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How Social-Emotional Imagination Facilitates Deep Learning and Creativity in the Classroom

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> *Imagination is not only the uniquely human capacity to envision that which is not, and therefore the fount of all invention and innovation. In its arguably most transformative and revelatory capacity, it is the power that enables us to empathise with humans whose experiences we have never shared.*
>
> J. K. Rowling, 2008

Developing creativity in students is not a luxury. Technology experts project that about 47% of current jobs in the United States will become obsolete because of computers within the next decade or two, and the jobs that will remain are those that require creative intelligence (Frey & Osborne, 2013). In this chapter we propose that supporting youths' capacities for social-emotional imagination – their abilities to creatively conjure alternative perspectives, emotional feelings, courses of action, and outcomes for oneself and others in the short- and long-term future – is a critical missing piece in many classrooms.

This mental act of imagining precedes and translates into creative behaviors – behaviors that demonstrate divergent thinking or a novel approach to a problem and result in the formation of a useful idea or work.

Students' school success and lifelong creativity are facilitated not only by the cognitive skills measured by IQ tests but by other cognitive and social-emotional attributes. Critically, a capacity for imagination enables many of these cognitive and social-emotional skills, such as intellectual curiosity, openness to experience, passion, inspiration, love of work, envisioning future goals, persistence, sense of mission, courage, delight in deep thinking, tolerance of mistakes, and feeling comfortable as a "minority of one" (e.g., Cox, 1926; Duckworth & Seligman, 2005; Fredricks, Blumfeld & Paris, 2004; Furnham & Bachtair 2008; Kaufman, 2013a, 2013b; Kaufman et al., 2015; Nusbaum & Silvia, 2011; Oyserman & Destin, 2010; Runco, Millar, Acar, & Cramond, 2010; Torrance, 1993, 2003, 2004; von Stumm, Hell, & Chamorro- Premuzic, 2011). Imagination is central because it allows students to reflect holistically about what they learn such that school-related tasks are more meaningful, personally relevant and rewarding, and more connected to the adulthood they hope to achieve one day. Imagination facilitates creative, critical dispositions toward new content and skills by helping students conjure new connections between ideas and invent new ways to represent and apply information.

Clearly, students who are able to find personally relevant meaning in the content and skills they are learning, who are able to envision the instrumental connections between their current work and their later success, and who can dream about a more accomplished life than they currently have are better able to persist and achieve (Oyserman, Bybee, & Terry, 2006; Oyserman & Destin, 2010). Yet, schools often singularly emphasize developing youths' task-related competencies in the near term. Some schools may not recognize that students' abilities to persist with the hard work of academic learning, and to use what they learn as groundwork for a satisfying life, are tied to something bigger. Students are rarely taught that their persistence is enhanced by their abilities to cultivate an imagined

possible future and to connect what they are learning to the meaning that future holds (e.g., Oyserman & Destin, 2010; Torrance, 1993). Thus imaginativeness not only helps students persist in school, but it also helps them develop the creative skills that will be most critical for their employability when they leave school. Preparing students to undertake creative intelligence tasks means scaffolding them in the ability to focus intently on a task at hand and also in consciously, appropriately, and temporarily disengaging from the task to situate its broader purpose in a larger, personally meaningful goal.

Given the link between students' personal socio-emotional qualities, creativity, and long-term achievement in the face of obstacles, how might schools support young people in developing creative dispositions toward learning – the kinds of creative dispositions that will support persistence, well-being, meaning making, and hard work? To help answer this question, we first review recent research in the emerging field of social-affective neuroscience. We then discuss the roles of future-oriented cognition, constructive internal reflection, positive constructive daydreaming, mind wandering, social-emotional reasoning, and multiculturalism on learning and creativity. We conclude with practical recommendations to help learners and supportive adults harness students' social-emotional imagination, and hence their skills for thinking creatively, in the classroom.

A Tale of Two Brain Networks

Recent neuroscientific research suggests that two interdependent but distinct brain states support, on the one hand, attention to the current context, task-oriented focus, action-oriented mindset, and contextualized cognition, and on the other hand imagination, creativity, meaning making, personally relevant cognition, retrospection, and prospective thinking (Andrews-Hanna, Smallwood, & Spreng, 2014; Immordino-Yang, Christodoulou, & Singh, 2012). Both mindsets are clearly important for student achievement: attention to the current context and an action orientation are necessary to participate in class discussions, focus on challenging work, and learn new information. Imagination-oriented

mindsets, by contrast, are important for connecting to the broader, longer-term purpose of the work, and for inferring the connections across domains and exemplars.

That the brain state that supports creativity and maintenance of long-term goals often requires a relative "tuning out" of the current physical context has critical implications for education. Building from what is known about the brain states that underlie these two modes of thought, here we argue that classrooms should be designed to scaffold *both* kinds of thinking, and to support students in mindfully maneuvering between these two states. We argue that by overly emphasizing task-oriented focus (e.g., stressing standardized test performance) while providing little support or opportunity for reflection or meaning making, standard educational environments, and practices may undermine both creativity and long-term goal attainment.

