

Adolescence is a “sensitive period” for dev of SUD

- The surge in gonadal hormones which trigger the development of secondary sexual characteristics exert profound effects on brain structure and cognition
- These developments predispose teens to **approach, explore and take risks leading many to experiment with drugs**
- Chronic drug use during adolescence results in repeated activation of neural circuits during this formative period and may produce long lasting adverse alterations in brain function
- Teenage brain is “under construction” and at high risk for substances to permanently “hijack” neurodevelopment
- Prevention and early intervention are critically important

Puberty and Socioemotional Control

E.H. Telzer / *Developmental Cognitive Neuroscience* 17 (2016) 57–67

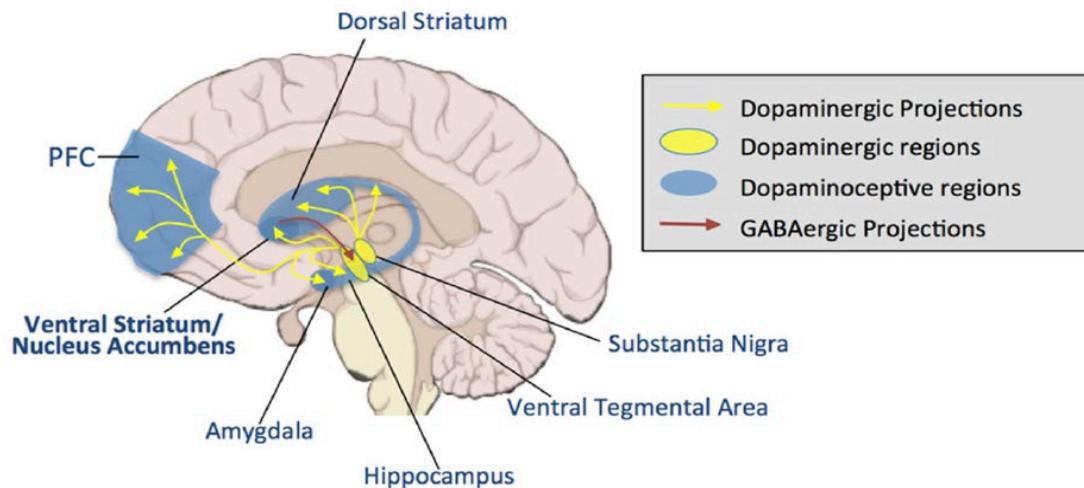


Fig. 1. Dopaminergic pathways in the brain.

Diffuse temporal cortical changes (temporoparietal junction, anterior temporal cortex)

– social cognition and peer relations

- Puberty triggers non linear decrease in grey matter with linear increase in white matter
 - pruning plus improved signaling
- Changes stabilizes in early 20s
- Puberty brings a shift in social affiliation from parents to peers, peer influence peaks in mid adolescence then wanes in adulthood

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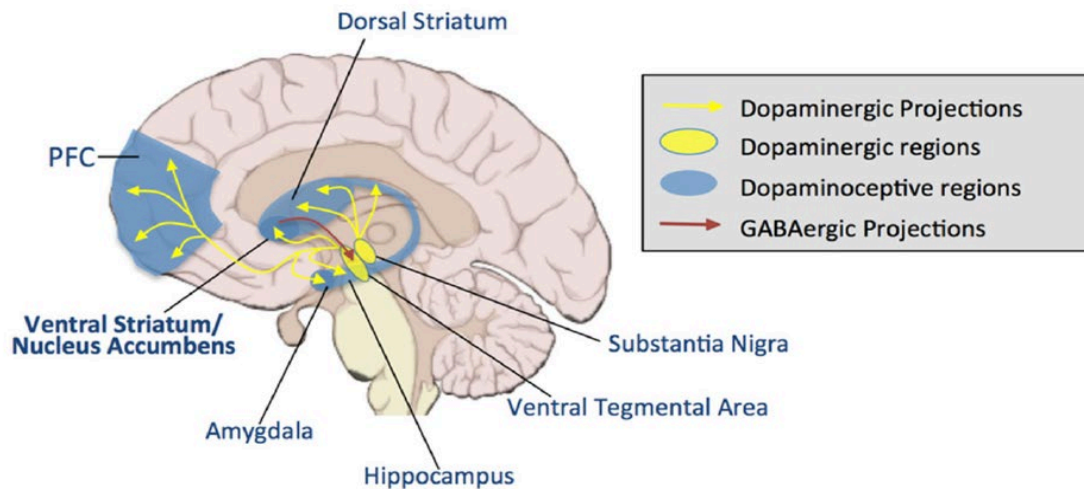


