

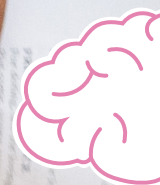


ALLIANCE FOR
EXCELLENT EDUCATION

Science of Adolescent Learning:

Risk Taking, Rewards, and Relationships

September 2018



**SCIENCE OF
ADOLESCENT
LEARNING**
REPORT SERIES

Acknowledgments

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The **Alliance for Excellent Education** (All4Ed) is a Washington, DC–based national policy, practice, and advocacy organization dedicated to ensuring that all students, particularly those underperforming and those historically underserved, graduate from high school ready for success in college, work, and citizenship. all4ed.org

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Executive Summary

As the education system seeks to prepare students for success in college, a career, and life, educators must ensure that school cultures and environments promote positive mindsets in adolescent students, motivate them to take risks associated with positive outcomes, and support them in developing supportive relationships with their peers and adults. As adolescents' awareness of their social environments increases, their mindsets about learning evolve. During this developmental period, adolescents increasingly seek novel and thrilling experiences as their capacity for self-regulation matures. Meanwhile, the roles of peers and adults shift and take on new significance for adolescents, affecting their learning and identity development. Furthermore, recent evidence from neuroscience provides an increased understanding about how changes in the brain relate to these observed changes in adolescent behavior and inclinations.

This report examines learning and development research that supports the Alliance for Excellent Education's (All4Ed's) Science of Adolescent Learning (SAL) Research Consensus Statements 6–10 (see page 3 for statements). The report highlights the following essential findings about adolescent learning and development:

1. The most effective methods for motivating students change as students reach adolescence as a result of changes in the brain's reward-processing systems and students' experiences in new social contexts. Educators can influence how adolescents engage in academic and social activities through the mindsets they encourage and the types of motivation they provide. A school culture that supports students' positive identity development and allows them to pursue their own learning interests can inspire academic achievement and a lifelong passion for learning.
2. Adolescents' increased inclination to engage in risk-taking behaviors is not a deficit. During the adolescent stage of brain development, individuals are more sensitive to the effects of certain rewards, which can increase the likelihood that they will take certain risks to obtain those rewards. Educators can provide adolescents with school-based opportunities to take risks associated with positive academic and social outcomes, such as college acceptance, career preparation, and developing friendships, to allow students to benefit from their tendency to pursue new, varied, and intense experiences.
3. The role of peer and adult relationships shifts during adolescence. Peers become increasingly important as they influence the reward systems within the adolescent brain. Meanwhile, adult roles must shift from seeking to meet the needs of adolescents to supporting adolescents in meeting their own needs. Educators can shape school environments to provide adolescents with opportunities to engage with their peers during learning experiences and support students as they take responsibility for their own learning.

This report also includes recommendations for how educators, policymakers, and advocates can apply adolescent learning and development research to policy and practice. By using developmentally appropriate motivation strategies; supporting positive relationships between adolescents, their peers, and educators; and providing opportunities for adolescent students to take risks that will enhance their own educational experiences, education leaders can design learning environments that support adolescent learning and development throughout the entirety of the education system, helping to improve schools and close achievement and opportunity gaps.

About All4Ed's SAL Consensus Statement Report Series

In November 2017, All4Ed convened researchers, practitioners, and policy experts to examine advances in research and how recent findings from SAL can advance student learning and inform high school improvement strategies under the Every Student Succeeds Act (ESSA). During the event, an interdisciplinary group of researchers representing multiple scientific perspectives identified the most critical learning needs of adolescents.

After the convening, the researchers collaborated with All4Ed to develop a set of consensus statements about adolescent learning and development research, listed on pages 3–4. These statements, along with an accompanying series of reports, provide the foundation for [All4Ed's SAL initiative](#). Each of the reports listed below translates supporting research on adolescent learning and development that informs the consensus statements, which are grouped by theme. The reports also offer key considerations for education practitioners and policymakers on how best to support adolescent learning, particularly for students from historically underserved populations:

1. [Science of Adolescent Learning: How Body and Brain Development Affect Student Learning](#)
2. [Science of Adolescent Learning: Risk Taking, Rewards, and Relationships](#)
3. [Science of Adolescent Learning: Valuing Culture, Experiences, and Environments](#)
4. [Science of Adolescent Learning: How Identity and Empowerment Influence Student Learning](#)

The following researchers, all members of All4Ed's Expert Advisory Group, endorse the consensus statements and continue to support All4Ed's SAL initiative and this report series in their respective areas of expertise:

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To learn more about All4Ed's SAL initiative, visit all4ed.org/SAL.

All4Ed's SAL Research Consensus Statements

Consensus statements featured in report 1

1. In addition to body changes, the onset of puberty may trigger a second period of brain plasticity, increasing both the opportunity and vulnerability inherent in adolescence. Certain life conditions may cause the process of puberty to occur earlier or later, meaning that physical, cognitive, social-emotional, and other changes associated with puberty can begin at various ages.
2. Adolescents are in a stage of development during which the brain becomes more specialized and efficient. Learning experiences and environmental influences play key roles in this process. Learning and development are inextricably intertwined; these dual processes shape patterns of neural connections during adolescence.
3. As the brain becomes more interconnected during adolescence, young people are increasingly able to engage in adult levels of complex cognition, such as abstract reasoning, future thinking, and social cognition.
4. The ability to form memories and reflect on the accuracy of those memories continues to improve during adolescence. Adolescents become better able to assess their own learning, allowing for more time for additional information gathering and review.
5. Adolescents face an increased risk, compared to adults and younger children, for certain issues related to mental health, behavioral health, alcohol and substance use, accidents, trauma, sexual health, and nutrition due to physical, cognitive, and emotional changes they experience.

Consensus statements featured in this report

6. During adolescence, biological and environmental changes affect motivation and mindset. Because adolescents have an increased sensitivity to social evaluation, praising their learning process and successful strategies, not effort alone, can support development of a positive mindset and motivate them to learn.
7. Adolescents are more sensitive to some types of rewards, such as social recognition, than adults and younger children. Adolescents are more likely to engage in both positive and negative forms of risk taking, especially if peers support that behavior.
8. The transition from childhood into adolescence is associated with an increased sensitivity to social evaluation, including feelings of belonging, acceptance, admiration, and respect.
9. Peer relationships strongly influence adolescents, even more so than younger children, in ways that contribute to opportunities as well as vulnerabilities.
10. Compared to younger children, adolescents are able to spend more time with peers without adult supervision. However, support, communication of consistent expectations, and monitoring of activities and emotional functioning by adults are essential as adolescents become more independent.

