Ann. N.Y. Acad. Sci. ISSN 0077-8923

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES
Issue: *Beyond the IQ test*

Cultivating the social–emotional imagination in gifted education: insights from educational neuroscience

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Evidence from education, psychology, and neuroscience suggests that investing in the development of the social–emotional imagination is essential to cultivating giftedness in adolescents. Nurturing these capacities may be especially effective for promoting giftedness in students who are likely to lose interest and ambition over time. Giftedness is frequently equated with high general intelligence as measured by IQ tests, but this narrow conceptualization does not adequately capture students' abilities to utilize their talents strategically to fully realize their future possible selves. The brain's default mode network is thought to play an important role in supporting imaginative thinking about the self and others across time. Because this network's functioning is temporarily attenuated when individuals engage in task- and action-oriented focus (mindsets thought to engage the brain's executive attention network), we suggest that consistently focusing students on tasks requiring immediate action could undermine long-term cultivation of giftedness. We argue that giftedness—especially in science, technology, engineering, and mathematics (STEM)—can be cultivated by encouraging adolescents' intellectual curiosity and supporting their ability to connect schoolwork to a larger purpose. Improving STEM and gifted education may depend upon a shift from knowledge transmission and regimented evaluation to creative exploration, intentional reflectiveness, and mindful switching between task focus and imagining.

Keywords: social–emotional imagination; default mode network; giftedness; STEM education

In a village in Sierra Leone, rebel fighting often broke out, taking the lives of hapless civilians. One 15-year-old boy saw his mother die when she was shot by rebel fighters in the marketplace. Determined to help his community prevent this violence, the boy collected discarded electronics and tinkered with the junk to build a radio broadcast network that could be used by local townspeople to warn one another when the rebel fighters approached. Over time, this radio network became a platform for public debates, helping to organize the townspeople to reestablish a peaceful system for public discourse.

Many people would feel inspired by this boy. Indeed, when we tell this true story to our low-socioeconomic-status (SES), Los Angeles–based high school research participants, many report feeling awed by this young boy's accomplishments and motivated to contribute their own talents to help improve their community. This boy from Sierra Leone had no instruction manual and no one telling him he needed to build a radio. He was guided only by his engineering ingenuity and his passionate belief that there were problems in his world that he had the capacity to help address. Fortunately, most students will not have to face the hardships that propelled this boy into his inventive pursuits. Yet, his story and our adolescent research participants' reaction to it may offer clues about how we can support

doi: 10.1111/nyas.13165

gifted youth in developing (1) a vision for a brighter future, (2) confidence that they can contribute to building this future, (3) tenacity to work toward this future, and (4) creativity to try new things in the service of their goals.

Here, we label this important set of skills the *social–emotional imagination*. In this commentary, we argue that students' social–emotional imaginations—their capacities to consider multiple cognitive and affective perspectives, courses of action, and outcomes for themselves and others—are an essential, yet regularly omitted, component of identifying and educating gifted students. Promoting reflective and discerning attitudes toward situations and information encourages students to establish fresh connections among skills across time and disciplines. Further, the abilities to envision alternate possibilities, to think divergently, and to work at solving seemingly intractable problems help students invent new strategies to utilize and synthesize information in meaningful and long-lasting ways that offer solutions to real human challenges. All of these skills—which together compose the social–emotional imagination—are relevant to both academic success and lifelong creative achievement.[1,2] Illustrated by the aforementioned story of the engineer in Sierra Leone and examples throughout, we discuss how social–emotional imagination can promote success and persistence in science, technology, engineering, and mathematics (STEM) fields, especially for students who are underrepresented in STEM.

In order to optimally promote social–emotional imagination in gifted students, we argue that it is important to understand as much as possible about the contributing psychological mechanisms. Here, we turn to a building body of neuroscientific research on the brain's so-called default mode network (DMN). This network is thought to be important for narrative construction (i.e., for thinking about the self and others across time and in relation to values and ideas).[3,4] Because this network's functioning is dampened during task- and action-oriented thinking,[5] it is possible that overly and consistently focusing students on tasks requiring immediate action and task orientation could undermine the long-term cultivation of giftedness. We argue that the sort of giftedness that fuels innovative, ethical, and useful solutions to important and difficult social and scientific problems can possibly be cultivated by encouraging adolescents' intellectual curiosity. This, in turn, can be accomplished by supporting adolescents' ability to connect new skills and information, such as those they gain in school, to a larger socially situated purpose and a rewarding image of the future. It may be that helping students shift strategically and appropriately from knowledge gathering and action orientation to modes of intentional reflectiveness could be useful for promoting the long-term development of giftedness. Evidence is already accumulating for the power of reflectiveness in promoting success in the sciences,[6] which requires expansive, innovative thinking in the service of bettering the human condition, but is often taught with a narrow, task-oriented focus.[7]