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Basal Ganglia (VS and Nac) - motivation to pursue rewards, novel situations and intense sensations

- Puberty brings marked decrease in volume secondary to pruning
- fMRI activity suggests increasing efficiency and influence
- Puberty associated with sensation seeking, immediate gratification and risk taking

Rudolph MD et al. *At risk of being risky: The relationship between "brain age" under emotional states and risk preference.* *Dev Cog NeuroSc.* 24 (2017) p 93-106

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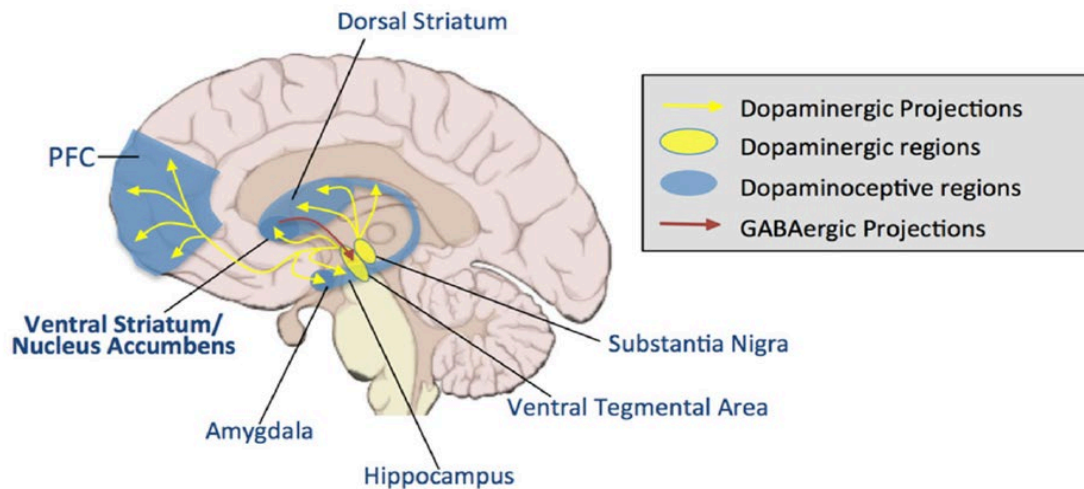


Fig. 1. Dopaminergic pathways in the brain.

Amygdala - emotion, anxiety, fear and depression

- Puberty induces marked increase in volume + increased cortical connections
- Puberty brings an increased influence of emotion on decision making - diminishes in adulthood

