toward perspective taking.

Cultural stereotypes and school

The adult social world is complex, and the human mind tries to simplify and predict what to expect when we meet a stranger or interact with a friend. One strategy is to use stereotypes – simplified concepts about social groups that are applied to individuals to characterize them and anticipate their behavior. If I inform you that you will be meeting a librarian in one room and a professional athlete in the other, you immediately conjure up a stereotype to prepare for these social encounters (probably you imagine a smaller, meeker person in the first room and a larger, boisterous person in the second). It does not occur to you at first, without deeper reflection, that a professional jockey might be smaller and milder than a librarian.

Many stereotypes are harmless, but some are pernicious. Rousseau was concerned with the pernicious stereotypes and prejudices that Émile would

be exposed to in public education, and outlined a scheme to shield the boy. He proposed a well-trained, private tutor and no public schooling with groups of children. Whatever one thinks about this, it is not practical for society to educate children through one-on-one tutors for each child 'to guide him from birth to manhood'. Rousseau, of course, acknowledged this impracticality. So what is to be done?

One step is to examine the stereotypes that confront children as they enter formal schooling and the influence they have on children's education and self-development. A further step would be to design interventions to change things. This discussion focuses only on the former.

A collection of pernicious academic stereotypes concerns race and gender. This is particularly salient for mathematics and reading. One pervasive stereotype is that science, technology, engineering and mathematics (STEM disciplines) 'go with' males and that reading and poetry 'go with' females (Nosek, Banaji, & Greenwald, 2002; Nosek *et al.*, 2009; National Academy of Sciences Report, 2011). Our concern here is when these cultural stereotypes are absorbed by the child and begin to influence their sense of identity and schooling.

There is new evidence that as early as primary school, American girls have assimilated the cultural stereotype that girls are not associated with mathematics and have extended this belief to themselves (Cvencek, Meltzoff, & Greenwald, 2011). Academic stereotypes about other children who are perceived as 'like me' influence children's own self-concepts and can constrict their academic interests and aspirations.

Math-gender stereotypes in young children

Conceptual problem. American adolescents take a standardized test measuring mathematics and reading called the Scholastic Aptitude Test (SAT). Every year for the past 20 years, boys have significantly outscored girls on the SAT-Mathematics portion of the test. This has led to some to speculate that boys have a higher 'innate aptitude' for mathematics, others to suggest differences in upbringing, and still others to dispute the validity of the test or suggest other factors (Ceci & Williams, 2007; Spelke, 2005). We cannot solve this dispute in any simple way, but my colleagues and I decided to assess young children's thoughts about cultural stereotypes for mathematics and their own dawning feelings of interest and identification with the discipline (Cvencek, Meltzoff, & Greenwald, 2011).

We made conceptual distinctions among three ideas that are often conflated in the literature on educational and developmental psychology (and more clearly separated in social psychology with adults). First, we said that a child's *gender identity* refers to children's association between themselves

and a particular gender (male or female). Second, *math-gender stereotypes* refer to the association of mathematics with male or female. Third, *math self-concept* refers to the association between oneself and mathematics. These conceptual distinctions allowed us to separate children's recognition of cultural stereotypes about groups (math-gender stereotypes) versus their own felt self-identification with mathematics. In principle, one could be raised in a culture that holds stereotypes about one's gender without subscribing to them oneself; the stereotype refers to the social group to which one belongs, whereas the self-concept refers to you as an individual. What is the developmental pattern connecting these three concepts?

Empirical findings and inferences. We tested a large number of children in the schools, with equal number of boys and girls at each grade between 1st and 5th grade. We used both explicit (self-report) and implicit (child Implicit Association Test) measures (see Cvencek, Meltzoff, & Greenwald, 2011 for details). Our results confirmed previous work showing that girls and boys identified with their own gender in 1st grade (gender identity). The new finding was that children as early as 2nd grade have already assimilated the pervasive American stereotype that math is for boys (math-gender stereotypes). A little later in development, sex differences emerged in self-concepts, such that boys tended to self-identify with math (math self-concept) and girls with reading. A schematic of the results are shown in Figure 3.

The striking finding is that boys and girls both believe that math is for boys as early as 2nd grade. This is *before* they have learned their multiplication tables (a 3rd grade topic in American schools). It is widely known that inasmuch as there are any grades given for mathematics or pre-mathematics in kindergarten through 2nd grade, girls receive higher grades than the boys. We do not think, therefore, that children are using their own personal experience with mathematics to build these early stereotypes or academic self-concepts. What is going on?



Figure 3. Schematic child development timeline based on research on gender identity, math-gender stereotypes, and math self-concepts in young children. (See Cvencek, Meltzoff, & Greenwald, *Child Development*, 2011).

We think that even the youngest girls and boys are profoundly influenced by pervasive cultural stereotypes. They intermix cultural stereotypes with their own knowledge of themselves to draw implications. Children unconsciously complete an Aristotelian syllogism in a way that is *psychologically* compelling: I am a girl, girls don't go with math, and therefore math is not for me (Cvencek, Meltzoff, & Greenwald, 2011).