The neuroscience of the social–emotional imagination

The latest evidence from the emerging field of educational neuroscience suggests that the brain's executive attention network (EAN), which undergirds the skills commonly measured for IQ-based determinations of giftedness, is functionally distinct from the brain's DMN, which supports many social–emotional, imaginative, and creative processes and divergent thought. The admissions standards for gifted programs focus heavily on IQ and standardized achievement tests[8] and the cognitive skills they measure. Yet, educators would be remiss to overlook the relevance of identifying students' social–emotional imaginative attributes and creativity, especially given the neural evidence that these skills may be relatively distinct. That is, appreciating the skills supported by the DMN may help improve the way in which students are selected for gifted and talented education by expanding admissions criteria to include additional important capacities.

The EAN comprises several distributed brain regions, particularly in the lateral prefrontal cortex and anterior inferior regions of the parietal lobe. These regions work together to support an individual's ability to attend to, think about, and take action on his or her immediate environment (e.g., see Ref. 9). This network supports, among other abilities, working memory and attention.[10] The DMN, which consists of distributed brain regions in the medial prefrontal cortex, medial temporal lobe, posterior cingulate and medial parietal cortices, and inferior lateral parietal cortices, is associated with processes that are quite different from those the executive network supports. They include psychological processes, such as mind wandering, imagining, and making meaning about past or future personally or socially relevant information.[3,11–13]

Despite the fact that the skills enabled by the EAN are privileged in intelligence assessments, the skills supported by both the EAN and DMN probably contribute meaningfully to the development of adolescents' giftedness. Given this, we advocate a balanced approach to skill assessment and development in gifted education. That is, we advocate a balanced view of the skills that qualify a student for entry into a gifted and talented program and a balanced understanding of the array of skills that educators should cultivate in our most talented students. Specifically, giftedness requires an equilibrium between outwardly focused skills, like those enabled by the EAN, and inwardly focused thinking, which the DMN supports. This viewpoint is further supported by the emerging understanding of the relationship between these two brain networks, which suggests that creative, divergent thinking—a marker of creative giftedness in adolescence—requires a collaborative use of both networks and flexible shifting between these networks (e.g., see Ref. 14). Students need opportunities for both traditional, task-focused, cognitive skill development and for the development of reflective social–emotional skills that have to date received less attention in schools, especially in schools' conversations about academic learning.

The urgent need to include social–emotional imagination skills in identifying students for gifted and talented programs becomes especially apparent when examining traditional selection into gifted and talented education. IQ tests have historically been culturally biased, in that members of different racial, ethnic, and linguistic groups consistently score differently. These differences do not appear to reflect genetic propensities for intelligence,[15] but instead reflect day-to-day differences in environmental, experiential, and contextual factors during the testing session.[16] If students are selected for giftedness placement merely on their test scores, without considering the factors that systematically cause minority youth to underperform, minority groups will be systematically excluded from gifted education. On the other hand, racial and ethnic differences are substantially reduced or eliminated for creativity measures such as the Torrance Tests of Creative Thinking, as well as evaluations of college students' drawings and middle school students' creative writing (assessed using the consensual assessment technique).[17–19] For example, a panel of 13 experts, including middle school creative writing teachers, highly accomplished creative writers, and psychologists who study the development of creativity, assessed on a six-point scale the creativity of middle school students' writing using their own standard of what constitutes creativity. There were no differences in their ratings of creativity for the works produced by Caucasian versus African-American writers or male versus female writers.[19] This suggests that the routine incorporation of these alternative measures could be helpful in identifying deserving youth.

Another major shortcoming of relying too heavily on IQ testing for identification of giftedness is that the set of skills measured by IQ tests—such as the ability to hold in mind and manipulate information—does not reflect the significant contribution of critical social skills, such as the ability to make use of relevant autobiographical information to solve novel problems. For example, this personally relevant kind of intelligence is not included among the nine cognitive abilities that compose the prominent Cattell–Horn–Carroll model of intelligence.[20] There is a general consensus that the variance shared across scores on different IQ tests is strongly correlated with working memory (e.g., see Ref. 21), which is now known to be supported by the brain's executive networks.[10] Other important dimensions of giftedness (e.g., thoughtful self-reflection or imagining the steps needed to achieve a goal), which turn out to be related more to the functioning of the DMN,[12] have not been included in IQ tests. Overall, IQ tests historically have included only a narrow range of cognitive skills and have overlooked dimensions of giftedness that are related to an individual's ability to harness his or her giftedness for personal and social success and fulfillment in the long term.