Cognitive Control

E.H. Telzer / *Developmental Cognitive Neuroscience* 17 (2016) 57–67

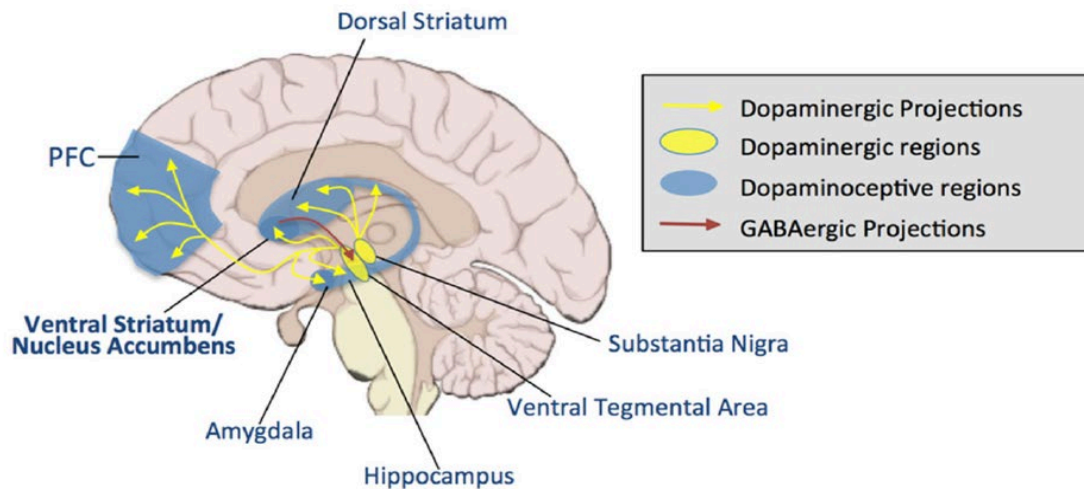


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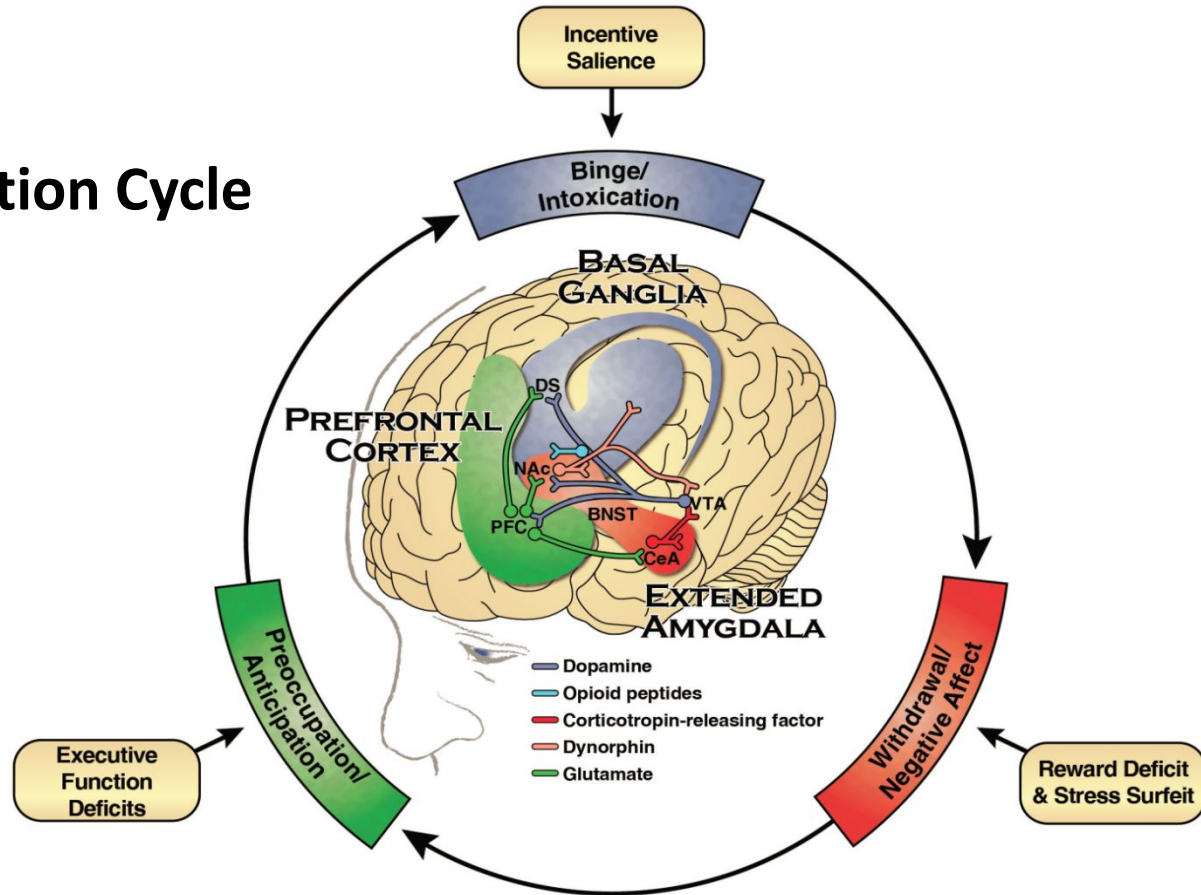
Prefrontal Cortex (PFC)- executive control, impulse and response inhibition, attention regulation, emotional regulation and planning