(continued)

Consensus statements featured in report 3

11. Culture constructs the nature of learning environments and ways adolescents experience them including their values, motivations, and beliefs related to learning.
12. Adolescents seek learning environments that are consistent with and meaningful within the social and cultural contexts of their lives.
13. Digital technologies, such as computers, the internet, social media, and smart phones, dramatically have changed the way individuals learn, play, and interact with each other. Their impacts may be greatest for adolescents who are young enough to embrace novelty and old enough to master the technologies.
14. Adolescence is marked by significant biological shifts, resulting in heightened stress-induced hormonal responses. Stress is a major modulator of human learning and memory processes. As pressures around school, work, and relationships increase, adolescents experience greater stress.
15. In addition to physical, social, and emotional impacts that economic disadvantage has on adolescents, poverty and socioeconomic status are associated with a diverse set of neuroscientific structural and functional outcomes. Based on current evidence, the most sensitive systems are those related to executive functions, language, learning, and stress regulation.
16. Inequality, bias, and the persistence of structural discrimination constitute serious hazards to the positive development of all adolescents.

Consensus statements featured in report 4

17. While adolescents still are developing self-regulatory systems, under some circumstances they make more rational choices with the similar mental capacity of adults. However, the expression of self-regulatory skills depends on context and learning opportunities.
18. For adolescents, social and emotional development involves exploring meaning and finding purpose; sometimes this development is at odds with institutional structures and expectations.
19. Adolescents are developing their own adult identity, trying to understand their roles and contributions in social contexts and communities. This identity development continues into adulthood, as the individual has more diverse experiences.
20. Adolescents seek opportunities for agency where they can decide how they spend their time and influence policies and practices of institutions that shape their lives.

Risk Taking, Rewards, and Relationships

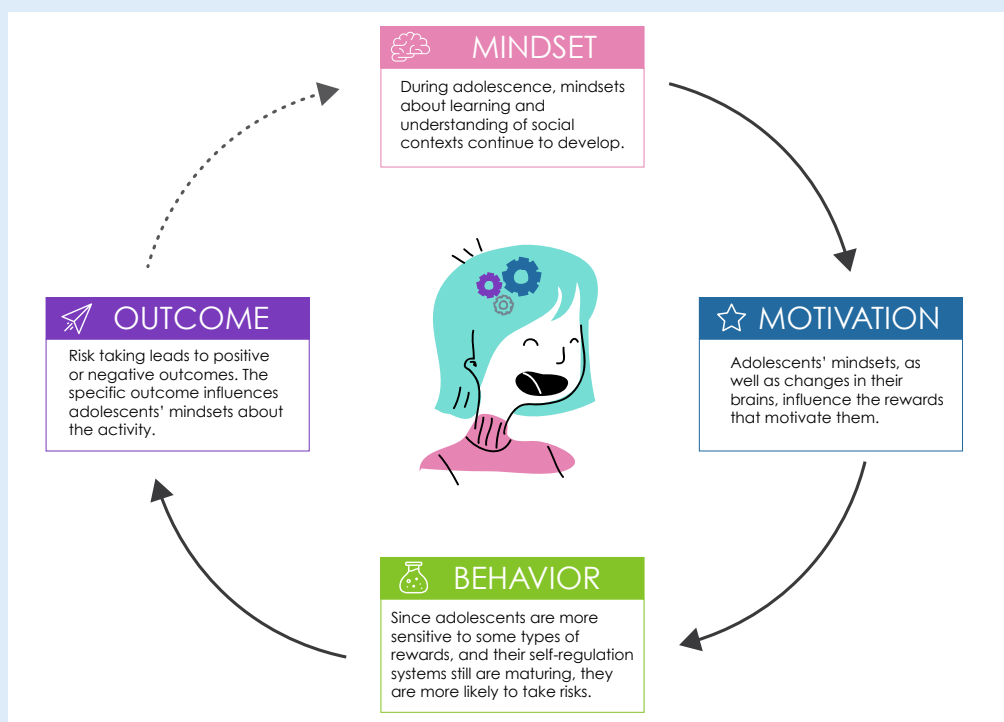
Recent evidence from neuroscience provides an increased understanding of how biological changes in the brain relate to social and behavioral changes in adolescents. The body and brain developments that occur during adolescence, combined with adolescents' changing social environments, affect what motivates adolescents and, subsequently, how they learn.

While stickers and promises of extra recess may have motivated students to learn during the early grades, the motivations for middle and high schoolers change. (See Figure 1: The Relationship Between Adolescent Mindset, Motivation, Behavior, and Outcomes below.) Adolescents seek novel and thrilling experiences and opportunities for social development. Educators and leaders can leverage these inherent tendencies in adolescents by incorporating new and engaging instructional approaches and motivating adolescents to take rewarding prosocial risks to support their learning and development in school.

As students reach **adolescence**, the roles that **peers** and adults held for them as younger children shift. Peer relationships become increasingly important, and adults begin to support

adolescents in becoming more independent. School leaders and educators shape a large portion of an adolescent's social experience. Consequently, ensuring that young people develop positive **relationships** with peers and adults at school is essential to motivate middle and high school students and promote increased academic engagement and success. Evidence from the science of adolescent learning (SAL) further stresses the need for the education system to ensure that school cultures and environments encourage positive mindsets in adolescent students, motivate students to take risks associated with positive outcomes, and support students in developing supportive relationships with their peers and adults, not only to prepare students for success in college, a career, and life but also to support their healthy development.

FIGURE 1: The Relationship Between Adolescent Mindset, Motivation, Behavior, and Outcomes



The following sections examine the learning and development research that supports All4Ed's SAL Research Consensus Statements 6–10 and recommend ways in which educators, policymakers, and advocates can apply adolescent learning and development research to policy and practice.

A Mindset and Motivation to Learn

SAL Research Consensus Statement 6: During adolescence, biological and environmental changes affect motivation and mindset. Because adolescents have an increased sensitivity to social evaluation, praising their learning process and successful strategies, not effort alone, can support development of a positive mindset and motivate them to learn.