The importance of balance

Many tasks typically performed in school place high demands on externally focused attention. For example, students must concentrate intently when listening to lectures and taking notes, completing worksheets, or following a laboratory procedure. Given that the EAN supports externally focused attention, we suspect that this network is heavily taxed at school. Reflection, connection building, and personal meaning making are tasks thought to be supported by the DMN.[3] Balancing a focus on the concrete and immediate with increased time in school for these more introspective tasks could possibly help promote more authentic and stable success and giftedness.[3] In designing curricula or school schedules, educators wishing to cultivate giftedness should strive to include downtime and other activities that allow for contemplation. For instance, to young students, it can seem tedious to memorize times tables or properties of fractions in preparation for short-term payoffs like a single test grade. However, if pupils could be encouraged to situate this task in the larger picture of how it will enable them to move through life more fluidly, it develops meaning beyond enduring an immediate evaluation. As teachers may know, incorporating a brief discussion such as this to preface a lesson can help students uncover the personal relevance of a skill that is also essential to engaging in many scientific disciplines and could facilitate student learning.

Empirical evidence is beginning to accrue for the importance of functional balance between the brain networks involved in attention/executive control and reflection/narrative construction. For example, one of us recently conducted research revealing that prolonged assessment of novel information (a type of creative thinking) requires coupling activation between the DMN and executive network.[14] Similarly, this cross-network coupling has been shown to support cognitive control,[22,23] emotion regulation,[24] and artistic expression.[25] Also, divergent thinking is positively associated with reduced deactivation of the DMN.[26] The fact that slow reallocation of attention away from the DMN supports divergent thinking may suggest that this network, along with others, is recruited during creative thinking. Taken together, this research suggests that a unitary focus on skills supported by the executive network in assessments and cultivation of giftedness is not only incompatible with the skills we know to be important for giftedness but is also out of sync with our emerging understanding of how distinct brain networks collaborate to produce creative giftedness, especially over longer time periods than a single testing session.

Nurturing the social–emotional imagination

It is possible (and is an empirically testable hypothesis) that, since creative people engage the DMN to a large extent,[27] then perhaps allowing students more opportunities to engage in activities supported by the DMN might facilitate the development of this network and in turn promote creativity down the line. As we have argued previously, investing in social–emotional imagination through curricular and instructional changes may allow students to realize their creative potential and learn traditional academic content in a more fulfilling and long-lasting way.[2] Among the valuable psychological processes supported by the DMN or facilitated by stronger DMN connectivity are understanding narratives, feeling empathy and compassion, and imagining the future and thinking about the past, especially in emotional, social, and personally relevant contexts.[28–31] Highly creative individuals from across disciplines—artists, writers, filmmakers, neuroscientists, and molecular biologists—draw on these skills and have been shown to heavily recruit the DMN when engaging in banal tasks.[27]

There is a fundamental tension between the expression of creativity, which requires breaking consensus to push forth new ideas, and organizational culture (whether corporate or school based), which values individuals who conform to the group.[32] We argue for a need to shift the school culture to accommodate creative expression. Traditionally, high school students have spent more than 75% of their class time engaged in individual, noninteractive, outwardly focused tasks, like listening to lectures, taking notes, doing homework, or taking tests, while they spent less than 15% of their class time in interactive, engaging, informative, open-ended group discussions or group work.[7,33] Similar results have been found in traditional middle schools.[34] The EAN supports the working memory abilities[10] and cognitive control[35] that make it possible for students to engage in those activities for the majority of their time. However, more time spent on skills supported by the DMN might allow students' creative giftedness to shine through. Consistent with the emerging evidence in educational neuroscience, the psychological literature supports the notion that helping students imagine their futures, personally connect to school content, understand themselves as socially situated people, and empathize with others contribute to developing their talents. Here, we review how various aspects of the social–emotional imagination contribute to academic success, creativity, and giftedness.

