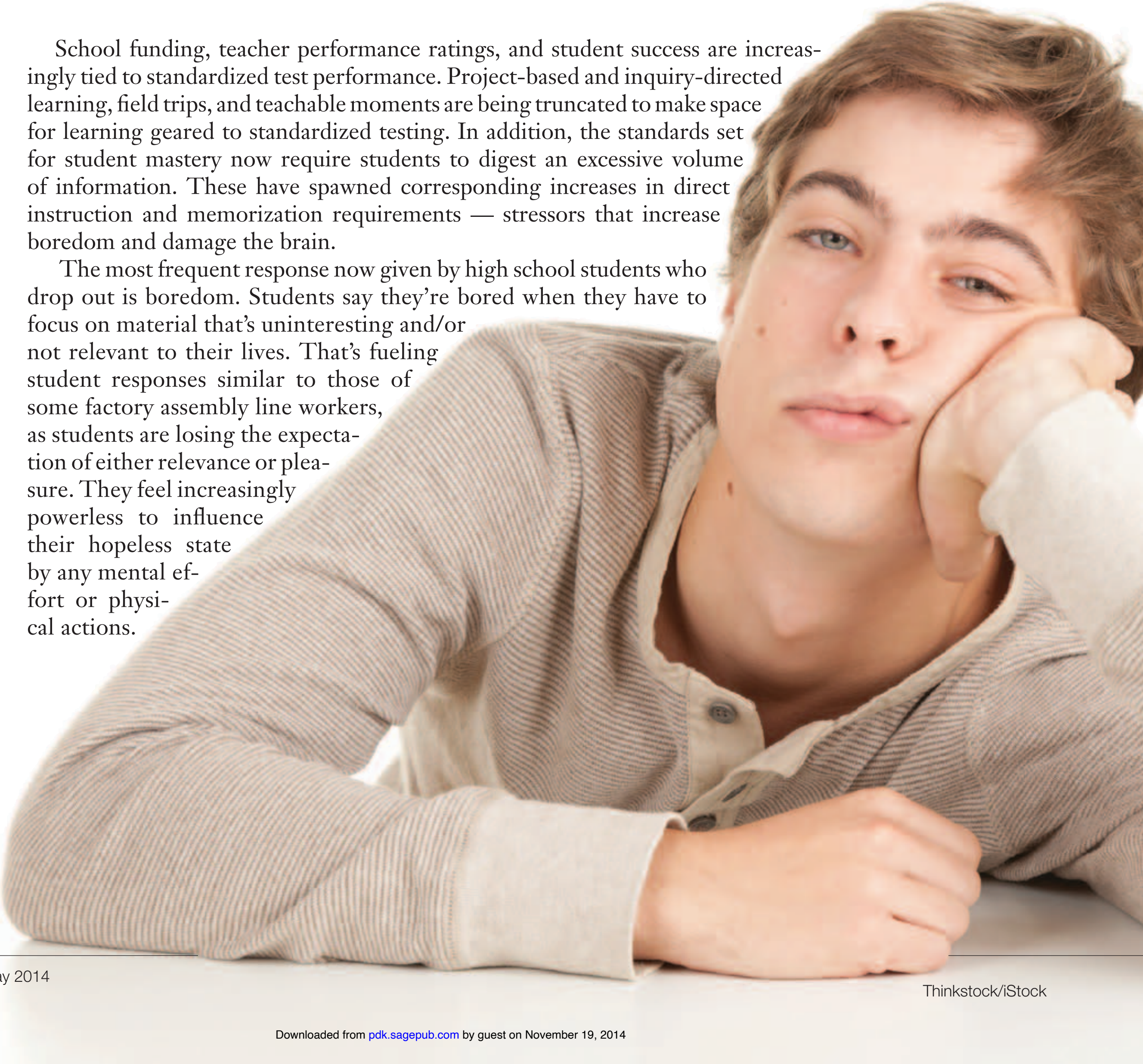
Neuroscience reveals that boredom hurts

Students who seem to willfully defy admonishments to focus on their work may not be doing so intentionally but rather as a normal, age-appropriate brain reaction.

