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Adolescents, brain development and alcohol

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The brain

We are learning more about the brain all the time ...

- weighs 1300-1400 grams
- approximately 100 billion neurons and one trillion supporting cells
- neurons grow and organize into efficient systems operating for life
- controls all activities and never stops adapting and changing
- by around 12 years, a child's brain has the size, folding, weight and regional specialization of an adult's ... but it's different!



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Adolescent brain: what do we know?



Adolescent brains are far less developed than we once thought

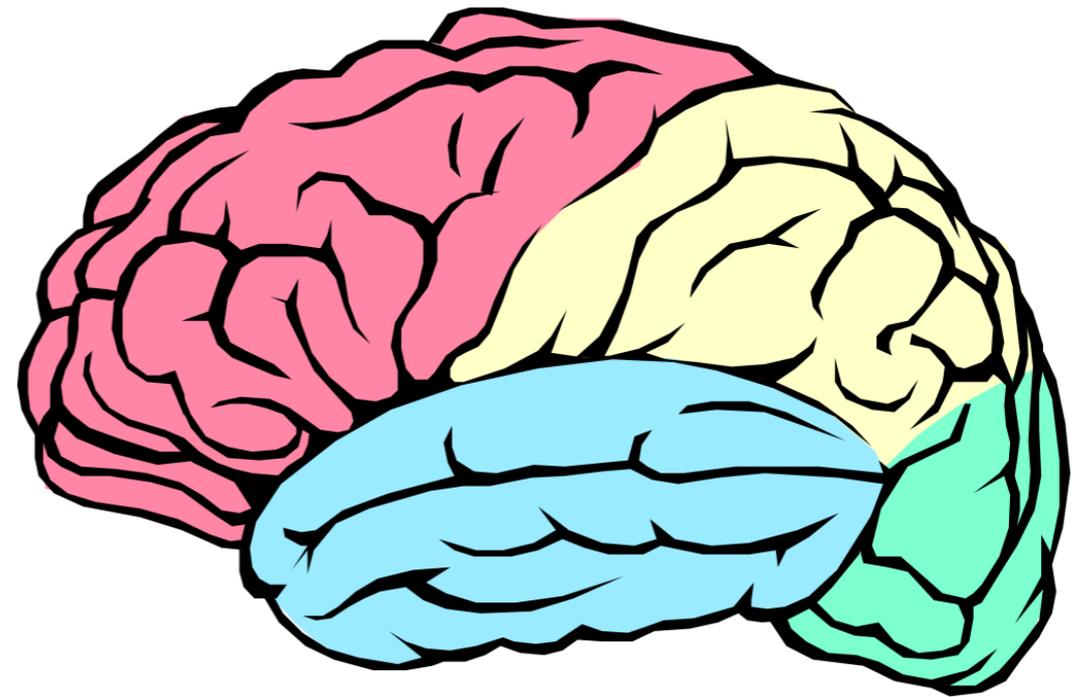
Underdevelopment of the frontal lobe, prefrontal cortex and the limbic system make adolescents more likely to behave emotionally or with 'gut reactions'

Adolescents tend to use an alternative part of their brain - the amygdala (emotions) rather than the prefrontal cortex (reasoning) to process information

- **a decrease in reasoned thinking and an increase in impulsiveness**



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The development of the brain