Imagining the future is a step toward building that future

The ability to imagine the future is instrumental for productivity in one's current context. For example, when low-SES, urban, minority middle school students had a clear vision of their academic future selves that included affective and behavioral dimensions, they were more likely than youth without this vision to regulate their current behavior in productive ways for achieving their academic goals. Specifically, those students with a clear vision for their future selves spent more time on homework, became more active class participants, and earned higher grades in school.[36]

Similarly, one intervention study invited teenagers (mean age 16.3 years) who had been identified by educators as creative to participate in a career-development workshop that aimed to help them identify their creative strengths, understand which activities were associated with a sense of flow, and envision their ideal work day. These students subsequently showed increased interest in pursuing innovative occupations and they engaged in more career exploration.[37] That is, as students developed a richer understanding of their talents and skills and a clearer vision for how to allocate time to achieve their desired goals, the students began to identify themselves with career paths that they felt would provide optimally satisfying opportunities to contribute to society.

The ability to both construct an academic or career vision and to imagine the process involved in making that vision a reality requires simulating one's self in the future—a creative process that recruits the DMN.[38] Thus, to help students, including those in particular need of support, to develop and harness their own intrinsically motivated drives, there needs to be space in gifted education for students to imagine freely what their aspirations are and how they will achieve them. Even individuals with clear visions of their goals need their aspirations to feel doable and proximal in order to rally the gumption to pursue them.

Self-confidence and self-reflection facilitate success in STEM classes and careers

Creative pursuits are often fraught with initial failures and with criticism from people unaccustomed to the novel idea being proposed. To be able to overcome these setbacks, push forward in the face of others' derision, and fully demonstrate one's creativity requires a substantial amount of confidence in one's self and in the worth of one's ideas,[32,39] as well as abilities to reassess those ideas and constructively utilize criticism. Developing a realistic sense of self-confidence to persevere requires the kind of self-reflection and autobiographical thought that the DMN is known to support.[40] For example, the greater the connectivity among regions within the DMN when completing a challenging test, the less self-doubt individuals experienced. This was especially true for individuals subject to cultural stereotypes about low intelligence.[41]

In addition to confidence to pursue creative endeavors, students' interest must be sparked. Students are likely to be more interested when they reflect on how the content they are learning is relevant to broader questions and issues. This means that educators can foster interest in academic content by encouraging reflection about its personal relevance, a skill supported by the DMN. For example, in a randomized field trial with ninth grade science students, some wrote a few essays over the course of a semester about the germaneness of the material from their science class to their own lives, while others simply wrote summaries of course material.[6] Teachers and students were blind to condition and did not know the researchers' hypotheses. Students in the personal-relevance condition reported being more interested in the course material and received higher grades. Importantly, this was especially true for the students who least expected themselves to succeed in science class.[6]

Not only is interest in and enthusiasm for science content important for improved academic success in a ninth grade science class, but it is also critical for success in STEM careers. Interviews with a range of British employees who have science-based occupations in fields such as biotechnology, pharmaceuticals, engineering, and environmental and geological sciences suggest that enthusiasm for scientific work (along with solid procedural knowledge of what constitutes evidence) is the most valuable attribute to develop in adolescent scientists while they are still in school.[42] In order to develop an enthusiasm for scientific work, students should feel as though they will be accepted and successful in the field, but cultural stereotypes often make some students feel more welcomed than others.

Averting stereotype threat; expanding the diversity of gifted STEM students

Pervasive gender-, race-, and class-based stereotypes about intellectual abilities, especially in STEM fields, prevent some gifted individuals from being identified as such because their performance may be artificially suppressed by stereotype-threat effects. Stereotype-threat effects occur when a stigmatized aspect of a person's identity is made salient and anxiety around conforming to the stereotype causes the person's performance to decrease.[43] Engaging in personal reflection, a skill supported by the DMN, can help guard against deleterious stereotype-threat effects and help gifted students with aspects of identity that are stigmatized in STEM fields become immune to stereotype-threat effects.

For example, one study compared Graduate Record Examination math test scores among two groups of anxious women in a stereotype threat–inducing situation. The women who had a tendency to reinterpret their negative affect in a positive light performed better on the test and had less self-doubt than the women who did not reappraise their negative affect.[44] The metacognitive ability these women possessed to tell themselves an alternate narrative for why they were anxious and provide positive reinterpretations of their affective state involves the intrapersonal awareness that results from reflection.

