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Implications of Affective and Social Neuroscience for Educational Theory

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Abstract

The past decade has seen major advances in cognitive, affective and social neuroscience that have the potential to revolutionize educational theories about learning. The importance of emotion and social learning has long been recognized in education, but due to technological limitations in neuroscience research techniques, treatment of these topics in educational theory has largely not had the benefit of biological evidence to date. In this article, I lay out two general, complementary findings that have emerged from the past decade of neuroscience research on emotion and social processing, with a view to beginning a dialogue about the meaning of these findings for educational theory. First, emotion and cognition are intertwined, and involve interplay between the body and mind. Second, social processing and learning happen by internalizing our subjective interpretations of other people's beliefs, goals, feelings and actions, and vicariously experiencing aspects of these as if they were our own. Together, these two results from neuroscience could have important implications for the design of learning environments; to discover these will require reconciling established educational learning theories with the current neurobiological evidence.

Keywords: Mind, Brain and Education, Brain-Based Education, emotion, learning, embodiment, empathy

Advances in Social and Affective Neuroscience: Bringing Neuroscientific Evidence to Inform Educational Theory

Anyone involved in raising and educating children, from parents to teachers to coaches, mentors and beyond, knows that social learning is a major force in children's development. Typical children watch and engage with other people, imitate these other people's actions (including mental actions and beliefs), and look to trusted adults and peers for emotional and other feedback on their behavior. They imagine how other people feel and think, and those thoughts in turn influence how they feel and think.

Interestingly, evidence from social and affective neuroscience is shedding new light on the neural underpinnings of such social processing, affective responses and their relation to learning. These new discoveries link body and mind, self and other, in ways that only poets have described in the past (Casebeer & Churchland, 2003). They dissolve traditional boundaries between nature and nurture in development (Immordino-Yang &

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Fischer, 2010), and underscore the importance of emotion in 'rational' learning and decision-making (Damasio, 2005; Haidt, 2001; Immordino-Yang & Damasio, 2007). The challenge now for educators is to reconcile the new neuroscientific findings with established educational theories, to discover how this new information can be used to improve teaching and learning.

Our Bodies, Our Minds; Our Cultures, Our Selves

Traditional Western views of the mind and body, such as that of Descartes, divorced high-level, rational thought from what were thought of as the basal, emotional, instinctual processes of the body (Damasio, 2005 [1994]). By contrast, recent work in affective and social neuroscience has revealed a new view of the mind. Far from divorcing emotions from thinking, this research collectively suggests that emotions, such as anger, fear, happiness and sadness, are cognitive and physiological processes that involve both the body and mind (Damasio *et al.*, 2000). As such, they utilize brain systems for body regulation (e.g. for blood pressure, heart rate, respiration, digestion) and sensation (e.g. for physical pain or pleasure, for stomach ache). They also influence brain systems for cognition, changing thought in characteristic ways—from the desire to seek revenge in anger, to the search for escape in fear, to the receptive openness to others in happiness, to the ruminating on lost people or objects in sadness. In each case, the emotion can be played out on the face and body, a process that can be felt via neural systems for sensing and regulating the body, or the emotion can sometimes involve simulations of the body that do not leave the brain. And in each case, these feelings interact with other thoughts to change the mind in characteristic ways, and to help people learn from their experiences. Put simply, what affective neuroscience is revealing is that the mind is influenced by an interdependency of the body and brain; both the body and brain are involved, therefore, in learning (Immordino-Yang & Damasio, 2007).

Further, educators have long known that thinking and learning, as simultaneously cognitive and emotional processes, are not carried out in a vacuum, but in social and cultural contexts (Fischer & Bidell, 2006). A major part of how people make decisions has to do with their past social experiences, reputation and cultural history. Now, social neuroscience is revealing some of the basic biological mechanisms by which social learning takes place (Frith & Frith, 2007; Mitchell, 2008). According to current evidence, social processing and learning generally involve internalizing one's own subjective interpretations of other people's feelings and actions (Uddin *et al.*, 2007). We perceive and understand other people's feelings and actions in relation to our own beliefs and goals, and vicariously experience these feelings and actions as if they were our own (Immordino-Yang, 2008). Just as affective neuroscientific evidence links our bodies and minds in processes of emotion, social neuroscientific evidence links our own selves to the understanding of other people.

For example, how do we know that the atrocities committed on 9/11/2001 are wrong? And why do most Americans have such a difficult time understanding how the terrorists were able to carry out these actions? We automatically, albeit many times nonconsciously, imagine how the passengers on those planes must have felt, empathically experiencing both what they were thinking about and their emotions around these thoughts. For

many, just thinking of the images of planes hitting buildings induces a fearful mindset with all its physiological manifestations, like a racing heart and anxious thoughts. Similarly, we have difficulty empathizing with the terrorists who brought down the planes, because the values, morals and emotions that motivated these men are so different from our own.

Human Nature, Human Nurture

From the perspective of affective neuroscience, the social emotions that motivated the terrorists, as well as those we experience when empathizing with the passengers, represent a uniquely human achievement, and one that is relevant to education: the ability to feel emotions and engage in actions about the vicariously experienced beliefs of another person. Social emotions and their associated thoughts and actions are biologically built but culturally shaped; they reflect our neuropsychological propensity to internalize the actions of others, but are interpreted in light of our own social, emotional and cognitive experiences. Put another way, human nature is to nurture and be nurtured. We act on our own accord but interpret and understand our choices by comparing them against the norms of our culture, learned through social, emotional and cognitive experiences.