The Brain's Default Mode Network Is the Neural Engine of Imagination

For more than a decade neuroscientists have investigated a network within the brain that they refer to as the default mode network (DMN; Greicius, Krasnow, Reiss, & Menon, 2003; Raichle & Snyder, 2007). The DMN is composed of a distributed system of brain areas in frontal and parietal regions along the midline of the brain, as well as medial regions in the temporal lobe and lateral sections in the inferior part of the parietal lobe (see Figure 17.1). The DMN was so named because it is active when individuals are resting and it is generally not activated when individuals engage attentively in cognitive, task-oriented processing (e.g., in working memory tasks; Greicius et al., 2003). When one brain network is more active, the other tends to be less so (Esposito et al., 2006; Fox, Snyder, Vincent, Corbetta, Van Essen, & Raichle, 2005). Also, the internal coordination of components within each of these networks appears to be complementary, such that when one network increases coordinated co-activation

(stronger “cross-talk” between relevant brain regions), the other network’s coordinated co-activation tends to attenuate (Greicius & Menon, 2004; Dwyer et al., 2014).

Figure 17.1

Overview of the main brain regions comprising the default mode (DM) network, with brief descriptions of associated socioemotional functions. The DM regions listed are relatively more active and show coordinated activity during wakeful “rest.” The regions depicted are also involved in many other functions, including various cognitive association functions and aspects of homeostatic regulation and somatosensation, especially for the milieu of the internal body (i.e., the “guts”). The left side of the image shows the front of the brain: the right and left hemispheres are split apart to show the medial surface. Note that these brain areas cannot be said to “do” the functions listed. Instead, they are especially “associated” with these functions and as such are thought to play important roles within the complex networks of regions underlying the functions. I. Ventromedial prefrontal cortex (vmPFC): induction of social emotions; nonconscious induction of somatic responses, such as skin sweating associated with a sense of risk; modulation of the parasympathetic branch of the autonomic nervous system (important for calming of heart rate). 2. Dorsomedial prefrontal cortex (dmPFC): representation of self in relation to others; predicting emotional outcomes of social interactions for self and close others; judging psychological and emotional qualities and traits; feeling emotions about others' mental situations. 3. Anterior middle cingulate cortex (ACC): a centrally connected “hub” of the cortex, also heavily interconnected with somatosensory regions that feel the guts and viscera; error monitoring, emotion, and empathy; feeling physical and social pain; modulation of the sympathetic branch of the autonomic nervous system (important for activation of heart rate, arousal). 4. Posteromedial cortices (PMC): the most centrally connected “hub” of the cortex; high-level integrative representation of the physiological condition of the visceral “gut” body; construction of a subjective sense of self-awareness; activated in social emotions, moral decision making, and episodic memory retrieval; contains dorsal posterior cingulate cortex (dPCC); involved in attention monitoring or switching and integration of information. 5. Inferior parietal lobule (IPL): involved in successful episodic memory retrieval; empathically simulating others' perspectives and the goals of others' actions. 6. Hippocampus: formation and recall of long-term memories (not visible in these views).

Because neural activity in the DMN tends to decrease when individuals engage in many typical academic and cognitive tasks, and because the mind-wandering activities that it undergirds tend to decrease efficiency and productivity in the moment, a body of research has explored problems associated with involuntary activation of the DMN (Mooneyham & Schooler, 2013; Smallwood & Schooler, 2015). However, emphasizing the DMN's role in academic distraction and disengagement misses its essential role in students' creativity and meaning making, and likely in their ability to persist with schooling over the long term. Indeed, exclusively activating an outward task focus may bias the mind away from integrating academic experiences into one's own personal understanding – a bias that could potentially undermine long-term learning, retention, and persistence.

In recent years, research has accumulated suggesting that the DMN (and its interaction with the networks that support attentional control) are critical to the healthy development of a variety of skills that facilitate deep learning, including cognitive control, self-regulation, emotion regulation, memory suppression, mindfulness, and meta-awareness (Cocchi, Zalesky, Fornito, & Mattingley, 2013; Depue, Curran, & Banich, 2007; Dwyer et al., 2014; Hare, Camerer, & Rengel, 2009; Kilpatrick et al., 2011; Ochsner, Silvers, & Buhle, 2012; Peters & Buchel, 2010; Smallwood, McSpadden, & Schooler, 2008; Spreng et al., 2014; Taylor et al., 2012). DMN connectivity is even positively correlated with IQ scores (Song et al., 2009) and supports processes for encoding and retrieving information from memory (Piccoli et al., 2015). There is a robust correlation between high scores on traditional cognitive tests (e.g., of divergent thinking, reading comprehension, and memory) and more efficient functioning in the DMN. Critically, these positive associations are not due to greater or more consistent activity over time. Instead, high scorers show greater decoupling of the DMN from the externally focused networks during situations that call for flexible engagement of attention, perception, and cognition (Li et al., 2009).