By Judy Willis

School funding, teacher performance ratings, and student success are increasingly tied to standardized test performance. Project-based and inquiry-directed learning, field trips, and teachable moments are being truncated to make space for learning geared to standardized testing. In addition, the standards set for student mastery now require students to digest an excessive volume of information. These have spawned corresponding increases in direct instruction and memorization requirements — stressors that increase boredom and damage the brain.

The most frequent response now given by high school students who drop out is boredom. Students say they're bored when they have to focus on material that's uninteresting and/or not relevant to their lives. That's fueling student responses similar to those of some factory assembly line workers, as students are losing the expectation of either relevance or pleasure. They feel increasingly powerless to influence their hopeless state by any mental effort or physical actions.



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Boredom has been described as a mismatch between an individual's needed intellectual arousal and the availability of external stimulation with, "the aversive experience of wanting, but being unable, to engage in satisfying activity" (Eastwood, Frischen, Fenske, & Smilek, 2012). In a classroom overburdened with excessive curriculum, this mismatch is exacerbated by students' broad range of background knowledge and mastery. Instruction uniformity leaves many students unable to engage in satisfying activity — including students with inadequate foundational knowledge and those who already have mastered the skill or topics being taught.

These experiences of boredom, without hope or expectation of change, can have long-reaching effect. When the brain repeatedly experiences stressful boredom while engaged in an activity, it may respond by creating a generalized prejudice against the topics and activities and result in impaired classroom performance (Eastwood, Frischen, Fenske, & Smilek, 2012).

For example, the daily skill-building practice of conjugating verbs in a new language may be experienced as boring. Although this practice may take place for only 10 minutes of language class, the expectation of that boredom can translate into negative expectations for the whole class and reduced engagement and performance. Without hope of change, the brain loses an expectation of potential pleasure. Negative expectations and task withdrawal can ensue when the hopelessness builds class after class and year after year without students experiencing adequate positive emotional connections to what they are taught. Their distress is exacerbated when standardized or summative tests don't recognize their efforts and learning achievements as success.

Stress and brain traffic

The amygdalae, deep in the brain's emotional limbic system, are stress-reactive switching stations. The metabolic activity of these affective filters directly influences what information passes through them to and from the cognitive and reflective control networks in the prefrontal cortex (PFC). In the normal state of alertness, without high stress, the amygdalae allow input from the senses to reach the PFC where it is correlated with prior knowledge, evaluated by the neural networks of executive function where understanding is developed, and constructed into long-term memory.

Whenever the amygdalae are highly activated by stressors, including sustained boredom, the PFC loses communication with the rest of the brain. The output from these upper reflective control networks — such as judgment, goal-directed planning, risk assessment, attention focus, distraction suppression, and intentional control over emotional responses — can no longer reach the lower brain networks that produce behavioral responses. When the reflective PFC does not supervise the lower brain, responses become involuntary. This is what we see in the fight/flight/freeze survival responses found in other mammals and the zone-out and act-out responses when students experience sustained or frequent high stress.

Boredom is a mismatch between wanting intellectual arousal but being unable to engage in a satisfying activity.

