UNIT 3: SEEING OTHERS FROM THE SELF

Section 1:
Monkey see

In the mythology of *Star Trek*, Vulcans like Spock repress all emotions in an attempt to live a life of pure reason. In order to share experiences, thoughts, memory, and knowledge with other individuals, they resort to the Vulcan mind meld, which requires physical contact—placing the hands on the head and face of someone else to establish a conduit between brains. Humans, on the other hand, use emotion to link minds. We intuit the thoughts and motives of others by observing physical behavior and facial and bodily expressions, listening to vocal clues, and trying these out on our own neural networks. We notice the flushed face, the slight tremor of the lip, and the shift in vocal pitch and internalize these by imagining ourselves in some ways *as if* we were experiencing these changes. We experience these changes vicariously in the appropriate parts of our brain, and we sense the emotional state of the other person and imagine his or her thoughts. This simulation of the emotional cues of others allows us to infer their thoughts and goals, using networks of interconnected brain areas that, together, are responsible for all our various skills, behaviors, and sensations. In essence, we understand others through our understanding of ourselves.

Q: How do mirror neurons work?

A few years ago, a macaque monkey watched an Italian researcher walk into a lab eating an ice cream cone. Giacomo Rizzolatti and his team had taken a break from studying the neurobiology of delayed gratification but had left the monkey wired to the single-cell recording apparatus. So, they noticed the surge in activity in a certain part of the monkey's frontal cortex each time it saw the researcher lift the cone to his mouth to take a lick. What these researchers discovered was that the same parts of the motor cortex used for planning actions were activated when the monkey did no more than watch someone perform an action that it found both familiar and interesting. The monkey had tasted ice cream cones before, so it knew what the researcher was doing; presumably, the monkey needed its previous experiences in order to understand the researcher's actions. And so began the discovery of a basic biological mechanism that enables us to understand the goals and to imagine the feelings of other people, a mechanism with the...
slightly misleading name of "mirror neurons"—an important mechanism for empathy and learning.

New evidence suggests that this neural activity of "mirroring" occurs in areas where perception and action converge. In these areas, information from our senses might tell us that it's snowing, the road is icy, and the car approaching us is going much too fast. So, we step back quickly onto the curb. These are areas of high-level sensory association and motor planning.

(End of first column online)

Development and learning have long been understood to involve increasingly complex cycles of perception and action. We internalize our interactions, our sensory experiences, with the world and construct ever-improving skills for acting in it. But our experiences don't have to be real; they can be simulated or imagined and experienced as if they were real. Hook up a tennis player to an fMRI (functional magnetic resonance imaging scanner) and ask her to imagine playing, and neural activity will occur much as though she were running about on the court, though, not surprisingly, to a lesser degree.

Significantly, when the monkey observed the researcher pick up a pencil and use the same motion to bring it to his mouth as though he were going to eat it, there was no corresponding spike in neural activity in the monkey. This lack of activation indicates that the monkey's experiences with ice cream cones, its memory of eating and enjoying food, were critical to its empathic response. It appears that the monkey understood the goal of the researcher's action with the cone but not with the pencil; the cone-goal relationship meant something to the monkey and elicited the mental simulation of the action. So, it seems that mirror activation requires a shared understanding of the goal implicit in the actions being observed.

As a high school teacher who had once wrestled on a team in middle school, Bill always tried to attend wrestling matches at the schools where he taught. He found them exhausting. For as he watched, his body constantly tensed and contorted as he simulated the various positions and struggled in his imagination along with the wrestlers, trying to pin an opponent or escape a hold. At the end of each three-minute period, he consciously relaxed his muscles, easing himself back to a position that more closely resembled sitting. Colleagues with whom he sat at matches and who had never wrestled told Bill they tended not to have this physical reaction. It seems that understanding the goal of a certain move, like grabbing an opponent's wrist to shift his weight in order to set him up to dive at his legs and take him down, was critical to internalizing what he was watching. On the other hand, watching field hockey, which Bill never played, quickly bored him—no internal identification or understanding, no simulating the experience, and no interest.

A mirror, then, is a slightly misleading metaphor, for a mirror suggests passive reflection as opposed to a shared understanding of and active participation in goal-directed actions. Mirrors reflect whatever passes in front of them; the mirror areas of the brain are more selective. To the monkey, the researcher's action of moving a pencil toward his mouth is meaningless. The monkey has never done that, or if it has, the experience wasn't particularly memorable. So, mirror activation does not occur. By contrast, when the monkey observes the licking of an ice cream cone, which it has tasted and enjoyed, the goal is apparent, interest is engaged, and the mirror neurons fire.

It may be, then, that this "mirror" property forms the most basic biological mechanism by which we internalize and learn from another person's thoughts and actions. Although mirror neuron systems don't tell the whole story of how we process social interactions, they do provide an explanation for our ability to internalize and "read" the goals of others as a starting point to feel and understand their actions and...
emotions.

Glossary

**motor cortex**
An anatomical location in the brain in the posterior (back) region of the frontal lobe responsible for motor planning, control, and execution.