Evidence suggests that students need to increase DMN activation to optimally enable a global, personal type of academic engagement. The DMN seems to support mental states that are critically

important for generating imaginative thoughts and facilitating creative action (Beaty et al., 2014; Beaty, Benedek, Kaufman, & Silvia, 2015; Jung, Mead, Carrasco, & Flores, 2013). For example, the DMN is activated when we daydream, construct mental representations of ourselves and our future personal goal attainment, or think about autobiographical events (Addis, Wong, & Schacter, 2007; D'Armgembeau et al., 2010; Kucyi & Davis, 2014; Qin & Northoff, 2011). Similarly, individuals who spontaneously describe autobiographical memories when reacting to others' situations also show tighter connectivity of the DMN to memory-supporting brain regions during rest (Yang, Bossmann, Schiffhauer, Jordan, & Immordino-Yang, 2013). Simulating our social-emotional world, and feeling complex emotions such as compassion for social pain, admiration for virtue, or worry about our own anticipated pain also activate the DMN (Immordino-Yang, McColl, Damasio, & Damasio, 2009; Ochsner et al., 2006). Greater co-activation among DMN regions when at rest is associated with less self-doubt in a threatening academic testing condition and a more accurate impression of one's performance (Forbes et al., 2014). Thus, the DMN is thought to be critically involved in how we understand ourselves, how we learn about our emotional worlds, how we think abstractly about social situations, and how we construct and strategize to attain desireable possible futures (Immordino-Yang et al., 2012).

Though DMN activation supports the development of a personally relevant understanding of learned content, DMN activity must be reduced to engage in specific academic tasks that require external attentional control. For example, a study comparing high and low math anxiety students with similar mathematical proficiency found that students with high math anxiety showed greater activation in the DMN when attempting to stay on task in math problem solving, suggesting that they were completing the math tasks with less processing efficiency (Pletzer, Kronbichler, Nuerk, & Kerschbaum, 2015). Given these findings, next we focus on the skills that help students make meaning of academic content, connect to it personally, and relate it to their future goals.

Psychological Self and Creativity

Cultivating Creativity through Future-Oriented Thought and Imagined Possible Selves

The DMN underlies the process involved in imagining the steps one will take to achieve a goal or desired self (Gerlach, Spreng, Madore, & Schacter, 2014). One component of social-emotional imagination is the generation of future-oriented thoughts in which individuals forecast themselves or others into a temporally, spatially, and (sometimes) emotionally different context. This aspect of social-emotional imagination in itself involves creativity in the sense of creating a scenario that does not actually exist. Further, it is a skill that that has proven adaptive for helping students achieve and that positive psychologists suggest is key for psychological adjustment and happiness (Seligman & Csikszentmihalyi, 2000; Seligman, Railton, Baumeister, & Sripada, 2013). In turn, because positive emotion has been associated with expansive, divergent thinking (Fredrickson, 2004), future-oriented thinking could also indirectly promote some forms of creativity (e.g., Davis, 2009).

Future-oriented thinking, itself a creative endeavor, also impacts students' feelings and actions about their academic work in the present by lessening procrastination and promoting persistence. Whereas objective time can be measured predictably by the hours in a day and the days on a calendar, subjective time – the way one thinks about time or the feeling one has about the relative closeness of events across time – is dynamic and individually variable (Wilson, Gunn, & Ross, 2009) and impacts performance on academic tasks. For example, first-year college students who were made to feel as though their college graduation was near were more motivated to work hard now than students who were made to feel as though their graduation was in the distant future (Peetz, Wilson, & Strahan 2009). Similarly, students who thought they would perform poorly on a test reported feeling as though the test would occur further in the future than did their peers who believed they would perform well on

the test (Peetz et al., 2009). Individuals who were asked to estimate time to future events in smaller units (e.g., days rather than months) also perceived that they should begin preparations sooner in order to be ready (Lewis & Oyserman, 2015). Together, these findings suggest that students' perception of time, and specifically their abilities to mentally imagine themselves at a future time, is tied to their ability to work hard now and to persist toward meaningful goals (Horstmanshof, & Zimitat, 2007; Oyserman & Destin, 2010; Gerlach et al., 2014). After all, it is easier to start down a productive path once we have imagined its existence.

The fact that individuals vary in the extent to which they spontaneously simulate distant or improbable future experiences (Tamir & Mitchell, 2011) suggests that we can teach them to engage these simulations. Oyserman and colleagues have shown that this variation can be productively translated into effective interventions that help middle and high school students, including students from low-income families and challenging backgrounds, to envision desired future selves and then to attain them. They found that students who had been taught to connect their goal with the steps necessary to achieve it were more positive in their interpretations of the inevitable difficulties they encountered up to two years later. Students' visions of their future self appeared to help them regulate their current behavior, leading to better academic grades, more time devoted to homework, and more frequent participation in class (Oyserman, Bybee, Terry, & Hart-Johnson, 2004). In short, skills for mentally simulating a future self helped students take steps toward that future self.

Though these interventions leverage adolescents' developing abilities to realistically imagine the longer-term future, interventions have also been designed that are effective at supporting young children in managing their behavior to attain a shorter term goal. For example, Goleman (2013) reports that Walter Mischel, the researcher who conducted the famous marshmallow experiment with nursery school students, has collaborated with Sesame Street around a story line to help children envision a future self. One character on the show helps Cookie Monster resist the urge to wolf down a

plate of cookies by asking him, “What’s more important: this cookie now, or getting into the club where you’ll get all kinds of cookies?” With the thought of potential membership in the Cookie Connoisseur Club in mind, Cookie Monster is able to limit himself to only a nibble of a cookie now (Goleman, 2013). Young kids learn to hold their future goals online, in their working memory, as they weigh decisions about how to act now. They learn that present actions affect future, imagined outcomes. If we take creativity to mean thinking in a novel way and producing a new, useful idea, the aforementioned teenagers have acted creatively and the Sesame Street watchers have seen creativity modeled. They have created an imagined future in a way that supported their behavioral regulation in the present.