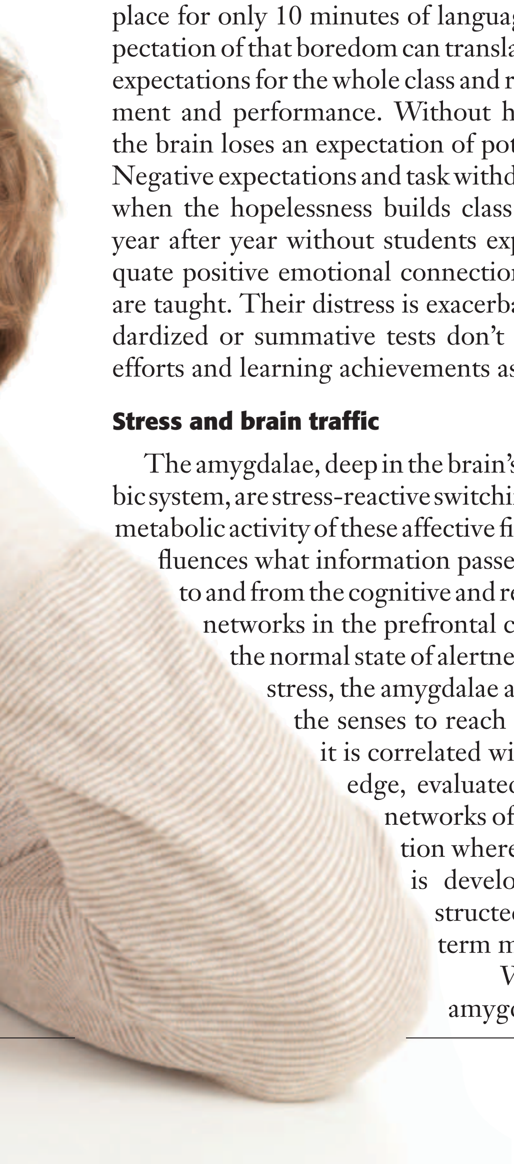
An example related to the boredom phenomenon is seen in some animals accustomed to freedom of movement when the mounting stress of extended confinement shifts their brains into the involuntary reactive state. This can manifest as uncharacteristic aggression or self-mutilating behaviors. In these animals and in humans — when boredom reaches the high-stress level — the combination of sensory deprivation (disengagement) and perceived loss of their ability to access pleasure and need fulfillment reduce voluntary behavior control.

Students' involuntary behaviors may be incorrectly interpreted as cognitive limitations, intentional lack of effort, or willful opposition when in fact their brains' reactive responses are involuntary and not willful. Such mislabeling may bring punitive consequences.

Boosting relevance

Relevance increases engagement and reduces boredom when students recognize instruction as related to their interests or as knowledge they want to acquire to achieve a desired goal.

One way to do so is by giving preassessments, which can guide instruction while also promoting student buy-in to the upcoming unit. Using the K-W-L construct (what I KNOW, what I WANT to know, what I LEARNED) to guide preassess-



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ment can prompt students to pose questions that will increase their buy-in to subsequent instruction. Opening units with essential questions with multiple dimensions and ways of answering expands opportunities for students to relate to the topic. Their engagement can be further sustained even through tedious memorization tasks when they are given frequent opportunities to reflect on their progress, revise initial predictions, and share insights relevant to the essential questions.

An example would be having a lit candle in the front of the room as students enter and asking them to determine whether the candle is a living thing. As the biology unit progresses and the candle fits more and more criteria of life — uses energy, takes in oxygen, reproduces, dies — personal relevance and desire for knowledge acquisition are sustained as students want information that supports or guides revision of their predictions.

Authentic performance tasks further prime student brains to the relevance of the instruction because students want to know what they have to learn. Before the unit on settlement of the New World, describing the project they will do promotes engagement, for example, by telling them, "You'll be working in groups of moon settlement planners. You will be able to create plans that avoid the mistakes that resulted in failures in some of the early New World colonies we'll study."

Students' emotionally positive past experiences and personal interests can be sources of relevance for teachers to link to their learning. Relating through interests is especially important when children are particularly challenged or need remediation to fill in gaps in their foundational knowledge. Incorporating student interests into their learning, along with scaffolding and encouragement, can make a critical difference for students who are at risk of disengaging. They benefit most if early on they are made aware of how their interests will be part of the learning.

Teachers can document and pass along what they learn about each child's most powerful sources of engagement and personal relevance to subsequent educators. They can then use that information to build within students the resilience to persevere through boredom, frustration, and setbacks.