Mindset and motivation are multifaceted aspects of human cognition that evolve, redefine, and solidify throughout an individual's lifetime, often in response to external environmental factors, including educational experiences. **Mindset** refers to a habitual or characteristic mental attitude, or set of attitudes, that determines how a person interprets and responds to situations; it affects how students approach education and learning.¹ Students with a **fixed mindset** believe that an individual's abilities are static and will remain the same regardless of the amount of effort a student exerts to change those abilities. By contrast, students with a **growth mindset** believe that they can develop their abilities, knowledge, and skills.²

Like younger children, adolescents with a growth mindset consistently outperform peers with a fixed mindset and demonstrate higher academic achievement, even after accounting for their socioeconomic status and other attitudinal factors beyond mindset.³ Research suggests that educators can encourage a growth mindset in students generally by praising their learning processes, the effort they demonstrate, and the successful problem-solving strategies they use, rather than praising their abilities alone.⁴ However, praising only effort can backfire for adolescent students specifically and make them less likely to believe that their work can improve their intelligence or skills. Because of their growing social awareness, adolescents notice when students receive praise and are rewarded for earning high grades and test scores. Some adolescents interpret this praise as a reward for demonstrating ability, particularly when students who demonstrate only improvement do not receive the same public recognition.

Why the Science of Adolescent Learning Matters for Education

Adolescence is a time of transition characterized by rapid physical, neurological, cognitive, and socioemotional development.⁵ As students move toward adulthood, their bodies and minds change.⁶ Those changes affect how they learn and, likewise, should influence how educators work.

A broad range of factors influence adolescent learning and development. These include *physiological* and *cognitive* factors, such as the maturation of neural pathways in the brain and the capacity to solve complex problems; *psychological* factors, such as the development of individual identity independent from parental figures; and even differing, sometimes conflicting, *cultural* and *societal* expectations.⁷ Consequently, rather than being a time of deficit, adolescence is a period of immense learning and opportunity.

Research about adolescent learning and development draws from a variety of disciplines, including but not limited to neuroscience, cognitive sciences, psychology, sociology, cultural studies, and medicine. By drawing from these multiple disciplines, SAL synthesizes what researchers know about adolescent learning and development and challenges traditional thinking about what it means to teach and learn during this developmental period. Furthermore, it offers a body of evidence that goes beyond simply observing students in the classroom and making assumptions about their learning and the strategies that support student needs. It provides a scientific understanding about how adolescents learn that can, and should, influence the approach to education reform.

Early childhood education benefited dramatically from efforts to increase educator and public knowledge about the importance of the early years of life for brain development and learning.⁸ Now educators, policymakers, and the public generally understand that quality education during early childhood can have lasting positive effects long into adulthood.⁹ Similarly, recent evidence shows that adolescence represents a second critical window for human learning and development.¹⁰ Consequently, education leaders have a responsibility to ensure that education systems align with research about adolescent learning and development.

Historically underserved students are more prone to hold fixed mindsets related to learning, because stereotypes about the intelligence, abilities, and outlooks of certain groups still permeate society. Throughout history, society falsely has stereotyped people of color as being less intelligent than their white counterparts. Also, misinformed educators may wrongly have labeled English language learners and students with disabilities as unintelligent because they require additional support in school. In fact, some research shows that validating a student's ability, along with praising his or learning process, is a strong motivator and predictor of success for historically underserved student populations and can help reverse the effect of negative stereotypes.¹¹

“ [A]dolescents with a growth mindset consistently outperform peers with a fixed mindset and demonstrate higher academic achievement, even after accounting for their socioeconomic status and other attitudinal factors beyond mindset.

Furthermore, students' mindsets influence their motivation to learn. **Motivation**, or the incentive that drives a person to take an action or display a behavior, often differs between individuals even when they approach the same task. There are two types of motivation: (1) **extrinsic motivation**, which results from the expectation of punishment or reward; and (2) **intrinsic motivation**, which comes from pleasure in the activity itself rather than because of any external benefits that might result. Students often encounter both extrinsic and intrinsic motivators in school. For instance, the potential of making the honor roll and getting into the college or career pathway of one's choice provides an extrinsic motivation to succeed academically, while a student's inherent love of problem solving can provide an intrinsic motivation to stick with a problem longer in search of a solution.

Motivations for adolescents tend to be extrinsic and tied to social status, shared peer values, personally salient autobiographical memories, emotional systems, and a desire for novel adult experiences.¹² Values, such as growing autonomy or a commitment to social justice, can motivate adolescents to learn and engage in academic and extracurricular activities.¹³ Meanwhile, research shows that for urban students, students from low-income families, and students of color primarily, identifying a higher purpose for learning that transcends the individual

student contributes to higher college persistence rates and more effective ways for students to monitor and control their behavior in academic settings, a process known as **self-regulation**.¹⁴

Critical changes in motivation occur during adolescence as a result of the changing social contexts adolescents experience and the responses of their developing brain systems to those new experiences, which affect adolescent students' engagement in their learning.¹⁵ Once students reach adolescence, engagement at school declines for some students, specifically their motivation to learn; the perceived value they assign to school tasks; and their tendency to plan, monitor, and evaluate their academic progress.¹⁶ Research indicates that students' perceptions of the school environment directly and indirectly affect their social, emotional, and cognitive engagement at school—three levels of engagement that influence academic achievement.¹⁷ The declines in student engagement during middle and high school may result from a lack of developmentally appropriate motivation that aligns with adolescents' changing needs and tendencies.¹⁸



Photo by Allison Shelley/The Verbatim Agency for American Education: Images of Teachers and Students in Action

Is the Risk Worth the Reward?

SAL Research Consensus Statement 7: Adolescents are more sensitive to some types of rewards, such as social recognition, than adults and younger children. Adolescents are more likely to engage in both positive and negative forms of risk taking, especially if peers support that behavior.

The onset of puberty has been associated with a substantial increase in **reward sensitivity**, or the way an individual feels about receiving a reward. In adolescence, this increase in sensitivity leads to higher instances of reward-seeking and sensation-seeking behaviors. **Sensation seeking** refers to behaviors associated with searching for new, varied, and intense experiences. **Reward seeking** refers to behaviors associated with searching for experiences that activate the reward system within the brain, regardless of their novelty or similarity.