Future-oriented thoughts are a form of creative thinking that research has shown can support students in becoming their best, desired selves. Because simulating far-future events is challenging and important for persistence, parents and educators can scaffold students in imagining their future selves. They can also model creative behavior as this spurs students to act more creatively themselves (Yi, Plucker, & Guo, 2015). Asking questions about students’ goals and the steps they are taking to achieve those goals or to avoid undesirable futures, as well as demonstrating steps to do so, can help students move along the path to their future self. In that spirit, we now turn our attention to the ways that reflection, daydreaming, mind wandering, and social-emotional reasoning engage and promote creative thinking.

Cultivating Creativity through Constructive Internal Reflection

In addition to future-oriented thinking, to cultivate creative, compassionate learners, the new information on DMN functioning suggests that students need downtime in which outward demands are not placed on their attentional resources and they are free to reflect (Immordino-Yang et al., 2012). Constructive internal reflection is a term we have defined previously to describe internally oriented

thoughts that can range from free-form daydreaming to focused, deliberate processing of information about abstract information, especially with socio-emotional relevance (Immordino-Yang et al., 2012). During constructive internal reflection an individual may build a complex representation of the self, envision possible futures, or engage in moral reasoning. Given that the DMN is thought to support multiple modes of constructive internal reflection, and given that the DMN does not readily co-activate with outwardly focused attention networks, Immordino-Yang and colleagues (2012) hypothesized that the opportunity for constructive internal reflection can be compromised by heavy environmental attention demands, such as may be produced by overbooked school schedules, the challenges of urban environments, or incessant texting and engagement with social media. Consistent exposure to such circumstances could conceivably undermine youths' ability to reflect and to think creatively, an idea that Immordino-Yang and her colleagues are currently testing (e.g., Rotenstein, Bansal, Yang, & Immordino-Yang, 2014).

Though the long-term effects of high environmental attention demands on inwardly directed thought are only now being tested, evidence already exists that productively engaging in constructive internal reflection can offer immediate benefits, such as improved academic performance. For example, the negative effects on academic performance of identity-based stereotypes can sometimes be reversed by priming activities involving constructive internal reflection. In one study, one group of women were encouraged to reflect about the full complexity of their identity and subsequently generated, on average, 38 self-descriptors; another group only thought of their most basic characteristics and subsequently generated about 7 self-descriptors. For those who reflected on the richness and complexity of their identity, but not for those who only thought about their basic identity characteristics, the typical gender-based performance decrement on a math task subsequently disappeared (Gresky, Ten Eyck, Lord, & McIntrye, 2005). Similarly, female physics students who wrote two 15-minute reflections over the course of the semester about values that were most important to

them outperformed a control group of female physics students on both an objective physics knowledge measure and course grades (Miyake et al., 2010). Internal reflection has also been shown to boost high-stakes exam scores. For high school and college students, writing about their thoughts and feelings about an impending test (but not writing about unrelated content) improved test performance. Further, the largest improvements were seen for the most anxious testers (Ramirez & Beilock, 2011). Though the results have been attributed to resolved worries and subsequent decreased cognitive load and greater working memory capacity (Forbes & Schmader, 2010; Rydell, Beilock, & McConell, 2009), we argue that part of dealing with worries involves helping the student consider the broader social implications of the task – a mental process likely supported by constructive internal reflection.

In any learning environment, but especially when students are experiencing states of high emotional arousal, supportive adults can encourage students to reflect about their goals and values. Educators can help create protected periods of time for engagement in constructive internal thought that allows them to see the implications of their current decisions for their future outcomes, and to conjure an image of self as a person on the path to the goal. Not only is this reflection intrinsically rewarding for students, but it may open students to thinking more freely and performing at their potential by helping them be comfortable with intellectual risk and divergent thinking (Dweck, 2006). Constructive internal reflection allows students to process information in terms of emotion and self, which facilitates the transfer of knowledge from a lecture to life (Immordino-Yang & Damasio, 2007).

Cultivating Creativity through Positive Constructive Daydreaming

One important dimension of internally focused thought that is often neglected in educational environments despite its relation to creativity is free-form, task-independent thought, sometimes described as daydreaming. Jerome L. Singer and colleagues discovered three daydreaming styles: poor

attentional control, guilty dysphoric daydreaming, and positive constructive daydreaming (Zhiyan & Singer, 1997). The first two styles have been the focus of much daydreaming research and have painted daydreaming as a maladaptive activity. Conversely, the third area – positive constructive daydreaming – is a pervasive, healthy, and beneficial human experience. We have previously defined positive constructive daydreaming as "characterized by playful, wishful imagery and planful, creative thought" (McMillan, Kaufman, & Singer, 2013). Similar to constructive internal reflection, positive constructive daydreaming can enable meaning making, idea integration, prospective thinking, metacognition, divergent thinking, creativity, and patience (McMillan et al., 2013). Strategic activation of the DMN enables positive constructive daydreaming (McMillan et al., 2013).