**mirror neurons**
Term describes an important neuroscience discovery at the turn of the 21st century regarding brain systems that show similar patterns of activation when engaged in, and observing others engaged in, familiar experiences.
UNIT 3: SEEING OTHERS FROM THE SELF

Section 2:
Empathy and context

How does empathy work?

Like a candle within a jack-o-lantern, emotions are the physiological light within us, shining outward through our eyes, body postures, and behaviors. And, of course, we are not single, independent agents. We are part of a society of jack-o-lanterns glowing in the darkness, inferring information about the candles illuminating those around us. As social beings intent on thriving in a culture, we care about what others think and feel, especially about us. We look for signs of displeasure or affection in our partners, bosses, children, and friends.

If you take some time to dwell on the picture above, you might notice changes in your physiology—perhaps your respiration slowing or a relaxation of muscles you were unconsciously holding tight. The picture might elicit a sigh of contentment. These physiological changes are a natural response to the emotions manifested in these people and even in the dog: their proximity to each other, the touching and embracing, the hints of smiles, the physical relaxation, and the vulnerable and open position of the dog. The picture becomes a trigger for our emotions, stimulating physiological changes and thoughts and feelings.

Emotions are social in the sense that the behaviors that comprise them can be visible and public, but they also lead to the private experience of feelings. We can see the bodily manifestation of the emotions in this family, but not the private and subjective experience of their feelings. Empathy allows us to infer their feelings and their thoughts because we imagine ourselves as if we are they in these physical postures and relationships. We imagine that we know a lot about what they are thinking.

Notice here that the emotions that each of these people and the dog are experiencing—the physiological state of their bodies—are quite similar. However, the feeling of this emotional state is different for each, based on the developmental level and sociocultural knowledge that each brings to the moment. That is, the father experiences or feels his emotion in the context of his role in the family, as the man who is responsible for these children and who has certain memories of and hopes for them. He feels his emotion
in a "fatherly" way. At the same time, the dog probably simply experiences the emotion that results from being bonded to these people, without any meaningful or socioculturally attuned reflection.

The people in the picture and our reaction to them provide a sense of the relationship between our biology and our experience: Our emotions are automatic biological reactions—packages of physical changes, behaviors, and thoughts. These reactions are shaped in part by our experiences, our culture, our socialization, and our learning. Although we do not purposely control the physiological package of behaviors that accompanies them, we can learn about what triggers our emotions, and we can learn to interpret them in more and more complex ways. The experiences of those in the picture give meaning to their emotions. They share the same physiological manifestations of their emotions—the rosy cheeks, the calmness, and the slow breathing.

However, the father may experience his physiological well-being as happiness because his children are thriving and as pride in his ability to provide a certain kind of life for his family. The younger boy may simply feel happy to be able to spend some time with a father who is often away at work. Although those of us looking at the picture cannot know for certain what any of them are feeling, our relaxed physiological response, our similar experiences, and our shared cultural understanding allow us to infer meaning that we assume is very close to the meaning felt by those in the picture. We look at them empathically, assuming that their feelings reflect experiences that we also have had. Our emotions, feelings, and thoughts seem aligned.

However, this alignment is more fragile than we often imagine, for it depends on shared experiences within a shared culture. This picture would likely elicit a very different reaction if shown in Korea, where people don't normally snuggle with dogs. Or try this experiment: Look back at the picture and pay attention to the changes in your body and mind as you interpret the interaction of these people in a new context—such as imagining that the man is recently divorced. Suddenly, the emotional context changes, and we might find ourselves feeling sad and thinking very different thoughts as we simultaneously empathize with and pity the different people in the picture. We are able to simulate or imagine this new situation in the sense of inferring a new goal for the man based on a new understanding of the context. We might imagine him enjoying a weekend visitation after two weeks of separation from his children. We might notice, too, a different interpretation of the look on the older boy's face, a hint of ambiguity that, in our original response to the picture, we overlooked.

The point is that context matters. The context in this picture and the experiences of these people determine the meaning each finds in this moment together. Context determines how we react to the picture. And context, both the classroom and the experiences students bring to it, affects the emotions of our students. (Note: This exercise is intended to demonstrate a point. This man is not divorced; he is the happily married friend of one of the authors.)

Like all emotions, empathy rides on the neurological platform of the body and the "self"—that sense of a "real me" (my needs, my desires, my beliefs) that is formed from our experiences.

(Opened ScienceTalk Sidebar)

The Brain, the Mind, the Self
Philosophers and theologians have speculated about the relation between mind and brain for millennia. More recently, psychologists and neuroscientists have taken up many of the same questions. A wide variety of views about the nature of the mind and brain have been offered over the years, so philosophers have come up with broad labels to categorize the different views.

*Materialism* comes in many varieties and is the most popular position in contemporary science. The central idea for materialists is that the mind is nothing but the brain. This basically means that all statements about the mind can be translated into statements about the brain, without remainder. There is only the brain and the physical world. What we consider to be the mind is merely epiphenomenal, inessential, and, to some, illusory.