(See the sidebar “The Brain’s Reward System” below for more information.) While some evidence suggests that the increase in adolescents’ reward-seeking behavior is due to their need for greater thrills to activate their reward systems, a larger body of evidence supports the theory that this behavior is a result of adolescents’ increased sensitivity to reward.¹⁹ In addition to this heightened desire for high-intensity, exciting experiences and reward, adolescents’ general desire to advance their social development through improved peer relations, social status, and romantic partners increases.²⁰ Reward seeking, which includes behaviors that might advance social development, and sensation seeking both reflect changes in adolescents’ motivational preferences and likely result from the continued maturation of neural pathways in the brain following the onset of puberty.²¹ Behaviors that result in reward are then reinforced, or learned, as the brain stores these experiences as pleasurable memories that can later motivate adolescents to repeat the behaviors in the future.²²

The Brain’s Reward System

The reward system refers to a group of structures in the brain that activate every time a person does something pleasurable. When an individual experiences a stimulus he or she finds rewarding, such as a favorite food, an exciting activity, or even an addictive drug, the brain responds by releasing **dopamine**. Dopamine is one of the many chemical messengers within the body, known as **neurotransmitters**, that carry signals between neurons and other cells in the body. Researchers previously thought that dopamine was the neurotransmitter responsible for causing feelings of pleasure. But recent evidence shows that dopamine **neurons**, the brain cells that make the pathways (via **synapses**) that produce and carry dopamine, activate before the reward is received. This indicates that dopamine has other roles. For example, researchers believe that it is involved in assigning importance to environmental stimuli associated with rewards and increasing reward-seeking behavior.²³ Hormones likely play a significant role in the activation and organization of the reward system, which may be particularly important for adolescents as they experience the hormone-driven changes in body and brain development associated with puberty.²⁴

The actual network of brain structures involved in processing reward involves multiple parts of the brain and several types of neurotransmitters. But what is often referred to as the “reward system” consists of the brain structures found along dopamine pathways in the brain. The **mesolimbic dopamine pathway** is consistently activated during rewarding experiences and therefore is the pathway considered to be the main structure of the reward system. The pathway starts in the **ventral tegmental area (VTA)**, one of the primary dopamine producers in the brain. From the VTA, dopamine neurons connect to the **nucleus accumbens**, located in the **ventral striatum**, a part of the brain strongly associated with motivation and reward. During a rewarding experience, dopamine neurons in the VTA activate and cause dopamine levels in the nucleus accumbens to rise, creating feelings of pleasure. These feelings often reinforce learning by connecting a specific behavior to a positive outcome.²⁵

Another major pathway that is activated during rewarding experiences is the **mesocortical dopamine pathway**. This pathway also begins in the VTA, but instead of connecting to the nucleus accumbens, this pathway sends signals to the **frontal lobes** of the brain, the region of the brain associated with higher-order **executive functions** such as planning, decisionmaking, and problem solving.²⁶

Rewarding experiences are tied closely to motivation and executive functioning, an important point for educators to understand. With this in mind, educators can identify the characteristics that make certain experiences more rewarding for adolescent students, such as peer interaction, and incorporate those factors into academic and extracurricular activities.

Adolescence appears to be a time of growing inclination for risky behavior.²⁷ Heightened reward seeking leads adolescents toward risky activities. This is a universal biological phenomenon that encourages adolescent mammals, including humans, to take the risk of ultimately leaving their families to attempt to survive on their own and to form supportive bonds with peers as they explore new territory and find mates.²⁸ This inclination for risky activities typically declines starting in late adolescence. Once adolescents reach adulthood, their self-regulatory systems begin to restrain these natural impulses to take risks.²⁹

"Risky" behaviors often are associated only with activities that can lead to negative or antisocial outcomes, such as crime or drug use. However, it is important to understand that some risks, such as starting a business or meeting new people, can lead to positive and prosocial outcomes. For example, adolescent students may feel that academic engagement and success might put them at risk of teasing or bullying by their peers. Yet, at the same time, a lack of academic engagement and mistakes in class may put adolescents at risk of having teachers and peers perceive them as less intelligent or capable. Evidence suggests that adolescents are more motivated to take risks associated with positive and prosocial outcomes when those risks lead to developmentally relevant rewards.

Rewards are one form of extrinsic motivation. If the desire to earn a high score on a college admissions test motivates a student to learn, then the extrinsic motivator, the test score, represents the student's reward for learning. Adolescents are more sensitive to some types of reward, such as social status and recognition, taste, thrill seeking, and monetary rewards, than are adults and younger children.³⁰ In addition, the thrills associated with taking risks may be more rewarding for adolescents than for adults or younger children.³¹ Since self-regulation and executive control systems in the brain continue to develop during this stage, adolescents are more likely to choose immediate over long-term rewards.³² Reward-seeking and sensation-seeking behaviors are most apparent during the beginning of adolescence, after which the frequency of the behavior declines.³³

However, educators should be cautious about overusing rewards to motivate students to engage in school. When rewards are used exclusively to change the behavior of others without their consent, especially if there is an unbalanced power dynamic between the parties, the practice is akin to a psychological

process known as **conditioning**. Although educators play a role in encouraging student behaviors that likely will lead to positive outcomes, and dissuading students from participating in behaviors that may lead to negative outcomes, relying completely on conditioning strategies to change behavior can lead to unintended consequences. For example, educators may believe that they are rewarding "good" behavior, but in fact may be encouraging students to assimilate their behaviors to meet the biased expectations of a dominant culture, an experience that many historically underserved students face in school. Therefore, educators should seek to increase students' intrinsic motivation to learn by providing opportunities for students to connect their academic learning to their personal and professional interests.

However, educators should not attempt to work against adolescents' natural development and predispositions for reward. In fact, when educators ignore adolescents' developmental needs, educational experiences become less enticing for adolescents, reducing the chances that they will want to engage. It is possible to provide developmentally appropriate rewards, such as public praise of learning and accomplishment, without conditioning students, and still promote a general love of learning. Educators can motivate students both intrinsically and extrinsically by creating a school culture that capitalizes on the motivational tendencies of adolescents and provides them with opportunities to connect learning to their own interests and real-world problems. Educators should shift from using transactional rewards, such as monetary rewards and treats for class participation or on-task behavior, and provide adolescent students with experiences that are novel, engaging, and social.

A common misconception is that adolescents lack fear or are less fearful during this developmental stage compared to other stages of life. However, research finds the opposite to be true. Early adolescents show higher activation in the **amygdala**, an area of the brain responsible for fear and threat perception, than young adults. For adolescents, higher levels of fear can result in greater thrills, resulting in a larger reward when undertaking high-risk activities.³⁴

Developmental patterns of sensation seeking and self-regulation, the two cognitive factors thought to influence risky behavior, remain consistent across most cultures, rising during adolescence

and declining in adulthood.³⁵ Research suggests that differences observed in the likelihood of risky behavior among different groups of adolescents may result more from context than biology.³⁶ Adolescents' propensities to engage in risky activities vary across the cultural contexts and environments in which these inclinations develop. Therefore, it is essential to remember that the environments in which young people grow up shape differences in their behaviors, even though those behaviors have strong roots in biology.³⁷

A Part of Something Bigger

SAL Research Consensus Statement 8: The transition from childhood into adolescence is associated with an increased sensitivity to social evaluation, including feelings of belonging, acceptance, admiration, and respect.