Positive constructive daydreaming is highly valued by Singer and his colleagues but relatively understudied and underappreciated more broadly (McMillan et al., 2013). Those who are more likely to engage in this kind of daydreaming also tend to score more highly on the big-five personality dimensions of openness to experience (Zhiyan & Singer, 1997). Early work by Singer (1961) suggests that daydreamers may also be more patient. He divided children into two groups – frequent daydreamers and infrequent daydreamers. When asked to wait quietly for as long as possible, the frequent daydreamers waited significantly longer. Having time to mind wander facilitated fortitude, delaying gratification and making adaptive choices for long-term rather than short-term benefits (Smallwood, 2013). Mind wandering, a critical component of positive constructive daydreaming, is also associated with strong personal and cognitive skills that produce creative students.

Cultivating Creativity through Encouraging Productive Mind Wandering

A cross-cultural investigation of mind wandering with participants from more than 80 countries suggests that mind wandering consumes nearly half of our waking hours (Killingsworth & Gilbert,

2010). Smallwood and Schooler (2015) posit from an evolutionary perspective that something to which individuals devote so much time must have had some adaptive features. Indeed, it enables creative behaviors that help people thrive in diverse and changing environments. One benefit of mind wandering is that it facilitates the reprocessing of long-term memories (Wang et al., 2009). Mind wandering also may help reduce boredom when engaging in certain types of tasks with low cognitive demand (Smallwood & Schooler, 2015). When students let their minds wander, they have a more enjoyable experience completing simple tasks (e.g., cutting out pictures for a concept collage or organizing a binder).

Mind wandering can be pleasurable and can help the thinker achieve a future goal or consider alternative courses of action (McMillan et al., 2013). In neuro-typical individuals, mind wandering is associated with thinking about one's future, planning for upcoming events, and contemplating plans to overcome potential obstacles (Baumeister & Masicampo, 2010; Oettingen & Schwörer, 2013; Smallwood, Nind, & O'Connor, 2009). As such, students who allow their mind to wander may be better prepared to tackle future challenges.

What appears to be most critical, however, is that meta-awareness about one's mind wandering can promote mind wandering that is productive. Mind wandering is often an uncontrolled process – we "catch" ourselves doing it and must exert considerable effort to stop (Smallwood & Schooler, 2015). Like other automatic processes that can be cognitively controlled when we become aware of them (Flavell, 1979), so too can we develop mind wandering meta-awareness. One study found that when individuals were aware that they were mind wandering (i.e., "tuning out"), as opposed to when they were unaware that their mind had drifted from the task at hand (i.e., "zoning out"), there was no decrement in performance on a reading task (Smallwood et al., 2008).

Compared to individuals with smaller working memory capacity, individuals with larger working memory capacity mind wander less as tasks become increasingly demanding (Kane & McVay,

2012), but they mind wander more than individuals with smaller working memory capacity when engaging in simple tasks (Kane et al., 2007; Levinson, Smallwood, & Davidson, 2012). It is possible then that higher working memory capacity increases an individual's ability to regulate one's mind wandering – to tune out and not zone out. When cognitive resources are available, individuals with high working memory strategically engage in mind wandering, but when the task requires greater cognitive resources, the high working memory individuals prioritize engagement with the demanding task. Individuals with lower working memory capacity have greater difficulty determining whether the demands of a task allow for mind wandering, and their performance suffers as a result.

Metacognitive regulation not only improves the strategic use of mind wandering; mind wandering also increases metacognitive awareness when performing a task. Allen and colleagues (2013) argue that individuals who are better able to switch between the DMN and the network that supports decontextualized cognition may be better at monitoring and optimizing their performance on cognitive tasks. These individuals have greater metacognitive awareness of the errors they commit while completing the task. The researchers suggest that mind wandering and self-monitoring are intertwined (Allen et al., 2013). Similarly, turning attention inward to examine the components of one's thoughts facilitates making creative connections and imagining new solutions to problems. While outwardly focused attention and high working memory capacity facilitates analytic problem solving, too much of this type of attentional focus undermines creativity and one's ability to solve intractable problems with original solutions (Wiley & Jarosz, 2012).

This is consistent with lore across various disciplines that some of society's greatest discoveries have come to individuals in a flash of insight – Archimedes, the bath tub, and determining volume of irregular objects; Isaac Newton, the apple, and gravity; and Paul McCartney, a sleepy morning haze, and the song "Yesterday." What is often not described in the legend of tremendous breakthroughs, and what makes Allen and colleagues' (2013) finding so important, is that years of dedicated study and

countless hours of outwardly focused learning about the topic of interest contributed to the ideas coming together in the moment of insight. Ericsson's theory of deliberate practice suggests that long-term focused and sustained engagement with a practice (across disciplines and domains) is necessary to develop expertise (e.g., Ericsson & Charness, 1994; Ericson, Krampe, & Tesch-Römer, 1993). A warm bath, a falling apple, or sleepiness alone would not have allowed these giants to come to their realizations without the years of study they already undertook. Research that we have just conducted suggests that creative thinking draws on both spontaneous thought, originating from the DMN, and on sustained cognitive control over those thoughts (originating from a separate brain network; Beaty et al., 2015).

