



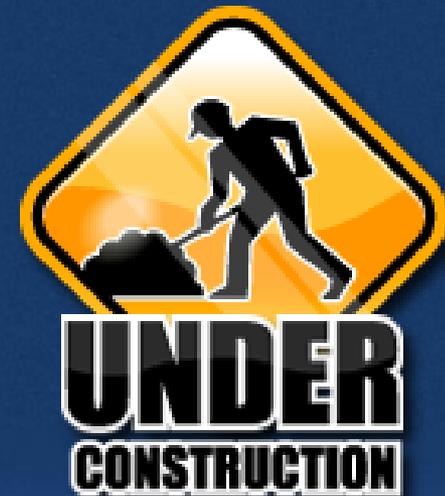
BOISE STATE UNIVERSITY

The Adolescent Brain: Under Construction

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Getting Started

- In what ways do you engage with adolescents?
- Why learn about the brain?

(Steinberg, 2014)



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UNDERSTANDING ADOLESCENCE

Defining Adolescence

- Transitional period between childhood and adulthood often co-occurring with puberty (i.e., sexual maturation)
- Approximately between the ages of **12-24** (some scholars suggest ages 10-25)
- A time of **substantial and systematic changes in the brain's anatomy**
 - “Adolescence is the new zero to three” (Steinberg, 2014, p. 10)



(Siegel, 2014; Steinberg, 2014)



Adolescence

- When you think of adolescence, what thoughts come to mind – behaviors, emotions, attitudes, etc. ?



Myths of Adolescence

1. Raging hormones cause teenagers to “go mad” or “lose their minds”
2. A time of immaturity and teens just need to “grow up”
3. Transition from dependence to complete independence
4. Increased risky behavior comes from ignorance, irrationality, delusions of vulnerability, or faulty calculations (i.e., problems with cognitions)

(Siegel, 2013; Steinberg, 2008)

Adolescents are positively impacting our world

- Inventions
 - Alissa Chavez, at just 17, recently came up with an invention to stop hot car deaths. The “[Hot Seat](#),” help s parents to monitor their baby’s chair in case it gets too hot.
 - Ann Makosinski invented the Hollow Flashlight - a flashlight that runs off the warmth that comes from being held in someone’s hands – no battery
- Altruism
 - Divine Bradley founded Team Revolution at the age of 17
 - <http://www.mnn.com/lifestyle/responsible-living/photos/8-amazing-kids-who-have-changed-the-world/divine-bradley#ixzz3H4zGFFkX>
- Fighting the status quo
 - In 1955, 15 year old Claudette Calvin refused to give up her seat on a bus and was part of a legal suit to end segregation on buses
 - www.mnn.com/lifestyle/responsible-living/photos/8-amazing-kids-who-have-changed-the-world/claurette-colvin

Adolescents are harming themselves and others

- Risky behavior
 - Accidents are responsible for ½ of all teen deaths (1/3 car accidents)
 - More likely to have unprotected sex
 - Of the 29% of Idaho HS students that reported having sex in the last 3 months, 43% said they or their partner did not use a condom (2013 Idaho Youth Risk Survey)
 - More likely to experiment with drugs, alcohol, etc.
 - 28% of Idaho HS Students reported consuming at least 1 alcoholic drink in the last 30 days (2013 Idaho Youth Risk Survey)
- Suicide
- Criminal activity



(Siegel, 2013; Steinberg 2008, 2014)

The Essence of Adolescence

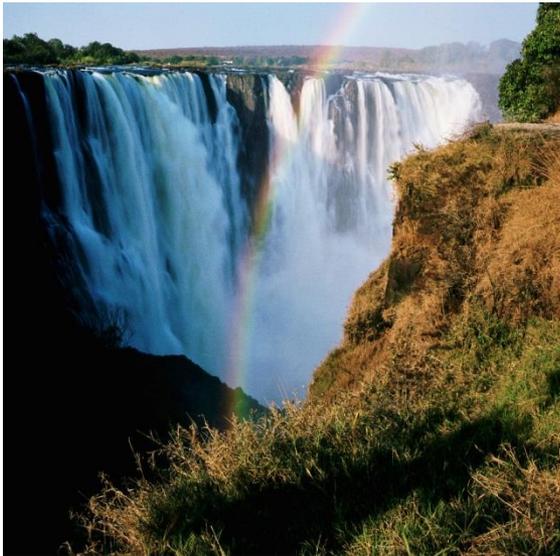
- ***Novelty seeking*** – motivation to try something new and feel life more fully
 - Upside: Open to change and live passionately leading to adventure and new discoveries. Evolutionarily necessary - need to survive and reproduce.
 - Downside: Sensation seeking and risk taking that overemphasize the thrill and downplay the risk leading to dangerous behaviors and injury
- ***Social engagement*** – enhanced peer connectedness
 - Upside: development of life long supportive relationships that contribute to well-being, longevity, and happiness
 - Downside: Teens isolated from adults and surrounded only by other teens have increased risky behavior