From a developmental viewpoint, children have followed others 'like me' since infancy. They engage in action imitation, duplicating the behavior of others when they are preverbal babies. They imitate more abstract rules by the time they are 3 years old (Williamson, Jaswal, & Meltzoff, 2010). I propose that this drive to imitate serves children well in the early phases of identification with people, but also begins to exert pressure on children to adopt attributes of the social group to which they belong. By school age, if not before, they begin to 'imitate' and take on the academic characteristics of others 'like me'. If girls are not associated with mathematics, according to a cultural stereotype, then young girls in that culture will tend to think mathematics is 'not for me', which can influence their self-concepts, interests, and future aspirations.

We are pursuing several questions: (i) What is the relative contribution of parents, teachers, peers and media in creating these stereotypes? (ii) What are the mechanisms by which individuals can overcome cultural stereotypes? They may have personal relationships that outweigh the dominant stereotype (e.g., a mother who is a mathematics teacher or a similar role model). (iii) Are there differences across cultures? In some countries girls systematically do better than boys on standardized mathematics tests, and Cvencek and I will initiate a cross-cultural study investigating the development of math stereotypes, self-concepts in Singaporean primary school children, starting in the autumn of 2011.

Reflections

Certain questions about human nature are too puzzling and foundational to remain the province of any one discipline. Such is the case with social cognition. We know ourselves from the inside; we know others from the outside. How can we connect?

Modern science offers an approach to the problem. We examine the social mind of infants. Babies do not speak or understand verbal language. Yet, they interact with their mothers, they emote, and they seem to be more than mere automata. They think without language. The hard question is what they think about *us*. The (relatively new) field of developmental social cognition is probing this issue, and the empirical results seem promising.

Theory

Starting from the beginning, we now know that newborns are not only visually attracted to faces, but that they can imitate them. When infants see a person act, they can map this onto their own corresponding body parts and duplicate it. This is puzzling because newborns have never seen their own faces – there are no mirrors in the womb. Yet they connect.

I argue that this recognition of the equivalence between self and other at the level of action is the bedrock of human social cognition. From the moment that newborns first see another face, they recognize it as ‘like me’. This felt kinship with other fellow humans is the start of social understanding, not its culmination; it undergirds and supports enculturation and does not spring from it in the first instance.

This ‘like me’ bond also provides an avenue for psychological change. It fosters change in two directions. Going from others to self, infants watch others and learn more about the causal consequences of human actions without having to produce them. This amplifies learning opportunities beyond trial and error learning and independent invention. Infants can profit from the successes (and failures) of others, because others’ endeavors are proxies for the infant’s own acts. This is adaptive for human infants who cannot move around much to perform their own experiments on the physical world.

Going from self to other, infants expand their understanding of other people based on their own felt experiences. Others are attributed the experiences infants have when they perform similar actions. Infants themselves have felt joy and produced smiles; this gives them leverage for ascribing positive emotion to others who are acting in this same way. At a certain age infants may try to manipulate objects and fail to achieve their goals. This gives them a way of interpreting the unsuccessful attempts of others. They know from first-hand experience that a certain pattern of try-and-try-again behavior is a concomitant of purposeful striving and effortful attempts toward a goal. They can recognize that another is matching their action pattern. Their unconscious inference is that others who act ‘like me’ have internal states and feelings like I do when I behave this way. As children’s self-experience broadens, it broadens their appreciation of others.

A similar argument applies to the pattern of gaze adults exhibit in every day life. Infants interpret the looking behavior of others in a ‘like me’ fashion. They know that when they close their eyes or have a barrier in front of them, they cannot see distal objects. This allows them to make inferences about the perceptual experiences of others. They can discern when another is or is not in psychological contact with the external world. This is the beginning of

appreciating someone else's the viewpoint – the dawn of perspective-taking and recognizing the similarities (and differences) in how others see the world (see Moll & Meltzoff, 2011, for more detailed argument).

Admittedly, these developments are only the first steps toward understanding the minds and hearts of other people. It is a useful start, however, because a chief stumbling block in other historical theories has been removed. We do not need to account for how a 'solipsistic' newborn emerges from his or her shell, because that is not the original state; nor are we compelled to think of newborns as having an adult-like understanding, because there is an inkling of how an initial state could be transformed through a combination of first-hand experiences and observations of other people.

While infants focus on their relationship with individuals (mom, dad, siblings), older children increasingly become concerned with groups. I think that the 'like me' mechanism available to infants also exerts force in older children and impels them to categorize people based on self-relevant attributes. New experiments are beginning to show that 'in-groups' are readily formed by preschool children based on gender (Cvencek, Greenwald, & Meltzoff, 2011) and based on other more arbitrary attributes in older children (Dunham, Baron, & Carey, 2011). In this essay we considered the implications for education and children's sense of identification with academic disciplines. We found that primary-school children had assimilated the cultural stereotype that boys are associated with mathematics. By primary school, children not only behave like others (action imitation) but also begin to take on attributes that are culturally assigned to the groups of which they are a member. The 'like me' mechanisms that connect young babies to individuals now functions to connect older children to groups and their associated attributes.

From theory to practice

Plato was concerned about the impressions adults make on our children and Rousseau despaired at the 'prejudices' of society to such a degree that he espoused private tutors rather than public education. Our children, however, cannot be shielded from our culture.

What can we do? We can educate ordinary citizens and policymakers alike about the new findings in child development. The science shows that our own children are watching us, which compels self-reflection on the models we provide. We now understand that education begins 'at birth' and we are teachers of our 'young and tender'. Society depends on the education of our children, and Plato's question is for all of us: 'What will their education be?'

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