Inspiring the next Archimedes, Newton, or McCartney involves scaffolding learners to mindfully oscillate between internally and externally focused thoughts. The creative individual gathers seeds of knowledge from explicit instruction and withdraws to plant those seeds in the soil of what is meaningful to her. In this view, educators should be less concerned with squelching lapses in attention and more concerned with ensuring that shifts between inwardly and outwardly focused attention are well timed and productive.

Social Processing and Creativity

Understanding Our Social World Requires Creative Thought

The ability to understand one's social world – to make meaning of socially complex scenarios, to reason empathically about others' circumstances, and to take the perspective of other individuals and cultures – is a form of imagination that leads to the reflective and motivated citizens our society would hope to create. Empathic and social reasoning enables individuals to act creatively in finding solutions to social

problems and to strive to better themselves by adopting the values undergirding others' admirable acts. Students engage in constructive internal reflection (Immordino-Yang et al., 2012), which helps them build a nuanced understanding of another's perspective. In the process of coming to understand the other person's feelings, they may imagine how that person must have felt by imaging themselves in that person's situation. This, in turn, could inspire them to behave more like that person. For example, in responding to a story depicting a young woman who, after tragically losing her sight, goes on to invent a braille system for the Tibetan language and moves to Tibet to open a school for the blind, one young woman responds,

> It kind of makes me reflect upon my own life and realize that considering that I haven't had as extreme, like, uncontrollable circumstances as all these people, it makes me realize, well, if they can do that despite whatever hardships they have then I definitely should be making more of my resources in my life.
>
> (Quoted in Immordino-Yang, 2010, p. 218)

As this young woman has done, students who come to engage deeply with stories about another person's virtuous actions or admirable personal qualities like bravery, determination, and selflessness may undergo a shift in their thinking. They can move from thinking about the specifics of the stories and toward thinking about the possibility of how they might alter their own behavior and actions in the future. When students make meaning of others' virtue, they are often inspired to act more virtuously themselves (Immordino-Yang, 2011; Immordino-Yang et al., 2009). Young people who tended toward internal reflection in responding to similar stories (as evidenced by looking away and slowing their speech) also reported feeling more inspired, and later showed increased brain activation in the DMN regions when responding to narratives about others' virtue (Yang, Pavarini, Schnall, & Immordino-Yang, 2012).

Astute teachers sense that when students pause in response to complex questions, they should be allowed time to answer. The student may be synthesizing information and drawing connections to their own understanding during that pause (Immordino-Yang et al., 2012). In this way educators can protect mini-moments in which students productively engage the DMN.

Empathy and Perspective Taking

Researchers suggest that empathic reasoning, an element of social-emotional imagination, has a cognitive and affective component. In its cognitive form, empathy is the ability to assume another person's perspective and comprehend that person's state of being; in its affective form, empathy is the will and ability to experience that person's thoughts or feelings (Riggio, Tucker, & Coffaro, 1989; Singer & Lamm, 2009). The maxim, "I feel your pain" is neurobiologically accurate. A meta-analysis of fMRI studies about empathy suggests that the same regions of the brain that are recruited when an individual feels her own pain (e.g., the anterior insula and the medial/anterior cingulate cortex) are recruited when empathizing with another (Lamm, Decety, & Singer, 2011). Relatedly, an fMRI study with individuals high in psychopathy, known for having deficits in affective empathy, found that those individuals recruited different neural circuits when thinking about another's physical, bodily pain than controls (Decety, Chen, Harenski, & Kiehl, 2013). Batson (2009) proposes that empathy arises most consistently from taking another person's perspective and imagining what he thinks or feels.

Seeing someone else's point of view or sharing another person's feelings are important skills in the classroom. Understanding contextual considerations and taking the perspective of a historical figure might lead a student to a richer understanding (and better performance) in a social studies class, for instance (see, for example, the "Facing History and Ourselves" Curriculum; Schultz, Barr, & Selman, 2001). In addition, perspective taking and empathy can facilitate beneficial interactions among classmates, such as intervening to stop bullying (Gini, Albiero, Benelli, & Altoe, 2008). Some scholars

have suggested that perhaps teaching empathic reasoning and perspective taking (two components of social-emotional imagination) could be one step toward curbing bullying for this reason (Nickerson, Mele, & Princiotta, 2008; van Noorden, Haselager, Cillessen, & Bukowski, 2014). Because feeling empathy results in students taking the perspective of another and can motivate students to imagine possible solutions to address a social problem (e.g., bullying) and then take action, empathy too can be thought of as generating creative social behavior and a deeper understanding.