The Essence of Adolescence

- ***Increased emotional intensity*** – enhanced vitality to life
 - Upside: Energy and exuberance for being alive leading to playfulness and humor
 - Downside: Intense emotion may rule the day, leading to impulsivity, moodiness, and extreme reactivity
- ***Creative exploration*** – new conceptual thinking and abstract reasoning abilities; pushing away from the status quo
 - Upside: innovation
 - Downside: identity crises, vulnerability to peer pressure, and a lack of direction and purpose

The Balancing Act

- Making the push for independence, the drive for reward, and the passion for novelty result in positive outcomes in life



“You cannot stop a waterfall, but you can learn to direct its course and harness its power” – Dan Siegel



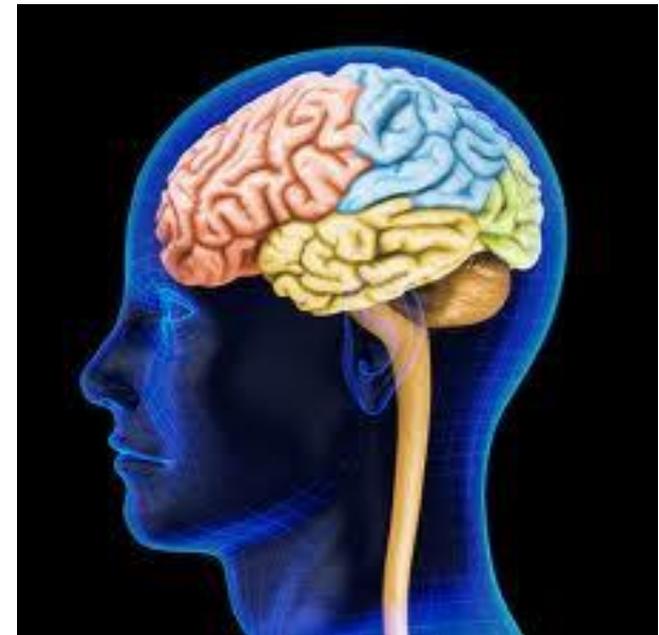
BRAIN BASICS

Basic Brain Facts

- The brain is plastic and experience dependent– it changes in response to experience
 - Adolescence is the *last* period of heightened plasticity
 - More malleable to positive and negative environmental influences
- The brain develops hierarchically (bottom up)
 - Hand model of the brain
 - <http://www.youtube.com/watch?v=LiyaSr5aeho>
(10:45-18:00)

Brain Stem

- Well developed at birth
- Controls automatic process (e.g., sleep/wake, appetite, temperature, etc.)
- When threatened, brain stem activates a reactive response -- one of 4 Fs – fight, flight, freeze, faint
- When safe, brain activates receptivity – open to learning and communicating



Limbic

- 5 Limbic Functions
 - Creates emotion
 - Motivation
 - Evaluation (good/bad)
 - Memory
 - Attachment
 - Seen
 - Safe
 - Soothe
 - Security



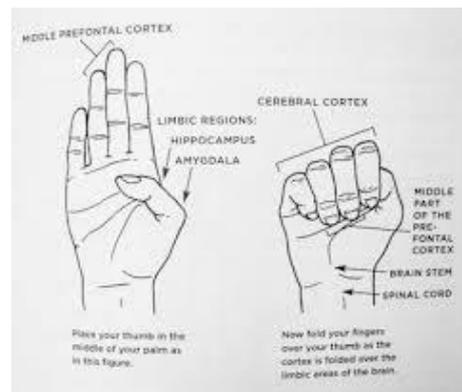
Cortex

- Responsible for high level cognitions (i.e., executive functioning)
 - Planning
 - Decision making
 - Inhibiting inappropriate behavior
- Map making area
 - Me (e.g., self-awareness)
 - You (e.g., other awareness)
 - We (e.g., interpersonal awareness)



Application

- Practice explaining the hand model of the brain to a partner (handout)
- Being Mindful
 - <https://www.youtube.com/watch?v=mkNMjiBpDjE>



Basic Brain Facts

- Use it or lose it
 - The more often you activate a particular brain circuit, the stronger it becomes – rarely activated circuits get pruned (i.e., axons retract, spines die off, synapses disappear)
- Implicit vs. explicit memory
 - Implicit memory filters our perceptions, behavioral impulses, thinking, feeling . . . and is generally automatic
- The brain is a social organ
 - Innate drive to connect with others and belong to social groups

Remodeling

- Pruning
 - Brain is becoming more specialized; unneeded or unused circuits die
 - Decreases in gray matter (e.g., synaptic connections); peaks in girls by age 11, boys age 14
- Myelination
 - Insulation around nerve fibers that increase speed of communication between neurons
 - Important synaptic connections strengthened



Developmental Progression

1. Limbic system more easily aroused – heightened emotionality, sensitivity to evaluation, and sensation seeking.

2. Prefrontal cortex more organized – improved decision making, problem solving, and planning,

3. Increased interconnection between limbic and cortex regions - improved self-regulation, inhibition of impulses, and long-term thinking.