A hallmark of adolescent risk taking is that it is far more likely than that of adults to occur in groups. Adolescents spend more time in peer groups than adults do, and adolescents' higher levels of risk taking result partly from those increased peer interactions and their heightened attentiveness to social stimuli.³⁸ Adolescents are more sensitive to rewards related to social evaluation, which include feelings of **belonging**, **acceptance**, **admiration**, and **respect**. During the course of development, an individual's sense of personal acceptance and of having a rightful and valued place in different social contexts stabilizes and can influence an individual's mindset and identity.³⁹

The human need for acceptance and belonging takes on special prominence during adolescence, when young people begin to consider seriously who they are and wish to be, with whom they belong, and where they intend to invest their energies and stake their future.⁴⁰ However, it should be noted that many of the research findings related to the development and value of these types of feelings in people may reflect a Western bias due to the background and natural implicit biases of the research investigators and the backgrounds of the adolescent participants observed. This bias will decrease as the diversity of researchers and research participants improve, leading to a better understanding of why adolescents have an increased sensitivity to social evaluation and the degree to which this aspect of adolescent development generalizes across cultures.

An individual's sense of belonging at school is particularly important during adolescence, which has far-reaching implications for a student's psychological and academic well-being.⁴¹ Adolescents who feel valued and respected by their classmates are more likely to report feeling motivated to achieve academically. Having strong friendships with peers who value academics also relates to a student's higher motivation for academic achievement. Conversely, having friends who are resistant to school norms relates to students being less motivated to succeed academically and to disengage from school.⁴²

A supportive and safe school environment is vital to a student's sense of belonging.⁴³ Unfortunately, during adolescence, particularly the middle school years, many individuals experience school contexts characterized by increased aggression and bullying behaviors that reduce students' feelings of belonging and increase their risk for academic and psychological maladjustment and school dropout.⁴⁴ In addition, middle and high schools tend to be larger, more compartmentalized, and more performance oriented than elementary schools. At these levels, schools typically separate subjects into distinct courses and place students in classes based on their previous academic performance and interests. Consequently, students are more likely to compare themselves to others based on academic standards without appropriate context and without many opportunities to develop the personal relationships with peers and adults to better understand those contexts. For example, schools typically do not allow students with poor academic performance or behavior to participate in extracurricular activities, despite evidence showing that involvement in such activities can increase prosocial behavior and feelings of academic competence.⁴⁵ Moreover, in addition to creating positive relationships with adults and peers as part of a supportive and safe school environment, adolescent students require **respect**, assurance that their social identities are an asset rather than a deficit, and autonomy to support their learning and development.⁴⁶

The Importance of Peer Relationships

SAL Research Consensus Statement 9: Peer relationships strongly influence adolescents, even more so than younger children, in ways that contribute to opportunities as well as vulnerabilities.

The importance and nature of peer relationships increase during adolescence. Social relationships, especially those with peers, become more rewarding. Simultaneously, changes in social contexts and norms, such as an increased expectation of independence from parents, further elevate the importance of peers. Young people become likely to spend more time with their peers, often with reduced oversight by adults, and emphasize the expectations and opinions of peers. Same-sex friends account for an increasingly larger proportion of adolescents' perceived primary social network, and friends equal or surpass parents as sources of support and advice to adolescents in many significant aspects of life.⁴⁷ Adolescence is characterized by psychological changes that affect an individual's sense of identity, self-consciousness, and relationships with others. Compared with younger children, adolescents are more social, form more complex and hierarchical peer relationships, and are more sensitive to acceptance and rejection by their peers.⁴⁸

Changes in brain structure and function that occur during adolescence lead to adolescents' heightened susceptibility to peer influence.⁴⁹ A growing body of research shows that risk taking does not result solely from spending time with peers but also because the presence of peers activates the same neural circuitry in the brain implicated in reward processing, which compels adolescents toward greater sensation seeking. That means adolescents are more likely to engage in activities that increase the positive feelings they associate with their peer group. When researchers observe adolescents with their peers, the brain regions related to rewards and risk taking demonstrate greater activity. Meanwhile, brain areas associated with cognitive control are recruited less strongly by adolescents than by adults. Furthermore, this lack of activity in the adolescent cognitive control system does not vary with social context, indicating that an adolescent's proclivity to act on impulse is not always a conscious choice, but rather a reflection of the stage of brain development the adolescent is experiencing.

Compared to adults, adolescents report lower resistance to the influence of their peers, and observational data likewise often points to peer influence as a primary contextual factor contributing to adolescents' heightened tendency to make risky decisions.⁵⁰ The awareness of peers selectively amplifies activity in the part of the adolescent brain responsible for processing reward, which, in turn, influences subsequent decisions about risk. The presence (and perceived presence) of peers "primes"

an adolescent for a reward-sensitive motivational state that increases the subjective value of the short-term benefits of risky choices over the long-term value of safe alternatives. In other words, peers can increase an adolescent's perceived value of a reward associated with an action, making the reward seem worth the risk associated with engaging in the behavior. These alterations in brain activity occur even when adolescents simply *believe* peers can observe or find out about their behaviors. Experiments reveal that risk-taking behavior increases when adolescent participants only perceive the presence of peers and do not interact directly with them, suggesting that explicit peer pressure to engage in risky activity is not the sole reason for these behaviors.⁵¹

New types of relationships emerge in adolescence, most notably romantic relationships, and new levels of the peer system appear, such as reputation-based crowds or a broader youth culture. In selecting friends, romantic partners, or friendship groups, young people become more sensitive to the ramifications or risks a specific relationship could have on their status or reputation within the broader peer system. In other words, young people must negotiate peer relationships and issues on a broader set of levels than they did in childhood. Adolescents' peer crowd affiliations, positive interactions with best friends, and the presence of a dating relationship appear to "protect" adolescents against feelings of **social anxiety**, while relational victimization and negative interactions in close friendships may contribute to feelings of social anxiety.⁵² Quality of peer **attachments** relates highly to adolescents' well-being, particularly to their self-esteem and life satisfaction.⁵³