The various proponents of *idealism* espouse the opposite, maintaining that the brain is better thought of as a by-product of the mind. The broad idea here is that mental phenomena are causally prior brain processes. For example, some idealists will argue that the mind’s grasp of universal truths, such as those of mathematics and logic, suggests we have access to a realm of ideas that is fundamentally irreducible to, and somehow constitutive of, the physical world. These kinds of “mind-only” views are less popular than they used to be, but still find strong support in some philosophies and religions, such as Buddhism.

*Interactionism* is a group of views in which the mind and brain are seen as distinct yet intimately interrelated, with causality running in both directions. According to these views, the brain and mind co-create one another in an evolutionary dynamic, a kind of psycho-biological boot-strapping, with the brain giving rise to the mind that then, in turn, reshapes the brain. Many contemporary psychologists and philosophers are interactionists, although experiments aimed at proving these views have been inconclusive.

Finally, *monism* refers to views in which there is a category of existence more comprehensive than both mind and brain. Monists argue that there is only one basic ontological reality. It has many dimensions that can be differentiated for heuristic and practical purposes, but ultimately questions about the relationships between mind and brain are misguided from the start, entailing a category error. These views are uncommon and found mostly among philosophers. The aim is to transcend but include the distinction between mind and brain, seeing them both as partial aspects of a more fundamental reality.

Questions about the relation between mind and brain are important in education, especially for those who want to use neuroscience to inform policy and practice. For example, the current popularity of materialism lends credibility to the idea that problematic students simply have problematic brains — “their brain made them do it.” Taken to an extreme, these trends could replace personhood with brainhood and change the very nature of education. If the personality or self is removed as the locus of agency and replaced by a semi-deterministic biological process, education could become primarily about methods for building better brains, as some proponents of psychopharmacology and
We see ourselves in others, and we understand others by simulating their actions and circumstances on the same neurological structures that keep us alive or maintain our sense of social well-being. Critical to this process is our ability to recognize the goals inherent in the actions we observe, which means that actions that appear random—actions seemingly unconnected to any goal—either go unnoticed or are misunderstood because we assign an incorrect goal to them. And randomness tends to be in the eye of the beholder. The behavior of most people, even of delusional paranoid schizophrenics, is goal directed; there is an internal logic (I stabbed her because she is an agent of the CIA, which is after me) even though it may appear random to others. Too often, what happens in classrooms can seem random because students and teachers fail to understand each other's goals.

Glossary

Gordian knot

It is often used as a metaphor for an intractable problem solved by a bold stroke ("cutting the Gordian knot"). In Greek legend, the Gordian knot was the name given to an intricate knot used by the peasant Gordius, who became King of Phrygia, to secure his oxcart. Oracles foretold that, not only would Gordius become King, but he who untied the knot would rule all of Asia. Alexander the Great severed the knot with a powerful stroke of his sword.
Q: Why is empathy important to learning and teaching?

Learning in social contexts, like schools, depends on recognizing, understanding, and sharing goals. If people do not recognize that another's actions are goal directed, simulations will not be activated, and the intended learning may not occur. Learners must understand teachers' goals, and teachers will be more effective if they understand their students' goals. Of course, as we have seen, in addition to understanding goals, teachers and learners must share a sense of the emotional relevance of the goals. It's possible to understand others' actions and goals but not to care about them. To foster meaningful learning, the goals must both be understood and matter to teacher and student. Most of us have been in classrooms in which the goals seem either misunderstood or misaligned—or both.

For example, Mr. Davis stands in front of his ninth-graders and begins a lesson that asks students to identify direct and indirect objects. He writes two sentences: "Sally kicks the ball to Sam," and "Sally kicks Sam the ball." The students, with Mr. Davis's help, will circle the subject, underline the verb, box the direct object, and star the indirect object. The goal is crystal clear to Mr. Davis, and he has explained it to his students. They have studied sentences, sentence parts, and parts of speech several times before. Mr. Davis begins: he asks questions, discusses the suggestions he gets and marks the words.

Sarah looks out the window at the soccer field, where she notices her coach getting ready for the afternoon game. Jamie stares at the white board, sees the first group of words and the marks: circle, underline, box, but no star. So he follows that pattern when marking the second sentence, making "Sam" the direct object. When Mr. Davis points out that the second sentence should have a star over "Sam" and a box around "ball," Jamie is quick to pick up the new pattern. "Ball" in both sentences is in a box, so why not a star over each "Sam"? Bob, who sits in the back row next to Sarah, a pretty girl whom he likes to make laugh, cracks a joke about Jamie. Clearly, the goals in this class are not shared. Sarah has more important things on her mind. To Jamie, the teacher's actions appear random, though he tries to figure them out, and it may be that Jamie's actions appear equally random to Mr. Davis. But everyone understands Bob's behavior.