As is the case for basic emotions, the neural processes for experiencing and interpreting these various choices are not independent from our bodies. Instead social emotions, though arguably a pinnacle human achievement, remain biologically grounded in our most basic physiological life-regulatory processing. The feeling of these emotions appears to modulate the neural systems that sense stomach ache and regulate blood chemistry, for example. Especially intriguing, these emotions also involve systems associated with visceral self-awareness that are related to consciousness. Quite literally, it appears that the ability to treat others as we would be treated relies on feeling the empathic welling in our throat or 'punch' in our gut—feeling these on the substrate of our own psychological and bodily selves and interpreting them in light of personal experience and cultural knowledge, including that provided by education.

For example, let us take an educationally relevant problem—why does a student solve a physics problem? The reasons are fundamentally emotional, and range from pleasing his parents, to the intrinsic reward of finding the solution, to avoiding punishment or the teacher's disapproval, to the desire to attend a good college. Each of these reasons involve an implicit or explicit social or emotional value judgment, as the student imagines how others would react to his behavior, or how it would feel to solve the problem. And how does the student solve the problem? To apply problem-solving skills usefully in physics, the student must first motivate and engage himself sufficiently, must recognize the type of problem that is before him, and must call up information and strategies that will steer him toward a correct solution. Emotion plays a critical role in all of these stages of problem solving, helping the student to evaluate, either consciously or non-consciously, which knowledge and skills are likely relevant, and which will lead to a correct solution, based on his past learning. As he begins thinking through the solution, he is emotionally evaluating whether each cognitive step is likely to bring him closer to a useful solution, or whether it seems to be leading him astray. From a neuropsychological perspective,

the brain systems for emotion form the 'rudder' that steers his thinking toward the development and recruitment of an effective skill (Immordino-Yang & Damasio, 2007), in this case for the solving of physics problems. Through regulating and inciting attention (Posner & Rothbart, 2005), motivation, and evaluation of possible social and cognitive outcomes, emotion serves to facilitate the student's recruitment of brain networks that support the skills he is developing. Here we use the example of solving a hypothetical physics problem, but the same mechanisms would be at play in the solving of other sorts of problems too, such as in deciding how to help one's friend or how to vote in a presidential election.

Emotion (Body and Mind) in Educational Context

Schools are social contexts. Each school is a community that functions inside a broader culture, and the social and emotional experiences that children have as members of a school's culture will shape their cognitive learning (Rueda, 2006). Children's bodies, brains and minds are meaningful partners in learning. Each child builds on his or her biological predispositions, his or her 'nature', grappling with his or her own biological and psychological 'self' as a platform on which to understand the thoughts and actions of other people, both peers and teachers.

When understood in this way, we can appreciate that even the driest, most logical academic learning cannot be processed in a purely rational way. Instead, the student's body, brain and mind come together to produce cognition and emotion, which are subjectively intertwined as the student constructs culturally relevant knowledge and makes decisions about how to act and think.

Taken together, the neuroscientific evidence linking emotion, social processing, and self, suggests a new approach to understanding how children engage in academic skills, like reading and math. While skills like reading and math certainly have cognitive aspects, the reason why we engage in them, the importance we assign to them, the anxiety we feel around them, and the learning that we do about them, are driven by the neurological systems for emotion, social processing and self. Neuroscientific evidence suggests that we can no longer justify learning theories that dissociate the mind from the body, the self from social context. To learn, students empathically recognize the teacher's actions, thoughts and goals, a process that reflects each student's own social and cognitive experiences and preferences. For example, to learn how to do a math problem, the students in the class must understand the goal of the exercise, and be able to relate that goal to the teachers' actions and thoughts, as well as to their own skills and memories. Using their own experience as a platform, the students struggle to discern and reconstruct the teacher's oftentimes invisible mental actions in their own mind. This process is subjective, emotional, and grounded in each student's predispositions and personal history.

Affective and Social Neuroscience and Educational Theory: A Plan for the Future

Despite their obvious relevance to educational environments, for the findings described above to have their full impact, educators and neuroscientists need to debate the general

principles that the findings reveal, in order to derive testable hypotheses for education. In bringing neuroscience to inform education, this updating of educational theory is often neglected. Many times, educators and neuroscientists alike, caught up in their zeal for new and exciting information and seeing the desperate need to improve education, overlook the importance of theory building. Take, for example, the Mozart Effect—a sound scientific finding relating spatial ability to music listening that was vastly misrepresented and misapplied as a learning tool (see Rauscher, Shaw & Ky, 1993). Attempting to directly move from brain research to educational innovation without passing through a theory-building stage limits the generalizability of the new tool, and is sometimes even dangerous for children (Hirsh-Pasek & Bruer, 2007).

For education to truly benefit from these neuroscientific findings in a durable, deep way, for the full implications to become apparent, educators must examine closely the theory on which good practice is built, to reconcile the new and exciting evidence with established educational models and philosophies. For example, affective and social aspects of development are generally considered in examining curricula intended for young children. Affective and social neuroscience findings suggest, however, that emotion and cognition, body and mind, work together in students of all ages. Future research and theory in education should attempt to understand how best to characterize and capitalize on the emotional and social dimensions of learning in older students, including adults, keeping in mind what is known of the biological underpinnings of these processes.

In conclusion, there is a revolution imminent in education. The past decade has seen unprecedented advances in scientists' understanding of the brain and mind, and new information about the brain is expanding the influence of cognitive neuroscience into the classroom. The neuroscientific findings from affective and social neuroscience in particular could have profound implications for education, eventually leading to innovations in practice and policy. To discover these, we must lay the findings on the table for theoretical and philosophical debate. Irrespective of their scientific value, the individual brain findings are powerful for education only insofar as they suggest changes to our general knowledge of how learning and development happen. This is the next frontier for educational neuroscience. Neuroscientists and educators must work together to produce the Holy Grail: new ways of understanding development that have practical implications for the design of learning environments.

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