Developmental psychologists note that peer relationships play a critical role in enabling adolescents to practice and develop behaviors vital to adult relationships and in facilitating social integration into the social environments they likely will encounter as adults, such as professional and political settings. Most young people experience adolescence within cultural and institutional spaces that provide virtually no systematic training for the task of constructing social systems of support, including cultivating positive peer relationships. Also, class and racial forms of segregation often define these systems, making it difficult for adolescents to interact with peers who have backgrounds that differ from their own.⁵⁴

Adolescent friendships, particularly emotionally strong ones, provide a socializing force and an important context for learning about the requirements of mature, principled relationships. Friendship in adolescence emphasizes intimacy and self-disclosure, and adolescents consistently report greater levels of closeness in their friendships than do younger children.⁵⁵ Additionally, adolescents begin to accept that their friends need to establish relationships with other people and grow through such experiences. In particular, they recognize an obligation to grant friends a certain degree of autonomy and independence.⁵⁶

The Importance of Adult Relationships

SAL Research Consensus Statement 10: Compared to younger children, adolescents are able to spend more time with peers without adult supervision. However, support, communication of consistent expectations, and monitoring of activities and emotional functioning by adults are essential as adolescents become more independent.

Previously, social scientists promoted a perspective that emphasized the competition between adults and adolescent peers in influencing the lives of teenagers, portraying adults as relatively powerless in countering peer group pressures.⁵⁷ Yet adults play a significant role in shaping the environments and peer groups of adolescents, and positive adult involvement can foster desirable behavior patterns and association with peer groups that also encourage those desirable behaviors.⁵⁸ For instance, parents retain some control over their adolescent child's choice of peers by determining the neighborhood in which the family lives or the schools, churches, and community organizations the family attends.⁵⁹

Moreover, perceived support from both teachers and parents provides an important buffer against the general declines in school engagement that occur during the secondary school years. Research suggests that teachers and parents substantially influence most adolescents when it comes to school engagement even though peers may tempt adolescents into misbehavior outside of the classroom.⁶⁰ Educators can promote students' positive identification with school and stimulate their willingness to participate in academic activities by offering

improvement-based praise and emphasizing effort while supporting, rather than pressuring, students for correct answers or high grades. This type of school climate provides students with more opportunities to feel successful.⁶¹ Additionally, educators and parents can improve students' sense of capability by emphasizing and highlighting the content and skills students master, rather than focusing solely on the grades they receive.⁶²

Another way educators can support adolescents is by facilitating nurturing contexts where adolescents can interact with peers and develop strong relationships. Young people need opportunities to interact where they can get to know and learn to trust one another, and adults influence when and where adolescent students engage in prosocial ways.⁶³ Additionally, educators need accurate knowledge about students' peer affiliations. Research shows that this form of teacher responsiveness increases feelings of school belonging for middle school students.⁶⁴ By being attuned to the social interactions taking place among adolescent students, including positive and negative peer pressure, educators can make informed decisions about practices such as seating and grouping students to create a supportive and safe school environment.⁶⁵

“ [P]erceived support from both teachers and parents provides an important buffer against the general declines in school engagement that occur during the secondary school years.

Some research shows that general adult presence can influence adolescent risk taking and decisionmaking as well. In one experiment, adolescents took more risks and expressed stronger preference for immediate rewards when they were grouped with same-age peers than when they were alone. When the researchers replaced one adolescent peer with someone slightly older, however, adolescents' decisionmaking and reward processing resembled what they had displayed when they were alone. Adding a young adult to an adolescent work team may improve group decisionmaking.⁶⁶

Implications and Opportunities for Education Practice and Policy

During adolescence, students' mindsets about learning develop and their motivations for academic persistence and success change. Developmentally appropriate rewards and positive relationships with both peers and adults are essential components of a secondary school culture that inspires and supports students to learn and achieve. By understanding the science behind student learning and development, education leaders can support adolescents throughout the entirety of the education system, closing achievement and opportunity gaps.

What do these findings mean for educators?

- Educators should connect learning to topics that interest students. Topics may relate to current events affecting the broader and school communities or students' specific experiences. Teachers can develop relationships with students and learn about their interests through activities such as questionnaires, exit slips, student advisory groups, journals, and online discussion boards. The strategies used should provide students with platforms to discuss their interests in structured formats that engage both peers and other adults and align with school policies and procedures. Examples include newsletters, speaking engagements, debate clubs, and intergrade or interdisciplinary communication activities. Academic approaches such as project-based learning and performance-based activities should offer students opportunities to choose from multiple ways of completing tasks to arrive at successful outcomes.
- School and district leaders can provide opportunities for students to engage in high-quality service learning and work-based learning. For example, educators can engage students in rigorous projects that integrate academics with social justice, service-learning projects to support causes important to students, and internships with business and community organizations. These types of learning opportunities can motivate students and provide them with opportunities to build relationships with their peers and adults in their community.
- School and district leaders should value the importance of peers in adolescents' lives and support the development

of positive peer relationships by creating opportunities for students to work with and learn from each other under the supportive guidance of teachers, parents, community members, business professionals, and other adults. Effective strategies for this include long-term group projects and other in-school assignments that engage students within and between grade levels and schools.

- Educators can use lunch time, student advisory and homeroom periods, or other less structured time to build supportive relationships with students separate from discussions about academic progress. This might include a time for students to talk openly about current events or community activities of interest to them. Students might even talk with their peers about social issues or seek help on assignments. Educators can use two-way communication approaches such as dialogue journals to allow students to communicate with their teachers without involving their peers.
- School and district leaders, including school board members, as well as educators should provide opportunities for students to establish personal academic, career, and social goals. Students are more likely to thrive and make positive choices when they understand (1) the relevance of education to their future success and (2) that high school is not an end in itself, but rather a path to greater autonomy and choice. Schools and districts can partner with community colleges and businesses to offer on-campus experiences, college-level course work, career training, and internships. Meanwhile, teachers and counselors can work with students, their families, and mentors to develop personalized learning plans that align with students' interests and goals.

What do these findings mean for policymakers and advocates?

- The relationships that adolescents develop with peers and adults heavily influence how they integrate into social, professional, and political settings as adults. Because class and racial segregation influence the people and institutions with which adolescents interact, it is important for public policy to promote diversity and prevent racial isolation. For example, the U.S. Departments of Justice and Education recently rescinded guidance aimed specifically at achieving diversity and reducing racial isolation in elementary and secondary schools. This [guidance](#) should

be restored immediately. Also, district leaders can create school attendance zones that consider the relative racial composition of areas in combination with the average household income and educational levels of parents in those areas. All students in a given area would then, regardless of their individual race, receive the same consideration when applying to a school based on how much their zoned area would contribute to increasing diversity or reducing racial isolation in that school.