Brain development occurs in two main stages

- growth spurts and overproduction of neurons
- pruning

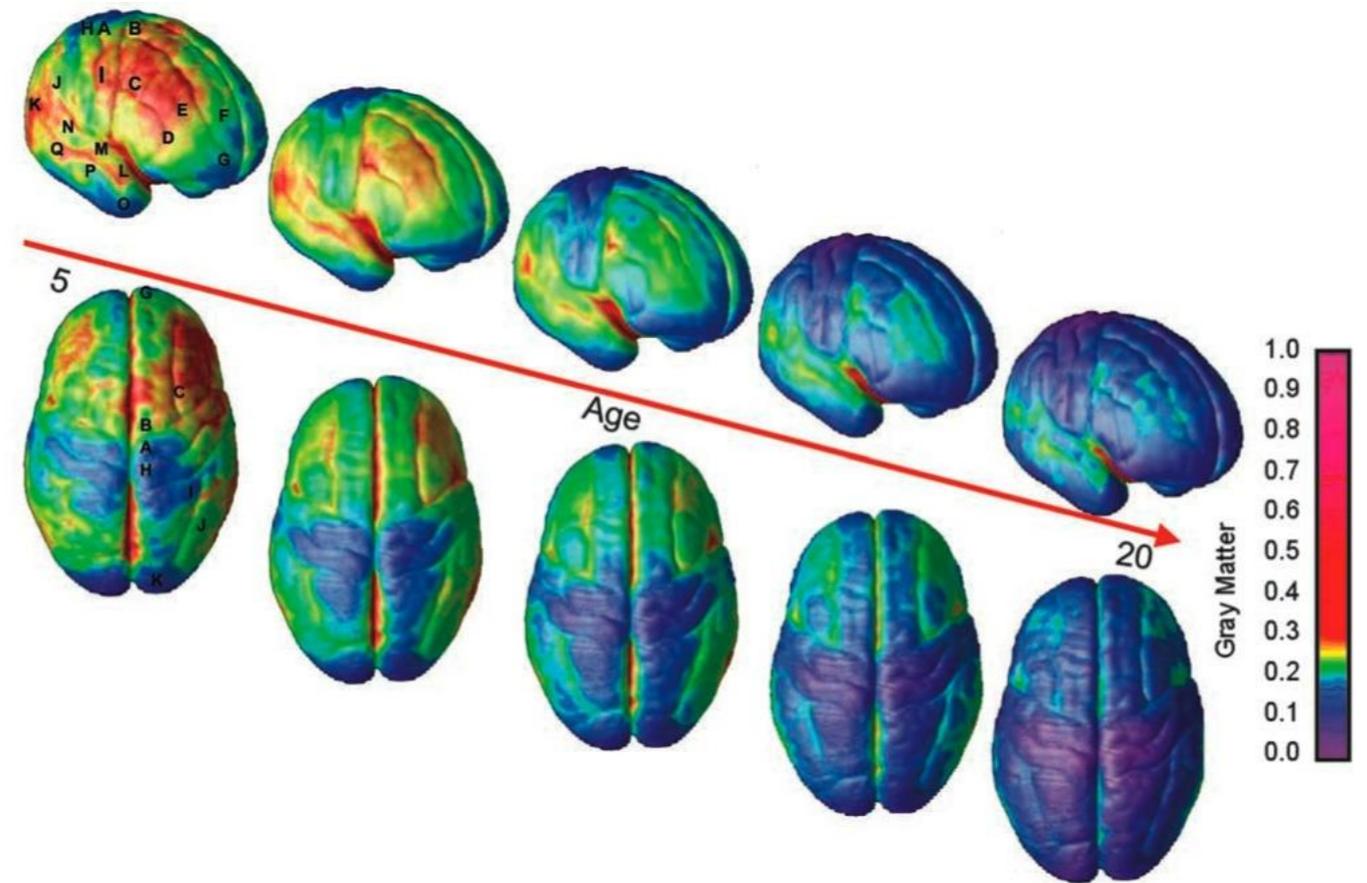
Critical growth phases take place at the following times

- in utero
- 0-3 years - overproduction period
- 10-13 years

Overproduction results in significant increase in number of neurons and synapses - giving the brain enormous potential



The development of the brain



The brain then **prunes** and organizes its neural pathways

- learning is a process of creating and strengthening frequently used synapses
- discarding unused synapses, keeping only the most efficient
- young people get to decide which flourish and which are pruned