Hallie Cohen, a music teacher at a public school in Ohio, had a class like this one. She teaches classes of as many as 45 middle school students, many of whom have no musical background. "I struggle with communicating and being able to pave a clear path between my knowledge and what I want to impart to students. The most effective way that I have found is through demonstration. But demonstrating has its limits. My toughest class to instruct was a group of seventh graders, a violin class. I had a small group within that class that had a different agenda from mine. They were hellbent on making my life and others' lives difficult. So my struggle was to get them on the same page.
as the rest of the class without compromising instruction. The biggest lesson that I had to teach this class was how to work as a team: they had to be able to be part of a violin section in their school orchestra. Teaching teamwork to kids who are struggling with their identity and who have an inherent lack of respect for people in authority is challenging."

Although Hallie's goal and her students' goals seemed to conflict, she realized that they shared a common thread: the desire to communicate. The students wanted to gab with each other about social stuff, and Hallie wanted them to work with others to communicate through music. Re-examining her class using the idea of aligning the teacher's goals with those of the students, she developed the plan of having them use the violin as an instrument for social communication. She began by having them work in small groups to develop skits about any social topic, whatever was going on in their life, but they were not allowed to use words to communicate with each other. Instead, they had to use the violin to create sounds that would express what they wanted to say to each other in the skit, and the audience would then guess what the skit was about.

At first, the students acted silly, but then the challenge of the game engaged them. As they became more involved, they began to understand that the purpose of the violin, of any musical instrument, is to express feelings and thoughts to someone else in a musical medium. The students connected with the violin as a way to connect with each other. Hallie's intervention succeeded because they used the violin in a way they could understand by connecting it to their goals.
she and her students had overlapping...

View video
Q: Why don't people do what they know they should do?

This process of simulating the actions of others within ourselves, on the neural machinery that regulates and senses our own internal body states, enables us to do even more than infer the mental states and goals of others. Our mirror systems and our ability to empathize also may be the basis for our most complex moral and ethical decisions. When we see someone in pain, either physical or emotional, we vicariously feel some aspects of that pain, a response that often induces compassion. And when we watch extraordinary feats of skill or virtuous behavior, our ability to simulate the experience internally and to understand and interpret it based on our world knowledge lays the basis for admiration. And both of these emotions, compassion and admiration, can motivate us—to emulate Mother Theresa or help the victims of Hurricane Katrina or develop the skill of LeBron James.

Mary Helen Immordino-Yang and her colleagues recently conducted an experiment to study the neurobiology of admiration for virtuous behavior and compassion for social or psychological pain (see "The Study," in the next section). Their discoveries may provide deeper insight into the relationship between the mind and the body driving emotion, particularly as these interact to produce intrinsic motivation. The data revealed that even the most complex, abstract emotions—the sorts of emotions, like admiration for virtue, that require maturity, reflection, and world knowledge to appreciate—do involve the highest sorts of brain networks, but they still get their "punch," their motivational push, from activating basic biological control structures in the lowest (most primitive) parts of the brain. Motivation, it appears, comes not simply from understanding the cognitive aspects of a situation, but also from the ensuing recruitment of the same biological drives that literally regulate the body's survival, including breathing, beating the heart, controlling blood pressure, and adjusting hormones.

And so, although research is still in progress, studies on emotion may provide a key to understanding one of the most persistent frustrations teachers confront: the great gap between students' good intentions and
their actual behavior. Almost like patients with ventromedial damage (see Unit 2), students often know exactly what to say; they know that the social norms and expectations—they know that success depends on their practicing better study habits, planning their time better, and resisting more attractive temptations. They know that they should be kinder to each other, more respectful of their parents, and more willing to help others. Yet, they walk away from motivational talks with their teachers leaving a trail of promises floating like empty candy wrappers as they hurry back to their friends and parties.

"Why didn't you study last night as you promised? Why didn't you keep your promise to meet Paul at the senior center on Saturday to help? Why didn't you come by for extra tutoring?"

"Oh," they say, "I guess I just didn't feel like it." And that, it seems, may well be exactly the reason, as neuroscience is discovering. People have tended to think of motivation as a conscious, cognitive function under our control. "Decide what you want to do, pull yourself together, and do it"—the old willpower-and-bootstrap theory of success. Neuroscience is revealing that the relationship between the body and the brain likely plays a critical role in motivating our thinking, learning, and behavior, both on conscious and nonconscious levels.

(End of first column online)

We have a brain whose original purpose was to ensure our survival. It regulates functions such as our breathing, heart rate, blood flow, and hormone levels. It allows us to feel the state of our body, to feel its harmonious functioning, or to alert us to malfunctions like disease or stubbed toes. It guides us to food and friends or away from predators. The brain links our body and mind and supports complex processes responsible for emotion, thinking, feeling, and behavior, both nonconscious and conscious. As we developed into more complex social beings, this same mind-body system, the same primitive brain parts, enabled us to experience feelings of well-being or threat in the social world—and to feel these with the same intensity and loaded with the same significance as they came to our ancestors in the red-in-tooth-and-claw physical world.

(Opened ScienceTalk Sidebar)

**Motivation from the inside and out: What motivates learners to action?**

© Patricia Saxler.