- States should consider incorporating rigorous standards for high-quality service-learning opportunities aligned with state academic standards into high school graduation requirements. This might be a set of criteria that districts use to approve service-learning projects. A state can also provide sample high-quality projects that districts can use to gauge the quality of their service-learning projects.
- Policymakers can support educators in providing developmentally appropriate motivation for adolescents. They can promote college and career planning and experiences by drawing on resources from the Strengthening Career and Technical Education for the 21st Century Act and through the reauthorization of the Higher Education Act to help adolescents contextualize the importance of secondary education as it relates to their own personal and professional goals. In addition, state accountability systems can encourage schools to offer college courses and provide pathways for students to earn industry credentials and obtain work experience while still in high school.
- Policymakers should find ways to support and incentivize teen mentorship programs, for example, by expanding funding for the Mentoring Opportunities for Youth Initiative available through the U.S. Department of Justice's Office of Juvenile Justice and Delinquency Prevention. Given the increasing influence of peers in the lives of adolescents, and their growing sensitivity to social evaluation, providing adolescents with positive peer role models is of paramount importance. Policymakers should find creative ways to grow mentoring programs in partnership with community groups and nonprofits by providing needed funding and finding ways to incorporate mentoring into school programming (e.g., include mentorship in college and career pathways so older students can support younger students in navigating work experience, training, and college classes and experiences).

Conclusion

Changes in the reward systems of the brain affect what motivates adolescents to engage in certain behaviors. Factors, such as peers, make experiences more rewarding to adolescents, increasing their likelihood to take risks in certain situations. Adolescents also are building their understanding of their own social surroundings, which influences their mindsets about their abilities to learn and succeed. Meanwhile, the roles of peers and adults change as adolescents rely on these relationships to support their social development into adulthood.

As school and district leaders work to ensure that middle and high schools meet the developmental needs of adolescent students and support their learning, it is essential to understand how adolescent students' learning mindsets, individual motivations, and relationships with peers and adults affect their willingness to engage in school.

Adolescents are less likely to engage in academic learning if school environments are not structured in ways that promote growth mindsets, connect academic learning to student interests, and allow adolescent students to build supportive relationships with their peers and adult educators. In addition, adolescents need opportunities to take risks in school, within their classroom assignments and through participation in rigorous extracurricular activities, that capitalize on their natural tendencies, rather than work against them.

Policymakers and educators should improve their understanding of adolescent development and behavior to ensure that continuous improvement efforts at the secondary school level are developmentally appropriate and meet all the learning needs of adolescents, not only their academic needs. Federal, state, district, and school leaders should align their efforts to create organizational structures that connect academic learning to college and career goals, foster positive relationships, and support adolescent students in taking risks that will enhance their educational experience.

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Glossary

acceptance. The action or process of being received as adequate or suitable, typically to be admitted into a group.

adolescence. The period of human development that starts with biological changes associated with puberty and ends once specific social expectations—determined by factors like family, culture, and society—are met.

amygdala. An almond-shaped structure in the brain that has an important role in memory, emotion, perception of threat, and fear learning.

attachment. The tendency to seek emotionally supportive social relationships.

belonging. The feeling of being accepted and approved by a group or by society as a whole.

conditioning. The process by which certain kinds of experiences make particular behaviors more or less likely.

dopamine. A *neurotransmitter* (see Glossary for definition) that has an important role in reward processing and is implicated in numerous mental conditions and emotional states, such as motivation and learning.

dopaminergic. Responding to, releasing, or otherwise involving *dopamine* (see Glossary for definition). For example, a dopaminergic neuron is any *neuron* (see Glossary for definition) in the brain or other parts of the central nervous system for which dopamine serves as the principal *neurotransmitter*.

executive functions. Basic cognitive processes, such as attentional control, cognitive inhibition, inhibitory control, working memory, and cognitive flexibility. Higher-order executive functions require simultaneous use of multiple basic executive functions and include planning, reasoning, and problem solving. These functions frequently are associated with neural networks that include the *frontal lobe* (see Glossary for definition), particularly the prefrontal cortex.

extrinsic motivation. An external incentive to engage in a specific activity, especially motivation arising from the expectation of punishment or reward (e.g., completing a disliked chore in exchange for payment). Compare to *intrinsic motivation*.

fixed mindset. The belief that attributes and abilities are inherently established and unchanging. Compare to *growth mindset*.

frontal lobe. One of four main lobes of each cerebral hemisphere of the brain. It is concerned with motor and higher-order executive functions.

growth mindset. The belief that abilities and intelligence can be developed. Compare to *fixed mindset*.

intrinsic motivation. An incentive to engage in a specific activity that derives from pleasure in the activity itself (e.g., a genuine interest in a subject studied) rather than because of any external benefits that might be obtained (e.g., money, course credits). Compare to *extrinsic motivation*.

mesocortical dopamine pathway. A network of *dopaminergic* (see Glossary for definition) neurons in the brain that connects parts of the limbic system with the prefrontal cortex. It receives input from the *ventral tegmental area* (see Glossary for definition), and its activity is related to emotion, reward, and substance abuse.

mesolimbic dopamine pathway. A network of *dopaminergic neurons* in the brain including the *nucleus accumbens* (see Glossary for definition) and *amygdala* (see Glossary for definition). It receives input from the *ventral tegmental area*, and its activity is related to emotion, reward, and substance abuse.

mindset. A habitual or characteristic mental attitude (or set of attitudes) that determines how a person will interpret and respond to situations.

motivation. The incentive that gives purpose or direction to behavior and operates in humans at a conscious or unconscious level. Motives are frequently divided into (a) physiological, primary, or organic motives, such as hunger, thirst, and need for sleep; and (b) personal, social, or secondary motives, such as affiliation, competition, and individual interests and goals. An important distinction exists between internal motivating forces and external factors, such as rewards or punishments, that can encourage or discourage certain behaviors. See *extrinsic motivation* and *intrinsic motivation*.

nucleus accumbens. The part of the brain located in the *ventral striatum* (see Glossary for definition) that receives *dopaminergic* signals from the *ventral tegmental area*. Dopamine release in this region may mediate the reinforcing qualities of many activities.