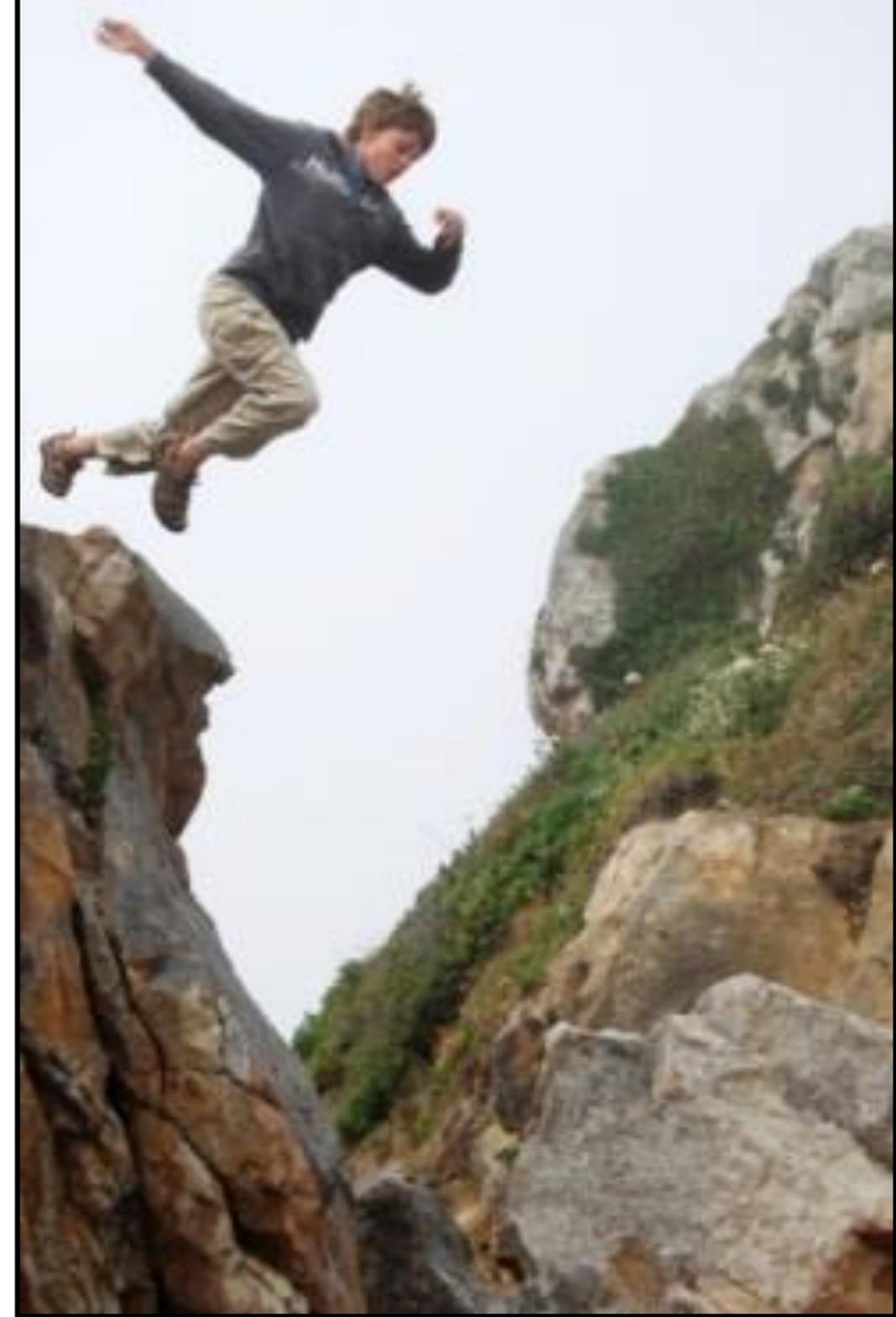
'Use it or lose it' - whatever an adolescent is doing at this time will result in those synapses being retained

- how teens spend their time is crucial to brain development
- their activities guide the structure of the brain

Adolescent brain: Implications for young people

The frontal lobe immaturity results in the following:

- poor judgment and difficulty thinking through consequences of behaviour
- increased risk-taking; inappropriate actions not as inhibited as in adults
- impulsive and emotional responses rather than logical and practical ones
- miscommunication with peers and adults -they miss subtle social cues, misinterpret expectations, and misread facial expressions

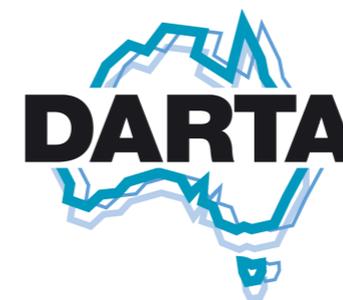


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What does 'increased risk taking' actually mean?