* Note: Parts of the brain responsible for pleasure seeking/reward (limbic) myelinate faster than inhibitory circuits (cortex).

(Casey, Getz, & Galvan, 2008; Steinberg, 2014; Woodford, 2012)

Adolescent Brain Sensitivities

- More sensitive to rewards
 - **Dopamine receptors** (that play a critical role in affective and motivational regulation) **increase during adolescence when engaging in pleasurable activities** (peaking around the age of 16) – nothing will ever feel as good as it did when you were a teenager (Steinberg, 2014)
 - Dopamine levels are actually lower at base level – leading to increased feelings of boredom, drive to experience new activities (Siegel, 2013)
- More sensitive to stress
 - Stress impacts us all; however the impact is greater when the brain structures required for self-control and regulation are under construction
 - Average age of onset for serious mental health problems (e.g., mood, anxiety, substance use, eating disorders, schizophrenia), is 14 (Steinberg, 2014)



Reliance on Peers

- Heightened activation of limbic, paralimbic, and medial prefrontal areas; increases in gonadal steroids on proliferation of receptors for oxytocin
 - Increased reliance on peers to meet attachment needs
 - Adolescents pay more attention to other people's expressions, thoughts, feelings, and opinions than adults
 - rejection is more painful to adolescents.
 - More likely to interpret neutral faces/statements as hostile.
- Overlap between the neural circuits that mediate social information processing and reward processing
 - Capacity for self-control and good judgment is dependent on environmental circumstances
 - Adolescents make poorer decisions when they are emotionally or socially aroused – **presence of peers means more risk taking** –

(Romer, 2010; Steinberg, 2008; 2014)



Adolescent Brain Facts

- Sleep
 - Melatonin is released 2hrs. Later in teens (and stays in your system later)
 - Adolescents need an average of 9-10 hours of sleep per night
 - Allows for memory consolidation (turning learning into longer term knowledge)
- Insufficient Sleep
 - Aggression
 - Impatience
 - Impulsive and inappropriate behavior
 - Low self-esteem
 - Impairment in learning
 - Inhibition of creativity
 - Slowing of problem solving skills
 - Poor memory
 - Acne
 - Overeating
 - Injuries
 - Illness



Impact of Substance Use on the Adolescent Brain

- Adolescent brain is more vulnerable to effects of substances
 - Impacts last longer
 - Greater doses of dopamine released in nucleus accumbens and dorsolateral stratum
- Drug use stalls hippocampi growth for up to **6 months**
 - Impacts regulation of mood and memory (Bosworth, 2012)
 - Example, just three “hits” of marijuana in one week stops hippocampi growth for six months
- Drug and alcohol use in early adolescence permanently affects the way the brain’s reward system functions (Bava & Tapert, 2010)
 - Changes in the prefrontal cortex and hippocampus lead to deficits in attention, memory, and executive functioning
 - Predisposes to psychotic and mood disorders
- Early substance use linked to problematic use in adulthood
 - Adolescents move from experimentation to daily use faster
 - People who drink alcohol before the age of 14 are *seven times* more likely to binge drink as teenagers and *five times* more likely to develop a substance use disorder later in life (Steinberg, 2014)

Other Influential Factors

- Parenting
 - Authoritarian parenting style (e.g., warm, firm, supportive) associated with positive adolescent outcomes
 - Secure attachment linked with positive outcomes
- Early childhood stress
 - Early childhood stress (e.g., neglect, abuse, chaotic/unpredictable caregiving, etc.) is linked to deficits in brain development
 - The more adverse childhood experiences (ACEs), the greater likelihood for risky behavior in adolescence – impulsivity argument -- impact of pruning (e.g., if you start out with only 1500 neural connections btw. Cortex and Limbic area b/f adolescence, pruning will decrease to 750 – not enough)
- Temperament
 - Adolescents with a natural tendency towards anxiety and fear show decreased risk taking behavior
 - Adolescents with a natural tendency towards impulsive behavior show increased risk taking

(Bava & Tapert, 2010; Romer, 2010; Steinberg, 2014)



Summary

Process of Pruning and Myelination

Heightened Limbic Arousal

Non-integrated
Cortex Region

Fluctuating
Dopamine Levels

Increased
External
Stressors

Heightened
plasticity



IMPLICATIONS FOR PREVENTION AND INTERVENTION

What is NOT working?