Multiculturalism

Extending social behavior outside even further, exposure to other cultures, individuals from different backgrounds, and new languages promotes creative thinking. Polyculturalism, or being part of multiple interacting and interrelated cultures, primes creativity (Morris, Chiu, & Liu, 2015). College students who study abroad score higher on culturally specific and general tests of creativity than their peers who intend to study abroad but have not yet done so and peers who have not and do not intend to study abroad (Lee, Therriault, & Linderholm, 2012). Similarly, actively participating in a novel and strange "diversifying" experience, even if simulated, has been shown to lead to more creative thinking (Ritter et al., 2012). Bilingualism in preschool-age children is associated with higher performance on measures of general creativity (Leikin, 2013), and across ages, people who have a greater degree of bilingualism score higher on a creativity test (Lee & Kim, 2011). Not only do these multicultural experiences promote creativity, but also one's acculturation and ability to reason based on different cultural norms impacts creativity.

Evidence from neurobiological studies suggests that an individual's cultural background and embodied experience processing emotions impact the way he constructs conscious experiences of his emotional reactions to the social world (Immordino-Yang, Yang, & Damasio, 2014). While cultures have traditionally been characterized dichotomously as individualistic or collectivist, culture-as-situated

cognition argues that all human cultures are imbued with individualistic and collectivist primes and that all individuals can reason through either of these lenses (Oyserman, Novin, Flinkenflogel, & Krabbendam, 2014). Thinking about problems from the perspective of a different culture helps individuals come to understand that there may be a variety of possible solutions to a problem – an insight indicative of creativity. Thus, exposure to other cultures is valuable not only for cultivating global citizens but also for building more creative thinkers. Educators and parents should strive to provide opportunities for meaningful engagement with or at least exposure to diverse ways of thinking and living, as well as opportunities to take others' perspectives.

Harnessing the Power of Social-Emotional Imagination

The evidence presented in the preceding section can support and guide effective educational practices. To move in this direction, we developed the following recommendations for practice, based on our reasonable assumptions from the research. Many of these practices are frequently utilized in the classroom, but their importance is often overlooked as less important "soft skill" development. Thus, we emphasize appreciating these essential instructional practices and discourage their well-intentioned sacrifice in the name of academic evaluation and task-oriented classroom management strategies.

- Schedule time for reflection, or capitalize on naturally occurring reflective moments. By ensuring sufficient time for reflection schools, teachers, and parents can support social-emotional imagination and cultivate learners who are more mindful, more strategic, and ultimately more creative. Building reflection time and skills into educational activities while minimizing external distraction may facilitate students synthesizing information, building complex connections, and recognizing potential relevance to other domains and

experiences. Allowing time for reflection may involve giving students quiet moments following an on-task academic activity in which students generate deeper questions, or in which instructors ask guiding questions to help students reflect on what they have learned. Because it helps students process worries and focus on goals, encouraging a few moments of reflection before high-stakes testing has also been demonstrated to actually boost performance (as reviewed earlier in this chapter). Further, writing about one's emotional response to personal events has been associated with improved mental and physical health (Pennebaker & Segal, 1999).

- Scaffold and model mindfully moving between task-oriented focus and meaning making. We encourage educators to offer cues to help students recognize times when they need to attend to a task versus times when reflection is appropriate. For example, a teacher might remind students of the environmental signals that task-oriented focus is necessary by saying something such as, "When your classmate speaks, please look at him." Similarly, a teacher might remind students of behaviors that aid reflection such as looking out the window, explaining to a friend, or encouraging them to write freely with minimal self-criticism. Not only can this help students recognize in the moment what they need to attend to, but it also can help students develop long-term strategies for focus on a task and alternately for imagining without inhibition.
- Encourage strategic internal reflection. Recognizing that momentary lapses in externally focused attention may be strategic or restful highlights their importance. By continually directing students to stay on task, and by providing entertainment or other distraction when students are resting, we may diminish students' problem-solving capacity by tiring them and by making it more difficult for them to connect their current work to future goals – in short, to make their academic efforts personally meaningful. Generating imagined

possibilities to problem solutions and generalizing strategies toward other problem solving contexts may also have benefits in some contexts that extend beyond the benefits of rapid processing and action orientation. For example, a common strategy to help students read technical texts proficiently and actively is to encourage the student to pause periodically to synthesize, connect the information with personally meaningful content, and integrate new information into existing knowledge schemas. This can help students consolidate information, make new information more readily available for subsequent tasks, and bring technical discourse into a student's personal life narrative.

- Scaffold meta-awareness. Increasing mindfulness through meditative moments may increase metacognitive awareness and control over mind-wandering processes (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013). By leading students in directed thought about the flow of their mental processes in age-appropriate ways and depending on the metacognitive abilities of the students, educators can help students begin to practice strategic switching between task focus and reflection.
- Encourage actively imagining pathways to goals. Activities that scaffold students' imagination as they construct pathways toward goal attainment can empower students to take better control of their academic and personal futures. Reflective writing or quiet contemplation in which students imagine themselves engaging in the process of studying or taking concrete steps toward achieving a desired academic goal can be more helpful in attaining academic success than focusing on achieving a higher test score or grade. Thinking of the future is not itself sufficient, nor is digging in to work hard now. The critical piece is connecting these two kinds of thinking together, such that students develop the habit of consciously reflecting on their hopes and dreams in both the near and farther future, and of

translating those dreams into strategies for success and purposefulness in the current context.