*Dr. Joanna A. Christodoulou works at the intersection of education and neuroscience with roles as a scientist (Department of Brain and Cognitive Sciences at Massachusetts Institute of Technology), clinician (Children's Hospital, Boston), instructor/professor (Harvard University: Department of Communication Sciences and Disorders at MGH Institute of Health Professions) and practitioner.*

Incentivizing behaviors, on scales large and small, is a pervasive goal in educational settings. Research dedicated to discovering what it takes to motivate a learner to action has revealed insights that clarify just how much—and how—externally driven versus internally driven motivation and incentives work. Here, we focus on one of several researchers who have explored questions in this domain: Kou Murayama and his team have used both behavioral and neuroimaging techniques to study motivation, emotion, and cognition.

**Personal Goals in Context**
The majority of studies on motivation have focused on what Murayama calls "personal achievement goals." For example, one type of personal achievement goal is how a particular student is performing relative to personal or peer expectations (Murayama and Elliot, 2009). Murayama and his colleagues make the case for an additional dimension focusing on classroom goal structures. Examples of classroom goal structures are those that emphasize performance and ability (termed "performance-approach goals"), such as the achievement expectations and academic standards subscribed to by the instructor and students. Murayama also is interested in the potential for interaction between personal and classroom goals. Consider that the prevailing approach for measuring motivation occurs either at the individual student level or as an aggregate of classroom performance indexed by averaging across students. Both approaches obscure information at the intersection of the individual and the classroom.

This work has expanded the focus of the types of questions that can and should be investigated by contextualizing personal goals in classroom settings so that student motivation profiles can be understood as they interact with classroom practices that are meant to motivate students. In practical terms, this work highlights an important concern of many educators: creating a classroom environment that communicates to learners that the teacher's expectations for performance are as important as the motivations the learners bring with them.

**Neural Correlates of Motivation**

Early studies investigating the impact of extrinsic motivation have focused often on monetary reward, a straightforward tool used in research to determine whether and how payment motivates a person to want to achieve a specific outcome. Murayama and colleagues (K. Murayama, M. Matsumoto, K. Izuma, and K. Matsumoto, 2010) used brain-imaging methods (functional magnetic resonance imaging, fMRI) to study what the neural correlates of motivation are and how these correlates are affected by monetary reward. Their behavioral and neural findings revealed the following patterns:

- **Behavioral Findings:** When a monetary reward was offered for completing a task, participants were less likely to be intrinsically motivated to engage in the task independently when the reward was later eliminated (in comparison to a group that was never offered the monetary reward to begin with). In essence, participants didn't pursue a task when they were accustomed to getting an external reward, while those who never got the reward were more likely to be intrinsically moved to do so.

- **Neural Findings:** Neural correlates reflected a boost in activation for systems supporting intrinsic motivation associated with monetary reward, followed by a sharp decline in activity in brain systems linked to reward and valuation when the monetary reward was no longer available.

**Motivation and Education**

Taken together, these findings provide evidence that extrinsic rewards can boost motivation, but only as long as the reward is available. In addition, external rewards actually undermine internal motivation. When the reward is removed, the motivation to engage in the task and the associated neural correlates are less than they are if a reward is never offered. This effect suggests the need to rethink how both learners and teachers value rewards and emphasizes the need to ensure that goals and rewards are aligned. If educators aim to harness and foster internally driven motivation, the use of temporary extrinsic rewards may undermine that goal, especially in the long term. This research provides an opportunity to consider how to improve educational practices so that they are as effective as possible in motivating learners for the appropriate reasons.

**REFERENCES:**
What does this mean for our social lives, particularly for our moral behavior? Our ability to empathize, to experience emotions based on our inferences about the minds and feelings of others, plays out on this same mind-body system. We discover that even our most exalted moral feelings and behavior (that which we claim make us most human) also may rely on this same primitive system, though the system is activated differently in the social world than it is for basic biological needs.

While our reactions to physical threats are instinctual and automatic, high level moral motivations, though grounded in the same basic system, result from complex, nuanced knowledge and critical reflection. Admiration for Mother Teresa, for example, relies on values (altruism, a belief in a responsibility to alleviate the suffering of others, a sense of a greater good) that are culturally transmitted and results from thinking about the suffering we see around us. Our experiences living in the world also contribute to our developing the values through which we view Mother Teresa’s behavior. We need to have suffered a bit ourselves in order to intuitively recognize the suffering of others and to appreciate the efforts of someone like Mother Teresa to alleviate suffering despite difficult obstacles.

However, although this sort of knowledge and cognition is essential in the moral realm, the motivation to do anything—to do, for example, what we know we ought to do—also may depend on this primitive system. In other words, the research suggests that those who want to flourish in the social world by pursuing meaningful goals may derive their motivation to act from the same system whose original purpose is to support basic survival through maintenance of the body. In essence, they feel like doing the right thing (often expressed as a "gut" feeling); but without that feeling, they may not do anything, no matter how good their intentions.