Achievement trumps boredom

Increased homogeneity reduces student engagement. Students may be bored from having already mastered the material or by an inability to understand due to inadequate foundational knowledge. Levels of mastery are rarely the same for every student. Combine these disparities with a topic requiring lots of memorization and the need for differentiated instruction becomes more critical to avoid the brain's stress blockade.

The power in differentiation comes when learners have opportunities to experience intrinsic satisfaction — a mental state fueled by the brain's own synaptic neurotransmitter, dopamine. When dopamine is released in higher than usual amounts, it flows beyond the synapse to other regions of the brain, producing a powerful pleasure response. This deep satisfaction — for example, when we quench a long thirst — is the brain's self-reward in response to achieving a challenge. It is correlated with a mammalian survival mechanism that rewards effortful behaviors that accomplish beneficial outcomes for the animal or its group.

Relevance increases engagement and reduces boredom.

After receiving feedback that a challenge is achieved, the pleasure reward from the release of dopamine prompts the brain to repeat that action so as to receive more dopamine pleasure. This phenomenon is seen when devotees play computer games with progressing levels of challenge. After successfully achieving the challenge of completing one level and reaching the next, the dopamine surge is followed by the desire to repeat the feeling. This motivates the player to sustain effort into the next higher level of play.

In the classroom, this dynamic can be activated by providing opportunities for students to progress at their individual levels of achievable challenge, using scaffolding, creating small flexible groups for as-needed support and collaborative groups into which students "enter" from their strengths.

Another aspect of providing achievable challenge also comes from the video game model. To produce intrinsic motivation, a brain needs feedback from achieving incremental challenges as it progresses toward the final goal. Incremental progress feedback can be provided by analytic rubrics, response journals, and effort-to-progress graphs motivating students to keep up. A variety of formative assessments also can allow students to use their individual strengths to demonstrate what they know, especially when they have challenges not related to the material, such as language differences, reading difficulties, and organizational skill limitations, etc. Students maintain focus, effort, and willingness to revise when they experience the pleasure of achieving goals. Classroom instruction that provides opportunities for ongoing feedback as students' progress pays off with reduced boredom-induced disengagement.

As you adapt instruction and assessment to suit student learning strengths and fill in gaps in foundational knowledge or provide enrichment for students who have already achieved mastery, their brain states shift from boredom to engagement. The behavior problems attributed to laziness, willfulness, or bad attitudes diminish as students are relieved of the sustained stress of boredom or frustration from learning experiences not suited to their background knowledge and mastery.

Boosting metacognition to reinterpret boredom

Consider a scenario in which your income depends on your only available employment: working in a factory where you spend eight hours a day watching a conveyer belt transport potatoes. Your job is to find and remove potatoes with more than six eyes.

In this job, with no variation in sensory stimulation or expectation of a desirable, personally relevant outcome or goal that you could reach by dedicating high effort, the intrinsic motivation needed to sustain focus decreases. As time goes on without change, your brain would develop diminishing expectation of any potential achievement-reward-pleasure (dopamine release) from the work. Interest, engagement, attention, and work quality could reactively wane.

Yet you might be able to contend with these challenges using your executive functions to recognize your increasing stress level. One can then intentionally exert "top-down" control on the metabolic state of the amygdalae.

Networks of executive function are the last part of the brain to mature through a strengthening of the connections among neurons. This goes on throughout life as using the neural network prompts its neuroplastic growth. As in business, the executive functions run the show, exerting top down control of the brain as the chief executive officer. The CEO networks of executive function are still at low efficiency into the late teens and even through the mid-20s. But, as the executive function strengthens, the brain is able to more successfully cope with boredom. Perhaps you'd find your own ways to challenge yourself or create ways to make the task feel relevant. In so doing, you would continue to do your job satisfactorily and even experience less boredom

When well wired, executive functions override the brain's innate compulsion to seek immediate gratification in order to achieve more long-term goals. Most school-age student brains don't have the skill sets to modulate their emotional responses to intense boredom when stress shifts control to their lower brains. When the brain switches to a physiological stress state of boredom, there is less prefrontal cortex brain activation seen on neuroimaging and more activity in the lower brain. This high boredom response with this decreased PFC activity in teens correlates to lower task learning and application and more "sensation seeking" (Cowan & Morey, 2006).