- Educational programs geared towards risks/costs of risky behavior
 - May increase knowledge, but this knowledge does not translate to significant behavioral changes
 - Adolescents typically know the risks, but due to hyper-rational thinking, minimize



(Steinberg 2008, 2014)

Encouraging Neuroplasticity

The Healthy Mind Platter



The Healthy Mind Platter, for Optimal Brain Matter

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Implications for Prevention

- Early intervention programs that help parents reduce stress and learn good parenting practices have been shown to reduce adolescents' risky behavior, improve grades in school, and have fewer psychiatric symptoms (Romer, 2010)
 - Youth who engage in early risk taking exhibit higher levels of impulsive behavior as early as age 3 (acting without thinking, sensation seeking)
- Parent education
 - Youth Prevention Survey: 5-16% of students reported that their parents hosted parties for them that included alcohol, meaning that approximately 632-2024 adults overtly condone adolescent alcohol use
 - **Distribute and discuss educational pamphlet**
- Parental involvement
 - Help parents recognize normal development so they do not take emotionality and push back so personal
 - Counselor- hosted book clubs (e.g., North Junior High in Boise)

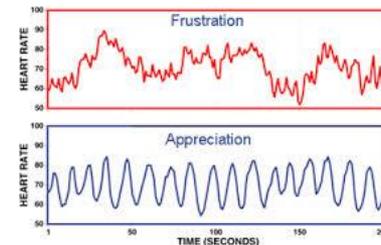
(Siegel, 2013; Woodford, 2012)

Implications for Prevention

- Find ways for adolescents to take healthy risks
- Help adolescents find new, creative outlets for emotional expression
- Notice good behavior and offer positive rewards
- Talk through decision making
- Set appropriate boundaries
- Connect before you correct; instilling a sense of safety and acceptance will increase adolescents' capacity for truly hearing you
- Avoid trying to “teach” adolescents when they are flooded with emotions; instead, focus on grounding techniques and save the talk for later

Implications for Prevention

- Focus programs on enhancing adolescents' general capacity for self-regulation
 - Mindsight skills (e.g., mindfulness, gaining self-awareness)
 - Aerobic exercise and sleep
 - SAFE SEL (social and emotional learning curricula – Collaborative for Academic, Social, and Emotional Learning (CASEL))
 - HeartMath tools





Implications for Intervention

- Empower adolescents in their passions
 - Explore values and meaning
 - Redirect risky behavior into less risky/ socially sanctioned activities
- Engage in neuroeducation
 - According to the 2014 Youth Prevention Survey, 45% of Idaho HS Seniors did not believe having one to two alcoholic drinks per day was a problem
 - Help adolescents understand brain development (“name it to tame it”)



Implications for Intervention

- One task at a time
 - Don't overwhelm with instructions or have the expectation that they should multitask
 - Give instructions in written and oral formats
 - Teach ways to manage time and tasks (the more practice, the better)
- Encourage collaboration
 - Fulfill need for social engagement in constructive ways
 - Change the culture around adolescence to foster collaboration between adolescents and adults in their life
- Limit opportunities for judgment to have harmful consequences
 - Importance of parental monitoring
 - Importance of **structured** group activities (e.g., sports, YMCA, etc.)
 - Public policies regarding price of cigarettes, enforcing laws restricting sales of alcohol to minors, raising the driving age, and expanding access to mental health services



Reflecting and Responding

- In small groups, brainstorm ways that knowledge of the neuroscience of adolescence can influence your prevention and intervention efforts.



Questions





Media Resources

- <http://www.youtube.com/watch?v=kH-BO1rJXbQ>
 - 1 ½ hour talk by Dan Siegel on adolescent brain development – based on Brainstorm
- http://www.ted.com/talks/sarah_jayne_blakemore_the_mysterious_workings_of_the_adolescent_brain
 - 14 minute TED talk on adolescent brain development
- http://www.youtube.com/watch?v=g2gVzVIBc_g
 - 5 minutes animation – nice for psychoeducation with adolescents
- <http://www.youtube.com/watch?v=XZEU08BVV6o>
 - Dr. Bosworth (2012) lecture to adolescents on how drug abuse affects teenage brain development
- <http://www.pbs.org/wgbh/pages/frontline/shows/teenbrain/view/>



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- Youth Prevention Survey (2014) http://www.sde.idaho.gov/site/safe_drugfree/docs/IdahoYouthPreventionSurveyReport_2014.pdf



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THANK YOU