Using Emotional Content in the History Classroom

At Boston Latin High School, Judi Freeman teaches a course on genocide and the Holocaust. She has incorporated video
testimonies of the Holocaust collected by the USC Shoah Foundation Institute for...

View video
Q: How do we develop empathy? Why do we need time to direct our attention inward?

As you may recall from Unit 2, basic emotions comprise our reactions to situations—we notice certain constellations of provocative circumstances, and our body and mind cohere around a strategy for responding. Our muscles contract or relax; we approach or ready our muscles and minds for flight. But what about complex, abstract situations that pose no immediate threat or offer no immediate help? Might even our reactions to these situations continue to honor their evolutionary history, calling into action basic readiness, even though our fight is for a moral cause, rather than for physical safety or comfort?

To find out, Immordino-Yang asked participants to listen to true stories about real people, stories meant to evoke admiration or compassion. The experiment involved videotaped interviews, fMRI scanning, and collecting psychophysiological data (such as heart and respiration rates). One story was about a young boy who grew up in a small city in China during an economic depression that often left him and his family hungry. John, a participant in the experiment, was shown a video clip in which the boy's mother describes how, one winter afternoon, she found a coin and used it to buy warm cakes for her son, who had been in school all day with nothing to eat. Despite the boy's hunger, he offered his mother the last cake, which she refused by lying and telling her son she had already eaten.

After the video, the experimenter asked John how this story made him feel, and John responded, "[Of the stories featured so far in the experiment], this is the one that's hit me the most, I suppose. And I'm not very good at verbalizing emotions. But ... um ... I can almost feel the physical sensations. It's like there's a balloon or something just under my sternum, inflating and moving up and out, which, I don't know, is my sign of something really touching. ... And, so, the selflessness of the mother ... and then also of the little boy. You know, having these wonderful cakes that he never gets to have, and he still offers them to her ... and then her turning them down, is ... uh ... [long pause]. It makes me think about my parents, because they provide me with so much, and I don't thank them enough, I don't think ... . I know I don't. So, I should do that."

John's response offers a clear picture of the interplay between physical sensations in the body (the signals of his emotional response) and the feelings and thoughts that these lead him to discover and articulate. He responds to the story using his own physical and psychological self, his memories, his feelings, his thoughts—all in the service of making sense of the story and of his emotional response to it, and he arrives at a discovery about a change he needs to make in his
behavior to his own parents. John comes to a motivated state that, despite its complex cognitive influences, certainly doesn't present itself as a purely rational manifestation that engages only his consciousness.

(End of first column online)

It also is deeply rooted in the nonconscious systems that keep us alive, that make us act, that organizes and regulates the functioning of our body.

As the fMRI revealed, activation extended all the way into the brain stem, far below the level of awareness, into the systems that keep our bodies alive, our most primitive depths. So, it seems, conscious thinking about the story combines with nonconscious gut reactions to produce the necessary motivation to stimulate meaningful action. Both processes, the cognitive and the emotional, work together and are necessary.

<table>
<thead>
<tr>
<th>Interrelated Forms of &quot;Self&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>We understand others' feelings in part by simulating them on our own neural mechanisms for bodily and mental self (in essence the subjective feeling or awareness of being &quot;real&quot;). ...</td>
</tr>
</tbody>
</table>

(View larger image)

<table>
<thead>
<tr>
<th>(Opened ScienceTalk sidebar)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What happens when we are at rest? Why the brain's default system is anything but resting</strong></td>
</tr>
</tbody>
</table>

© Patricia Saxler.

Dr. Joanna A. Christodoulou works at the intersection of education and neuroscience with roles as a scientist (Department of Brain and Cognitive Sciences at Massachusetts Institute of Technology), clinician (Children's Hospital, Boston), instructor/professor (Harvard University; Department of Communication Sciences and Disorders at MGH Institute of Health Professions), and practitioner.

Imagine the scene: A teacher wraps up a lesson and calls on a student, Alex, to answer a question, but he is obviously not paying attention to the lesson because he is day dreaming. Not surprisingly, the teacher is frustrated—how can Alex learn if he is always disengaged with her lessons and in his own head? Well, neuroscience may shed light on this, and the answer may surprise you!

When a person spends time reflecting, without the distraction of external stimuli but rather being absorbed by personal thoughts, the default mode (DM) of the brain is activated. The DM relies on a distributed network of regions near the midline of the brain, tucked deep within each hemisphere. This system is considered to be a complementary attentional system to that recruited when a person is asked to attend to externally driven information, as would happen in a classroom when a teacher is instructing. One of the most exciting advances in neuroscience research since 2000 has been the identification of the DM. The relevance of this brain system was not immediately apparent but has since become an active area of research, including understanding how the DM relates to education and to the development of the learner.

What Alex's teacher and, indeed, nearly all of the educational contexts we encounter demand is attention to externally driven processing of information, such as a lesson or demonstration. Attention can toggle between information generated by others that is externally directed to an internally driven focus on topics of personal relevance. We regularly ramp up the externally driven attentional system
and necessarily ramp down the internally driven system, and vice versa. In Alex’s case, he was focusing attention inward while his teacher was expecting him to focus outward. Could there have been any benefit to Alex's daydreaming?