Adolescents take more chances during this time of their life than any other – are they just being 'stupid' and 'reckless'?

- they take more risks not because they don't understand the dangers but because **they weigh risk reward differently** – in situations where risks can get them something they want, they value the reward more heavily than adults do
- 'they don't downgrade the risk, they give more weight to the payoff'
- this contradicts basic human behavior of survival – why does this happen?



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Increased risk taking is important



This is an evolutionary feature – young people need to 'engage in high-risk behavior to leave the village and find a mate'

This behavior is not exclusive to humans – adolescence is a time of 'risky business' for rodents, primates and even some birds – they seek out same-age peers and fight with parents – which 'all help get the adolescent away from home territory

Difficult to fight the biology of risk taking and to take on different identities – these are good and necessary things – need to find creative, positive outlets



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Adolescent brain: Implications for those working with young people



Young people do not take information, organise it and understand it in the same way adults do - they have to learn how to

- ❑ to appreciate consequences, one needs the ability to think through potential outcomes and understand permanence of consequences
- ❑ adolescents cannot do this effectively

Common sense or adult warnings are often not heeded as they simply may not be able to understand and or accept reasons that make sense to adults

Should we be providing alcohol to young people?

The DrinkWise advertisement targets parents, encouraging them to try to delay their child's first drink for as long as possible

- ❑ should parents provide their children with alcohol - is a sip problematic?
- ❑ will parents providing the alcohol prevent them from risky drinking in the future?
- ❑ new research has provided us brand new information that gives us a much better idea of how a developing brain is affected by alcohol



What does alcohol do to the brain?

Like other drugs, alcohol produces its effects by altering the actions of neurotransmitters

- modifies actions of two major neurotransmitters – GABA and glutamate
- these found throughout the brain – hence alcohol has widespread effects on behavior – i.e., intoxication
- greater effect on developing areas of the brain, compared to those fully developed – evidence suggests that the damage could be permanent



What does alcohol do to the brain?

Studies provide direct evidence that exposure to alcohol at intoxicating levels during adolescence produces permanent brain changes

'Plasticity' describes the brain's ability to physically change its internal structure when we learn new things

- during peaks of plasticity the brain must make key neural connections to wire us to become fully functioning adults
- drinking alcohol during peak periods of plasticity seriously damages 'brain wiring'