neuron. The basic cellular unit of the nervous system. Each neuron consists of a cell body, fine, branching extensions (dendrites) that receive incoming nerve signals, and a single, long extension (axon) that conducts nerve impulses to its branching terminal. The axon terminal transmits impulses to other neurons or to effector organs (e.g., muscles and glands) via junctions called *synapses* (see Glossary for definition) or neuromuscular junctions. Axons of neurons are often surrounded by a myelin sheath (fatty cells). In contrast to other cell types, neurons possess the capacity to modify their structure and function based on receipt of information and stimuli from their immediate environment. Also called *nerve cell*.

neurotransmitter. Any of a large number of chemicals that can be released by neurons to mediate transmission of nerve signals across the junctions (*synapses*) between neurons.

peer. An individual who shares a feature or function (e.g., age, sex, occupation, social group membership) with one or more other individuals. In developmental psychology, a peer is typically an age mate with whom a child or adolescent interacts.

relationship. A continuing and often committed association between two or more people, as in a family, friendship, marriage, partnership, or other interpersonal link in which the participants have some degree of influence on each other's thoughts, feelings, and actions.

respect. An attitude of, or behavior demonstrating, esteem, honor, regard, concern, and other such positive qualities toward an individual or entity. Respect can serve an important purpose in interpersonal and intergroup relations by aiding in communication.

reward. The outcome of a behavior or action that results in the frequency or probability of the occurrence of the behavior or action being increased. Also described as *reinforcement*.

reward seeking. The tendency to pursue experiences that stimulate the reward-processing systems of the brain.

reward sensitivity. The degree to which an individual's behavior is motivated by reward-relevant stimuli.

self-regulation. Control of one's behavior through the use of self-monitoring (keeping a record of behavior), self-evaluation (assessing the information obtained during self-monitoring), and self-reinforcement (rewarding oneself for appropriate behavior or for attaining a goal).

sensation seeking. The tendency to pursue sensory pleasure and excitement.

social anxiety. Fear of social situations in which embarrassment may occur (e.g., making conversation, meeting strangers, dating) or there is a risk of being negatively evaluated by others (e.g., seen as stupid, weak, or anxious). Social anxiety involves apprehensiveness about one's social status, role, and behavior.

synapse. The specialized junction through which *neurons* transmit signals from one to another.

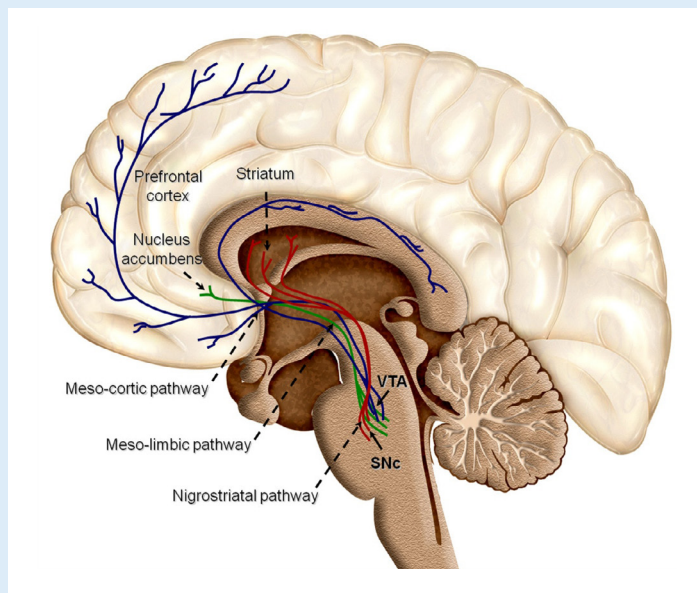
ventral striatum. A part of the brain strongly associated with *motivation* and *reward*.

ventral tegmental area. An area in the midbrain that forms part of the limbic system, sending *dopaminergic neurons* to the *mesocortical* and *mesolimbic dopamine pathways*.

Sources: G. R. VandenBos, ed., *APA Dictionary of Psychology* (Washington, DC: American Psychological Association, 2007); "Sensation-Seeking," *Psychology Today*, <https://www.psychologytoday.com/us/basics/sensation-seeking> (accessed July 5, 2018); S. H. Kim et al., "Individual Differences in Sensitivity to Reward and Punishment and Neural Activity During Reward and Avoidance Learning," *Social Cognitive and Affective Neuroscience* 10, no. 9 (2015): 1219–27, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4560942/>.

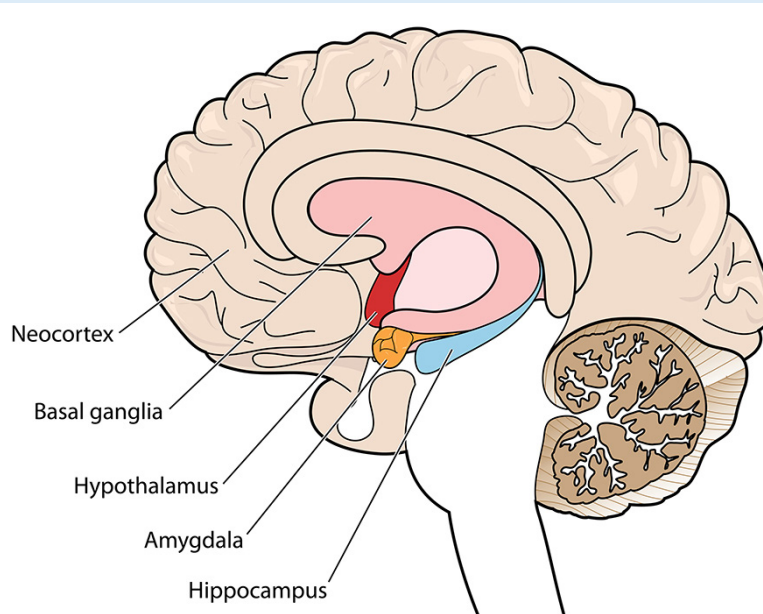
Appendix

FIGURE A1: The Brain's Reward System



Source: O. Arias-Carrión et al., "Dopaminergic Reward System: A Short Integrative Review," *International Archives of Medicine* 3, no. 24 (2010), <http://www.biomedcentral.com/1755-7682/3/24/>.

FIGURE A2: Location of the Amygdala in the Human Brain



Source: Wonderopolis, "What Does Your Amygdala Do?," <https://wonderopolis.org/wonder/what-does-your-amygdala-do> (accessed July 5, 2018).