The recent history of understanding the activation pattern of the brain when not engaged in a specific task set the groundwork for understanding Alex's behavior. The most important lessons to date are several. First, the live brain is never idle or at rest; however, when individuals are not directing attention outward to a task at hand but inward to personal thoughts, a unique brain activation pattern begins. Second, the default mode of the brain has been associated with self-awareness and reflection, recalling personal memories, imagining the future, feeling emotions about the psychological impact of social situations on other people, constructing moral judgments, and other psychosocial mental processing. Furthermore, activity in this brain system has been linked with performance on measures of both intelligence and reading ability.

The lessons for education based on the default mode of the brain will emerge slowly. But so far, it appears that when we are internally reflecting, we may be developing systems that are critical for socio-emotional health and understanding. This discovery suggests that we need some sort of balance between external and internal focus in order to reach our potential and that both attentional systems are skills that require practice to develop. In some contexts, such as in violent communities, students may be trained to overly employ the outward attention system to the detriment of developing skills associated with the inward attention system. Working together, educators and neuroscientists have an exciting new framework to consider the next time a student, like Alex, gets lost in daydreams. He may or may not be internalizing and integrating information from the lesson at hand. Perhaps he is processing a fight he had with his mother or creating the lyrics for a song that expresses his feelings about some aspect of his life. But chances are good that he is doing something. And what he is doing may well be what is most emotionally relevant to him.

Taken a step further, perhaps it is possible to create classrooms that invite students to internalize the day's lessons by choreographing a productive fluctuation between external and internal focus and helping students develop the skill of toggling between these attentional states in order to make sense of the lessons. For example, if Alex's internally focused attention could be harnessed to process how his learning relates to his sense of self or his understanding of others, then his time indeed would be productively spent. Among educators, the most common concern is how much attention a student is paying to the task at hand. Now research is making progress in understanding what happens when attention is not being outwardly directed. The next wave of research might benefit from focusing on what is happening when students are asked to focus not outwardly but inwardly. If current research continues to develop in the direction it has taken so far, we may be able to understand how internally focused attention is crucial for an individual’s development of sense of self, relation to others, and understanding of others.

REFERENCES:

At one point, John’s recounting of his feelings about the story echoes Amy’s response (Unit 2, Section 7) to the story of the blind woman who opened a school for the blind in Tibet. (Amy reported that she “found the story very motivational.”) Both had a similar long pause before moving from their feelings about the story to talking about how the story has made them look more deeply at their own circumstances and feel motivated to take action toward others. In turning inward, they reflected upon the stories as a means to experience the internal, psychological self, or the "real me," and to access their memories and to feel what these meant to them in relation to the stories. This process of inward reflection leading to meaningful analysis and a feeling of motivation requires more time than processing, which is externally directed. John and Amy both paused as they looked more deeply into the significance of their reactions to the stories they heard.

The area of the brain that becomes active when this internal reflection occurs also becomes active when we daydream, but it is suppressed when we turn our attention outward to the external world. Perhaps this slower internal focus on the self is essential for finding meaning. Perhaps neuroscience offers a biological basis for Wordsworth’s observation that: "The world is too much with us; late and soon, Getting and spending, we lay waste our powers: Little we see in Nature that is ours."

To see a classroom implementing these findings watch "Music and Emotion." View Video

**Empathy**

Research participants listen and react to stories designed to evoke social emotions such as admiration and compassion. The neural activity deep within the brain, including nonconscious systems that...

View video
UNIT 3: SEEING OTHERS FROM THE SELF

Section 6:
Implications for schools

Q: What does it mean to build schools for learners rather than for teachers?

Principles to consider:

- Schools must make room for the self of the students.
- Learning depends in part on mirror neurons and our ability to simulate.
- The goals of teachers and students must be aligned.
- Motivation to take moral action may derive from engaging in meaningful reflection about others' situations in relation to one's own.

"I just need a place where I can be myself." This was Jill's assessment of what was missing from her life in school, her feeling that school had nothing to do with her interests or goals. She spent hours in classes and doing homework that felt alien to the "real her." Experience suggests that she speaks for hundreds of thousands, maybe millions of students. School is not typically a place for the self, at least not the self of the student.

For example, during a department meeting, William, an English teacher, sneers at the fuzzy notion of the self, smelling the suspicious odor of low standards and "nonsense" like self-expression and self-esteem ("self-of-steam," as one former student humorously heard it). "What on earth is this self?" he asks as though holding it by two fingers at arm's length.

"Well," responds a colleague, "it's rather like your affection for Hemingway. You tell me he speaks to you, he touches some core of truth within you, and you love to read and teach his books. It's like that wonderful scene in The History Boys when Hector (I think that's his name), the old English teacher, is explaining the moment when you read a truth that you thought you were the only one to feel. Hector says something like, 'At that moment, the book reaches out and takes you by the hand, and you know you are not alone.' The book speaks to your self, speaks to that jumble of emotions and beliefs and memories and understandings that you experience as you. The book matters to you, and you feel it in your body and mind. When what you study and who you are come together, your education starts to matter to you."