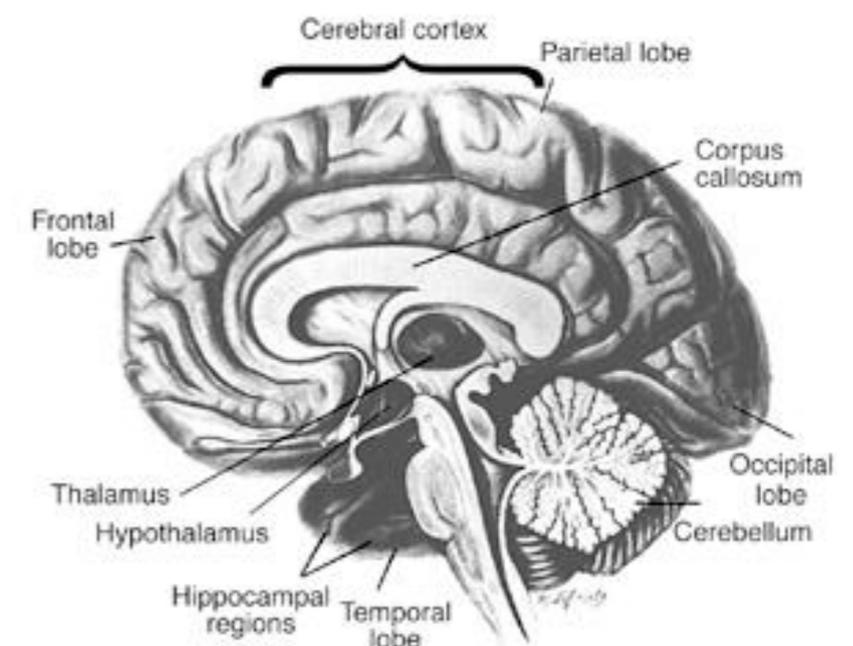


Alcohol and the developing brain

Alcohol damages two areas of the brain that undergo major changes in adolescence

- ❑ the **hippocampus** deals with memory and learning - suffers the worst damage. Those who drink more and for longer have significantly smaller hippocampi (up to 10% smaller)
- ❑ the **prefrontal area** undergoes most change during adolescence - teen drinking could cause severe changes, affecting the formation of adult personality and behaviour