- Appropriate times for communicative technologies. Parents and instructors can model and encourage context-appropriate disengagement from social media and communication technologies. While teenagers frequently switch between tackling a task and texting, for the reasons above we must preserve some "free" moments for internal reflection. Many middle and high school students have an overly involved relation with technology (Steinar-Adair & Barker, 2013), but adults can implement clear rules to allow for its appropriate use. For example, no texting at the dinner table, no cells phones during class discussion, or only searching for lecture-relevant content at appropriate times during class.
- Effectively integrate social media and social imagination. We should engage in productive discussions about technology use within social-emotional contexts. While social media, video conferencing, and other technologies connect us to each other in novel and productive ways, overuse can reduce attention to the multisensory content of social environments in which a student is physically embedded, thereby impacting social emotional imagination and development. During adolescence, when students' identities are fragile, teenagers are at risk for unhealthy obsessions with their online personas (Steinar-Adair & Baker, 2013). We encourage adults to assist students in understanding appropriate use of social and other media, and translating the subtleties found in face-to-face interactions into the complexities of social media interactions and relations. For example, adults can help students appreciate privacy concerns that exist in online relations that may not exist in face-to-face relations and help them recognize that emotion and intent may be perceived differently online than in person.

- **Use stories to help students build personal narratives**. Though technical academic content often feels disconnected from the people who invented or discovered it, in reality all human knowledge has humans behind it. It can be very motivating for students, as well as promoting of more complex and productive personal daydreams, to expose students to role models' accounts of struggles, interests, and accomplishments. Research into social emotional imagination suggests that these stories may have benefits to classroom instruction and students' long-term retention of course content. For one example, we all recognize that knowing that the sun is at the center of the solar system is critical to our understanding of Earth, but the importance of heliocentrism is amplified by the story of Galileo's willingness to endure the castigation of the Catholic Church to defend his scientific findings in support of that theory. A role model's narrative can be integrated into a student's imagined path to her future selves. By observing the process of discovery students learn about it, and gain skills for simulating their own possible future accomplishments.
- **Give students meaningful opportunities to make informed choices about curricular content**, for example in the form of projects, reports, or student-led initiatives. The best way to develop creative citizens is to give them supported practice at conceiving, developing, and following their interests, curiosity, and talents.

Overall, the research discussed in the earlier sections suggests strategically utilizing effective practices for encouraging imagination is beneficial for students both in the short and long terms, and in both "hard" and "soft" skills. Imagination is a lifeline that connects the student's inner, developing self with her exposure to the myriad of opportunities for formal and informal learning school and life experience provide.

Conclusion: Toward Fostering Creativity in Schools

Schools and teachers today are saddled with constraints to teach specific content and burdened by standardized testing pressures. In this climate of accountability, curricula scaffolding students' so-called "soft" skills are often among the first activities to be pruned. Recognizing that it is possible to foster students' academic achievement and their creativity can ease concerns about investing in students' imaginativeness. Ultimately, our country's future is in the hands of today's students, and a skilled, ethical, and creative body of students will hold the greatest promise for advancing our country.

In this vein, an integrative research approach that explores how to promote creativity is needed, including a deeper understanding of the biological, psychological, and cultural conditions that encourage productive reflection. Specifically, social and affective neuroscientists, cognitive psychologists, and educational psychologists can collaborate to improve our understanding of how to harness the benefits of the DMN and the psychological states that it produces, and how to teach deliberate, appropriate, and mindful switching between task-oriented attention and imagining. We echo our previous call for additional research about the way in which internal reflection and meaning making impact cognitive skills and social-emotional development (Immordino-Yang et al., 2012).

Social-emotional imagination and positive constructive daydreaming are two psychological processes that are undergirded by the brain's default mode network and that contribute to developing innovative, compassionate, and grounded learners. Social-emotional imagination is by its nature creative in its fullest form, but it also produces creativity in the more generic sense by enabling thinkers to apply emotional insights to their interpretation of technical material (Immordino-Yang, 2011). Renowned cognitive and educational psychologist Jerome Bruner (1986) argues that educators should foster in students "an appreciation of the fact that many worlds are possible, that meaning and

reality are created and not discovered, that negotiation is the art of creating new meanings by which individuals can regulate their relations with each other" (p. 149).

Each of these ideas depends on social-emotional imagination. Learners must interpret new information, cull emotionally relevant content, empathize with others' emotions, and make meaning out of a complex social world. Constructive internal reflection and positive constructive daydreaming provide the emotional and cognitive "play spaces" to understand the social world by providing a variety of alternative possible worlds. Empathy, perspective taking, and multiculturalism allow learners to perceive and feel alternative emotional states. They help us understand those around us so that we can, as Bruner (1986) argued, "regulate [our] relations with each other." Meaning making, a deep understanding of others' stories or one's own circumstances, may be a necessary prerequisite to feelings of inspiration to be one's best-self.

Aligned with Bruner, meaning making is a process of creation, not discovery. These processes together shape students' abilities to understand intricate social scenarios and feel complex emotions. By aiding students in effectively switching between decontextualized cognition and personally relevant cognition and ensuring that there are protected times in which students can productively struggle with social-emotional understanding, we will produce students who not only perform better on traditional academic metrics, but who also have a better understanding of their social-emotional world, and who will lead us into new creative territories.

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Appendix

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