Neuroscience seems to suggest a powerful case for making room for the self of students in school. The self is the platform on which we construct an understanding of the world and of others. We internalize our interactions with the world—whether with people or concepts—and give these meanings based on our experiences and our sense of how to thrive in this world. Our mirror systems—our innate ability to simulate and imagine, our sensitivity to the emotional responses of our body and our ability to make sense of these emotions by feeling them and reflecting on them—are critical tools for survival. Schools that take seriously their responsibility to help young people become skillful at using these tools.
might look very different from our current institutions. They also might feel very different to students. One difference could be that students' studies come to matter to them so that learning becomes more important than merely amassing grades for a college résumé; learning becomes emotionally relevant. But the most dramatic difference might be that students become attuned to physical and mental changes that signal the presence of an emotion that needs to be felt and understood. Perhaps the emotion is the result of skilled intuition, a gut feeling that is guiding a student toward a solution to a problem. Perhaps it signals a response to someone else's tone of voice or a look that needs to be reassessed. Schools that take emotions seriously as indispensable to and inseparable from cognition and learning might well achieve their lofty claims to "teach the whole student."

**Our brain's mirror systems and our ability to simulate experiences are powerful allies for learning.** "If" is the "open sesame" for the imagination.

More than 100 years ago, the Russian actor Constantin Stanislavski created an entire system of acting based on "the magic if," a system of training actors to improve their skill at imagining themselves in the situations of characters they played. The goal was to induce the proper emotions within themselves and more powerfully move the audience. In an interview, Marlon Brando, a great American actor who was trained in the Stanislavski method, was asked by a skeptic how he could portray a murderer if he had never murdered anyone. He responded that he had killed a fly. His answer suggests that once we have experienced the irritation that results in squashing an insect, we can imaginatively induce the emotion necessary to kill a person and communicate that emotion on stage.

This is the same technique English teachers have used for years to get students to imagine the lives of fictional characters—to "walk a mile in someone else's shoes," as Atticus Finch advises in *To Kill a Mockingbird*. Some great scientists also have stood on the platform of the self and felt their way to solutions to problems that mattered to them. Jonas Salk, inventor of the polio vaccine, said, "When I worked on the polio vaccine, I had a theory. I guided each [experiment] by imagining myself in the phenomenon in which I was interested. The intuitive realm ... the realm of the imagination guides my thinking." Einstein imagined riding a beam of light and discovered relativity, and Nobel Laureate Richard Feynman imagined himself floating among electrons and discovered new insights into physics. Such imaginative role-playing (imagining you are a character or an object) is likely to trigger mirror systems and help develop empathy and learning.

Too often, schools treat imaginative ability as "nice," perhaps something for the arts department, but as secondary to the real business of rational, rigorous, intellectual work. The evidence suggests that this point of view is not likely to produce large numbers of creative, effective thinkers.

**Teachers' and students' goals must be aligned for meaningful learning to occur.** Although more and more teachers over the past few decades have taken this responsibility seriously by stating their goals or writing them down for students to read, understanding the goals of someone else requires an emotional, not just an intellectual, recognition. Therefore, teachers cannot assume that stating a goal means the students have understood or internalized it. In fact, they may well have internalized an entirely different understanding than the teacher intended. In addition, aligning goals also requires teachers to understand students' goals, for it is the teacher who is ultimately responsible for creating the circumstances that bring
the goals together.

Of course, it is easier to align goals if students and teachers occupy the same classrooms for similar reasons—if the students have come because they want to learn chemistry or film or how to write poetry or how to work with special needs children. At the moment, most schools are not designed with this idea in mind, so teachers must work much harder to lasso the social goals that interest most young people (like figuring out who they are and who will accept them) and pull them into the corral. What if we imagine new ways to design schools based on a new understanding of how people learn—new structures, new practices, and new policies to support the imaginative work that many teachers are doing despite being hobbled by the old ones?

It may be that to develop the sort of morality that motivates us to take socially significant action requires that we reflect on events and people that inspire us. Perhaps schools need to help young people become more skillful at directing their attention inward in order to feel this inspiration—a process that requires more time than schools often allow for deep thinking or reflection. Schools constantly claim that their mission is to produce good citizens, yet so many of the motivators remain external—grades, college readiness, pleasing parents, and the ubiquitous fear factor. And conditions in the classroom tend not to foster meaningful reflection. Perhaps our ends and our means are not aligned. What do we mean by "good citizens"? Is neuroscience offering insight that might be useful to achieving this goal? Could it be giving us a glimpse into the survival and self-related processes underlying social behavior and creativity?

Peer Mentoring

Music teacher Hallie Cohen recognized that early adolescence is a time when making connections to other kids is a very powerful motivator. As a result, she began creating structured time for peer...

View video
UNIT 3: SEEING OTHERS FROM THE SELF

Section 7: Resources