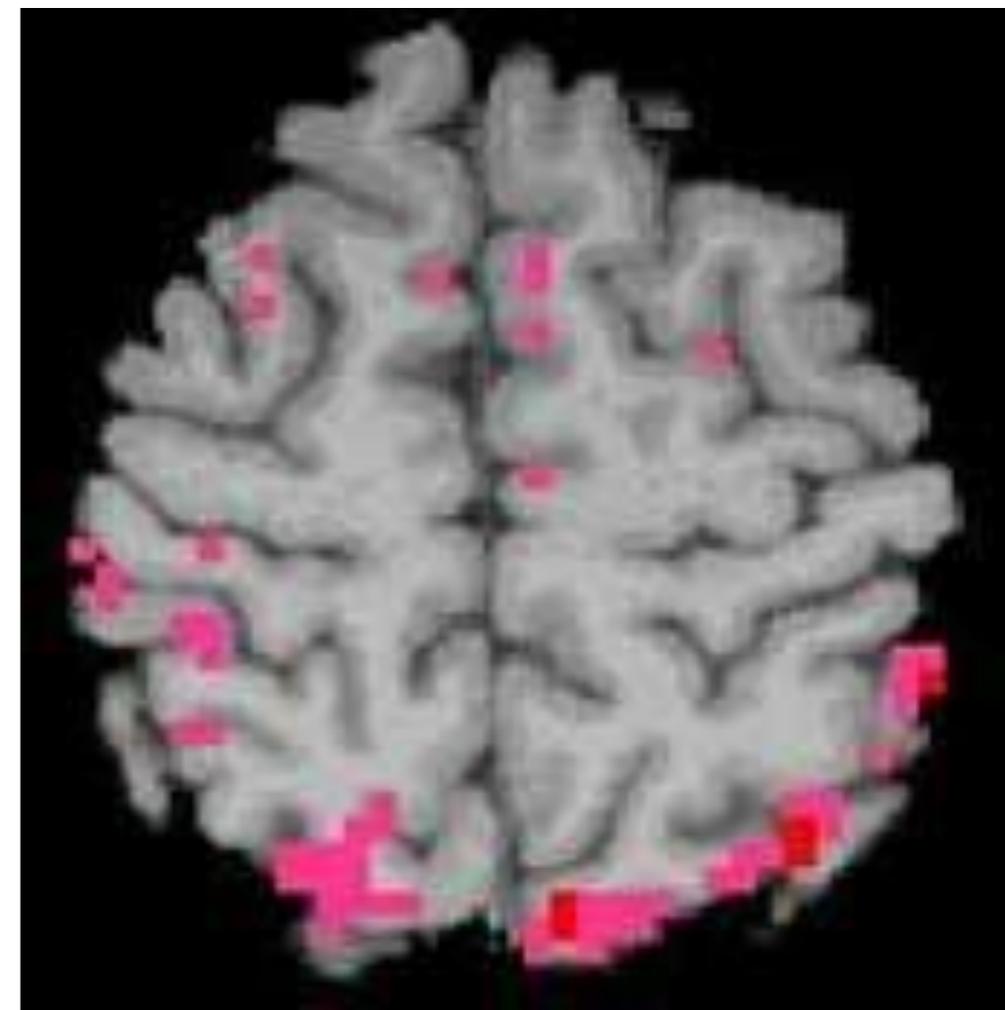
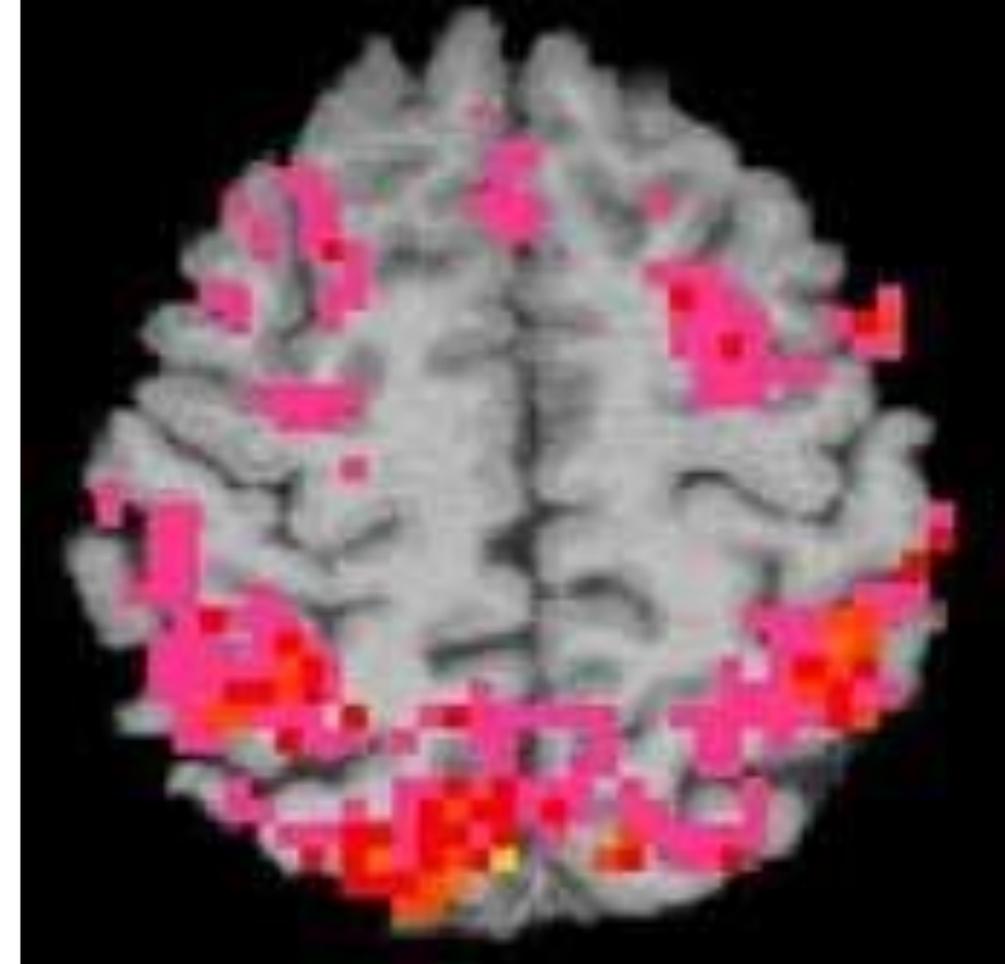
If a young person is going to drink alcohol at this time - need to make sure it is a small amount and that they do not drink regularly. However, the evidence clearly indicates **that they should not drink at all**



Alcohol and the developing brain

These brain scans show the possible impact that alcohol can have on the adolescent brain

- the first shows a 15 year-old non-drinker - the pink and orange indicates healthy activity, particularly in the prefrontal area and the hippocampus
- the bottom one shows a 15 year-old heavy drinker - an unhealthy brain with little or no activity in the key areas