Similarly, while gender-based differences in math performance under stereotype-threat conditions were observed when women who cared a lot about their math ability thought about their identity in a simplistic way, the stereotype-threat effect disappeared (i.e., men and women performed equally) when the women were primed to focus on a fuller picture of their identities by describing themselves as completely as possible.[45] Simply thinking about a positively stereotyped aspect of identity, even when negatively stereotyped aspects of identity are also primed, can reduce stereotype-threat effects. For example, for a female college student performing a math task, thinking about the fact that she is a college student and about the fact that college students can be successful at math can reduce stereotype-threat effects, even if she is also aware that the stereotype of women preforming poorly on math tasks is relevant to her.[46] That is, taking time for personal reflection about oneself and one's abilities may provide a way to exercise those abilities, especially for groups that contend with powerfully limiting societal stereotypes about their STEM capability.

Empathy facilitates academic comfort, collaboration, commitment, and communication

The ability to empathize facilitates social and, in turn, academic success. For example, middle school students with greater empathic accuracy are better adjusted socially.[47] Furthermore, the ability to construct a detailed simulation of social events may actually increase empathy and prosociality.[48] Conversely, possessing low levels of empathy is associated with being a school bullying perpetrator and bullying victim,[49,50] and being bullied is associated with less academic achievement.[51]

Positive social interactions not only increase comfort in the school environment but are also helpful for demonstrating giftedness beyond school, as many great achievements and many of the intractable problems that we hope today's students will eventually help to address require collaborative effort among diverse individuals. Indeed, the ability to empathize with people different from ourselves can often be learned quickly and can promote cooperation.[52] Working with diverse others goes hand in hand with producing creative and innovative work;[32] conversely, racial intolerance and the habitual use of stereotypes about racial groups are associated with lower creativity.[53]

While increasing empathy and improving social interactions are positive ends in and of themselves, developing a classroom culture that promotes empathy in the sciences may also be important for improved STEM engagement. University students who report higher levels of empathy are less likely to take courses in the physical sciences.[54] Many more female than male students reported high empathy levels.[54] Perhaps if physical science courses offered more opportunities for students to connect the importance of the course content to humanitarian goals, and if physical science classes were not seen as an emotionally sterile environment, those students with higher empathy levels, many of whom are female, might be more likely to pursue a line of study in the physical sciences. Thus, introducing more empathy into the classroom, a skill undergirded in part by the DMN, may be one way to increase the diversity and achievement of students in STEM.

Perspective taking is a component of empathy that allows an individual to imagine what another person is thinking. In order to communicate new ideas and spread scientific insights, scientists must be able to understand what their colleagues already know and guide them to new understandings. Indeed, the ability to have collaborative conversations is critical to the practice of science and yet almost nonexistent in current science education curricula.[55] Engaging in these conversations necessitates skilled perspective taking to appreciate what must be explained. Feeling socially connected to others in STEM is also important for persistence in those fields, especially for individuals traditionally underrepresented in STEM.[56] More broadly, an accurate simulation of others' affective and cognitive states and a sensitive focus on other people facilitates success across professions, including those in the sciences.[57]

Authentic educational experiences ignite the social–emotional imagination and learning

Beyond developing students' giftedness via a vision for their future, persistence, and habits of self-reflection and empathizing, giftedness can be promoted in youth through changes in school- and classroom-level teaching customs. Sir Ken Robinson, perhaps most widely known for his TED talk about the adverse impact of school on creativity, is an advocate of project-based learning to afford students an educational experience that is authentic and embedded in their social and community context.[58] One such example of an authentic, community-based science inquiry experience occurred when a group of 25 students aged 8–10 years conducted an experiment about bees' visual search strategies in flower foraging. These students, with the support of their teacher, a local university professor, and several other helpful community members, engaged in "real science" to conduct their investigation and ultimately to publish it in *Biology Letters*, a highly regarded biology journal.[59] In addition to genuinely advancing knowledge of bees, the students, all of whom coauthored the article, reported that "science is cool and fun because you get to do stuff that no one has ever done before."[59]

Whereas science students' research projects usually require them to merely replicate a study with known results in order to ensure mastery of certain content,[60] these students were offered the opportunity to engage authentically in the scientific process, just as career academic scientists would.[59] In this way, students were inspired to develop habits of inquiry around a novel question, which will likely prove more memorable and useful for them as lifelong learners than if they had merely been told information about how bees see.

Identifying and cultivating giftedness through the social–emotional imagination

Improving our ability to identify and develop our gifted STEM students depends upon a shift in educational practices from one focused unitarily on knowledge transmission to one of guided creative exploration with social–emotional relevance. Doing so, we argue, would help to identify a broader range of gifted students and would support those already identified in building a more purposeful, socially responsible, collaborative, future-oriented approach to their work.