In the stressful bored state, the decreased input of executive functions reduces considered decision making. Indeed, a study of South African adolescents found that the amount of boredom reported during leisure time was the strongest predictor of alcohol, cigarette, and marijuana use (Sharp et al., 2011). In age-matched subjects, electrical conduction speed and metabolic activity on brain scans were measured during tedious tasks. Subjects whose prefrontal cortex activity declined as they also displayed increased activity in the emotional circuits of their lower brains were slower and less accurate in the decision-making tasks. Subjects with greater neural networks activity in the PFC were more successful filtering out distractions and remembering more of what was required in the decision-making tasks despite the tedium. These subjects reported using strategies to recognize and respond to rising boredom and to actively maintaining focused attention, often by creating ways to make the task more personally relevant (Parasuraman & Jiang, 2011).

Students need to understand that boredom is not all bad.

The ability to evaluate one's emotions before responding to a trigger is a uniquely human trait. However, this reflective response can only take place if the overall emotional state of the individual is not in a high-stress mode. Teachers can help students lower the resistance that builds in their minds when they attribute their frequent academic or behavioral failures to their own fixed abilities. When students learn about their brains' emotional filter, they understand that their bad behavior doesn't mean they're bad people without the potential to grow. With this understanding, students who have taken ownership of the negative labels they've been given — lazy, incapable, troublemaker, etc. — gain insights to spark their effort renewal. Hold discussions about how you used the strategy of breaking down academic goals into achievable challenges en route to the goal. When students realize such a strategy increases effort and success, they can apply the same strategy when faced with boring, yet necessary tasks.

Students also can build self-directed strategies to minimize the effect of boredom and reinterpret boring experiences to increase engagement and success. This metacognition develops as you help them reflect and discuss the processes and strategies that they use successfully to sustain attentive focus during boring tasks.

When students in grades 5 to 10 were given math problems intended to be difficult and boring, those who recognized their boredom and reappraised the situation by developing ways to make them more relevant were more successful in reducing their feelings of boredom and achieving greater success on the task. This group of self-motivating students was also more likely to have higher academic achievement (Nett, Goetz, Hall, & Frenzel, 2012).

To this end, when teachers help students recognize the ways in which they connected students to task relevance through their interests, those students later can use those methods on future boring, yet necessary tasks. This should help students build metacognition about personal strategies to recognize when they are in the bored/stressed state and to plan achievable challenges, set personal goals, and discover connections through personal relevance. Teachers can help by providing reflection time as students embark on work that has a high likelihood of a stressful boredom response. Class discussion will provide students with more strategies and increase peer reinforcement for using these strategies.

A final, highly pertinent point about boredom is that students need to understand that boredom is not all bad. Students should not seek to avoid tasks that provoke boredom. Help them recall how they persevered through boring practice of the foundational skills or knowledge that ultimately allowed them to achieve the proficiency they enjoy in keyboarding, snowboarding, and most academic areas where they're successful.

Describe and model how boredom or other high stressors can motivate trying new things and discovering new interests as well as serve to inspire creativity and innovation. When subjects observed ways to regain emotional self-control in stressful situations and saw examples of others who used the strategies successfully, they increased their capacities to interpret their stress as a motivating push. These reinterpretations helped them respond in more resourceful ways to stress. They also reduced their release of stress-related hormones such as cortisol.

You don't need a lab or videos of strangers coping with stress to provide students with motivational examples. Undoubtedly you have a bit of stress during times in the classroom. These can become teachable moments as you describe the positive actions you take to overcome your own negative emotional state. Share what new ideas, changes, or innovations were activated in your prefrontal cortex when you chose to be propelled rather than controlled by the stress. They'll be especially impressed when they are the beneficiaries of these innovations.

"I rewarded two of my students for passing notes in class. It's so refreshing to see any of them actually writing."

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