- Largely independent of pubertal hormones
- Develops in a slow, linear fashion
- Not fully developed until mid to late twenties

Neurobiology of Substance Use, Misuse and Addiction

The Surgeon General's Report on Alcohol, Drugs, and Health. Washington, DC: HHS, November 2016

Addiction Cycle



Evolving adolescent brain is particularly vulnerable

Cognitive Imbalance

- Pubertal surge in socioemotional brain
- Overwhelms slow, non hormonal, linear path of cognitive control
- Adult reasoning once cognitive control and socioemotional rebalance

E.P. Shulman et al. / Developmental Cognitive Neuroscience 17 (2016) 103–117

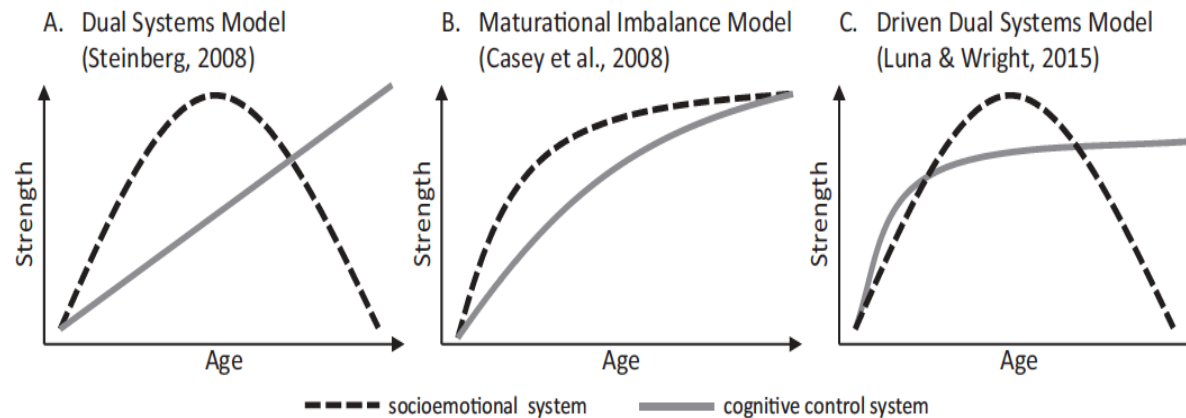


Fig. 1. Alternative theoretical models of the development of the socioemotional (reward processing) and cognitive control systems from about age 10 to age 25.

Control imbalance , not ignorance, influences behaviour
Can chronic drug induce permanent imbalance?

Adolescence “sensitive period” for dev of SUD

*Sensitive periods for substance abuse: Early risk for the transition to dependence.
Developmental Cognitive Neuroscience 25(2017) 29-44*

- Many teens experiment with substances of abuse
- 5-15% of teens who initiate substance use develop SUD
- Each year of delay (13-21 yrs) drops risk of SUD by 4-5%
- **Preventing and/or delaying chronic drug use, and early intervention for problematic drug use, is vital**