For example, returning to the story that opened this article about the boy in Sierra Leone who invented his own broadcast radio station, in an ongoing research project, we asked low-SES Latino and East Asian–American adolescents in Los Angeles how the story of this boy made them feel.[61] One participant remarked: "It's pretty intriguing, and that he's able to scavenge broken computer parts and put them together, that's pretty crazy. And it's a great thing that he's promoting innovation and helping out the community like that."

This student understood and effectively summarized the story and the impact of the boy's actions on those around him. He is even moved by the story, finding it "intriguing" and "pretty crazy." Yet, he shows no evidence of imagining what the boy might have felt, simulating the protagonist's cognitive or affective states, understanding his motives, or connecting the story of the boy in Sierra Leone to his own broader values or actions.

Another adolescent reacted quite differently. Consider his response to the story: "[It makes me feel] inspired. He inspired a lot of people. A lot of kids. He, he was brave. He lost his mom, but he still wanted to continue on with his life. He invented stuff. He invented his own radio show. That's pretty cool. Like that's a young kid! Like I can't even invent my own radio show. Like it's really hard, not just for him. He was, he had it all. It was really good. He was a good inventory. Inventory? [Interviewer: Inventor?] Yeah, inventor. It's really good."

This participant is sensitive to the boy's emotional state, recognizing the difficulty of moving forward after losing someone close to him. He appreciates the magnitude of what the boy accomplished even as a "young kid." The participant contextualizes this accomplishment by comparing his own (perceived) abilities to that of the boy's. He is able to infer the boy's desires (i.e., "to continue on with his life") even though they were not explicitly stated. He quickly forms an impression of the protagonist's personality traits (i.e., brave). The participant's reaction of being "inspired" shows that he may be able to use the exemplary actions of the boy in Sierra Leone to modify his own behavior. As such, the way he interprets the story could be a potentially powerful motivating force toward action. This participant repeats himself and he stumbles to find the word "inventor," but the ideas he communicates are sophisticated.

So which of these students is truly gifted? The adolescent who offered the first response has an IQ score of 130, while the second has a score of 86. We contend, however, that the second participant demonstrated the strength of his social–emotional imaginative abilities in his response. On the basis of IQ alone, the second teenager would certainly not be identified as gifted. Yet, it is for the sake of students like this one that we need to strike a balance in the identification of gifted students between valuing strong performance on tests of vocabulary and spatial reasoning (which the first student demonstrated), and valuing strong interpersonal perspective-taking abilities.

Further, shifting the way we identify giftedness is not enough. Even for (or perhaps especially for) traditionally identified gifted students, a curricular and instructional movement toward social–emotional imagination may allow their giftedness to blossom more fully. Instead of merely relaying scientific facts, we advocate for guided learning from authentic experiences and creative exploration. Rather than expecting students to be constantly externally focused, we need to capitalize on the contributions of their internal reflective processes. Teachers, parents, and caring adults can do so by facilitating conversations in which students contemplate their long-term goals and the steps involved in achieving them. They can help students think about themselves expansively, because when students appreciate the complexity of their own identities, they may feel empowered and open to seeing other people more fully. The tired question from parents of "What did you learn in school today?" might instead become "What experiences were important to you in school today?" This could be one small step in promoting social–emotional imagination by encouraging personal meaning making. For another example, had the first and second students above been classmates in a gifted program with a collaborative culture, the first student could likely have learned from the second about how to better appreciate the emotional impact of the young inventor's achievements.

In sum, our educational system is already proficient in engaging and cultivating students' outwardly focused attention and, to a degree, their executive network, but many schools expect and allow for too little reflection from students. We suspect that facilitating the mindful switching between executive network and DMN processes will facilitate creativity, interest, and achievement over time. This could go a long way toward developing intellectually, creatively, and culturally diverse gifted students in the sciences. It may also promote a sense of fulfillment, collaborativeness, ethics, and purpose among our next generation of STEM professionals.

Acknowledgments

Support was provided by National Science Foundation CAREER Grant 11519520 to M.H.I.-Y., Templeton Foundation Grant RFP-15-14 via the Imagination Institute at the University of Pennsylvania to M.H.I.-Y., the Brain and Creativity Institute fund, and USC Provost's Ph.D. fellowship to R.G.

Conflicts of interest

The authors declare no conflicts of interest.

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