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Different effects of alcohol on the adult and adolescent brain

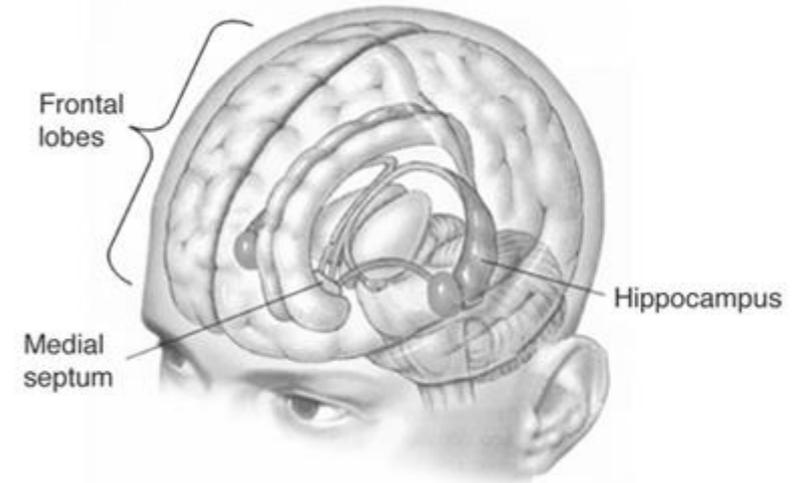
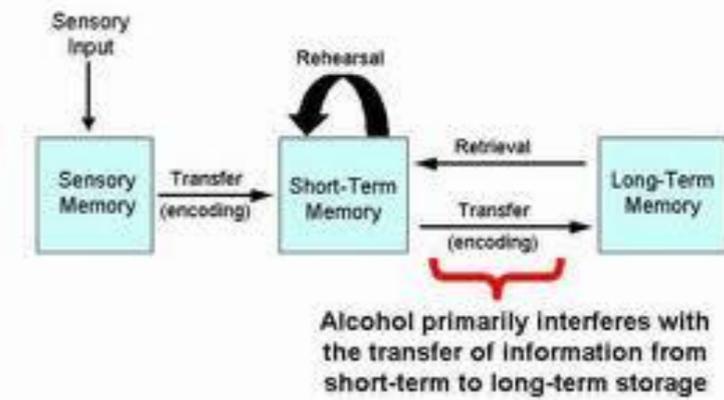


For a given amount of alcohol, adolescents are more susceptible than adults to some effects, but less susceptible to others

- more susceptible to effects relating to memory and learning (e.g., blackouts)
- less likely to be affected by the sedative effects caused by alcohol



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Different effects: Blackouts

Young people are far more likely to experience complete absence of memory with no possibility of retrieval

- due to effects of high alcohol concentrations on brain centres related to memory (particularly the hippocampus)
- uncommon in adults, but relatively common among adolescents
- consistent with greater susceptibility of adolescent memory centres to disruptive effects of alcohol



Different effects: Sedation

Young people are able to drink for longer than adults due to them being less susceptible to the sedation effect

- ❑ brain mechanism of this effect not known, likely that it has to do with GABA
- ❑ GABA system implicated in alcohol's sedative and motor-impairing effects
- ❑ final levels of GABA receptors are not reached until early adulthood - adolescents have fewer GABA receptors on which alcohol can act
- ❑ reach a certain age (i.e., early 20s), you just can't quite drink the way you used to



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What are the implications for young people?



Research shows that young people are able to drink more alcohol without sedative effects and experience memory 'blackouts' – this increases the risk of the following:

- ❑ young women – sexual assault
- ❑ young men – robbery and violence

How are we responding to this?



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So what are the takeaway messages?



The adolescent brain is different from an adult brain

The messages we provide to adolescents need to be age appropriate and be meaningful to them – messages around risks are not necessarily going to be heeded – the rewards are too great

Alcohol and the developing brain do not go together – delay, delay, delay ...

Harm reduction alcohol messages - practical - ideally should involve looking after friends, remembering that they believe 'it won't happen to them'