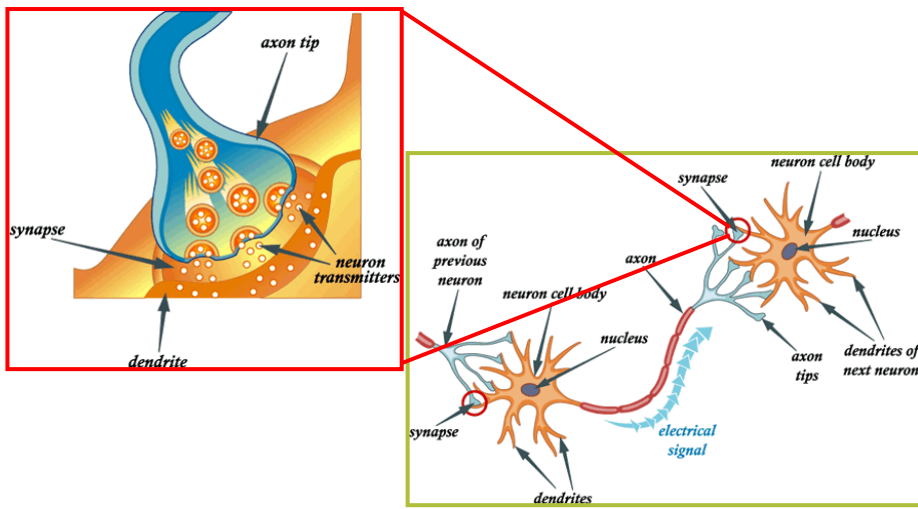


Blame Their Brain!
Why Adolescents Do What They Do!

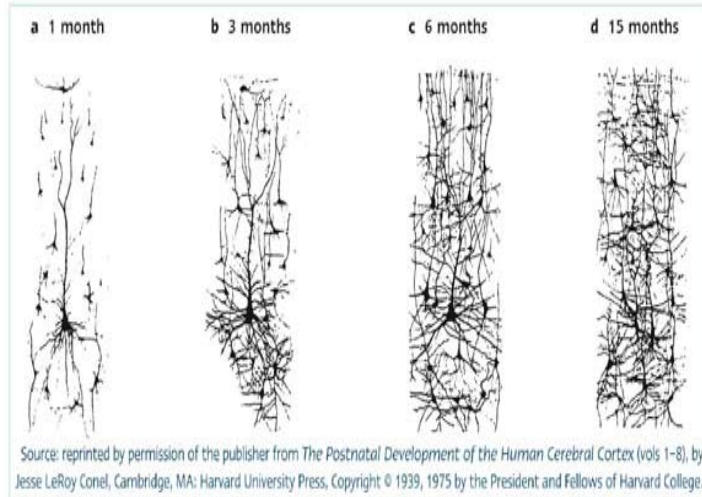
Michael C Nagel PhD
Associate Professor
Human Development and Learning
University of the Sunshine Coast
mnagel@usc.edu.au

Imagining the unimaginable!
The brain has branches!



Imagining the unimaginable! Experience shapes our neural architecture!

A 3 year old child has 3 times the synaptic connections of an adult and will burn 3 times as much glucose!

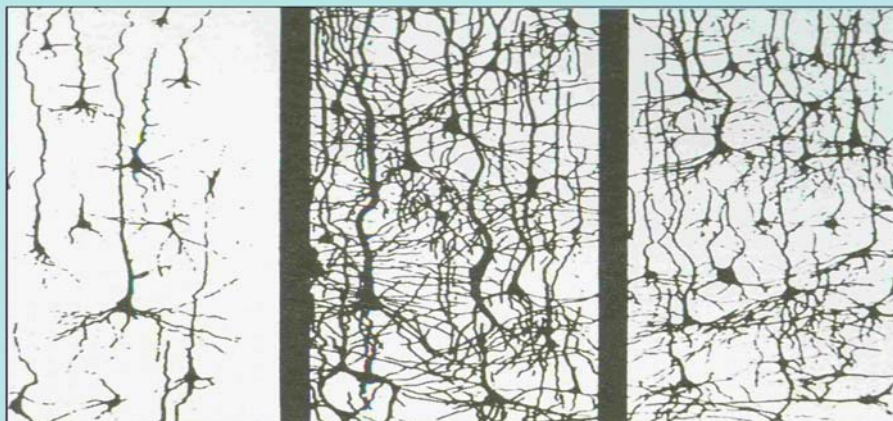


Synaptic Density – Changes Over Time

At Birth

6 Years Old

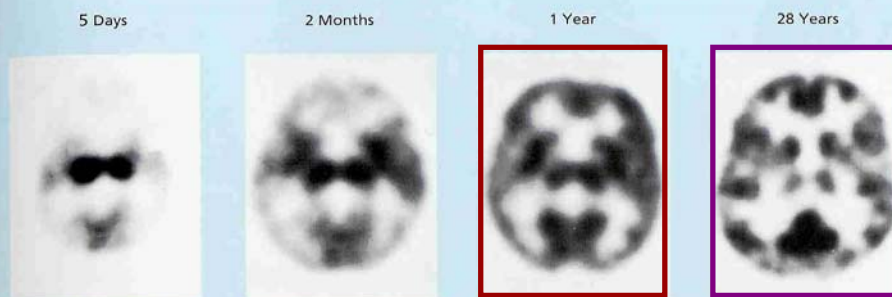
14 Years Old



Rethinking the Brain, Families and Work Institute, Rima Shore, 1997.

Imagining the unimaginable! Your brain changes every day!

During early development and through adolescence, the brain is very susceptible to the environment especially those things which impact on the brain's chemistry. Research tells us that the first three years are incredibly important for neurological development, especially in the emotional regions of the brain.



RAPID EARLY DEVELOPMENT: These PET scans suggest that the brain of a one year old more closely resembles an adult's brain than a newborn's.

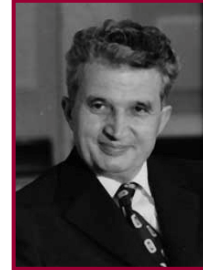
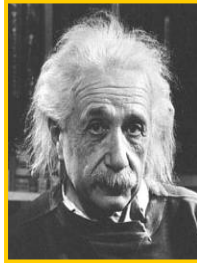
Source: H.T. Chugani

Sensitive Periods in Brain Development

Stimulation is vital when the brain is growing rapidly!

- Experience-Expectant Growth
 - Ordinary experiences "expected" by brain to grow normally
- Experience-Dependent Growth
 - Additional growth as a result of specific learning experiences

**Imagining the unimaginable!
Enrichment does not mean more!**



Deprived environments are of greater concern than worrying about enough stimulation...remember, **Einstein never used flashcards!**

No amount of stimulation, no matter how developmentally sound can inoculate children against the debilitating effects of poor environments they may encounter, such as poor quality schools, dysfunctional homes and neighbourhoods!

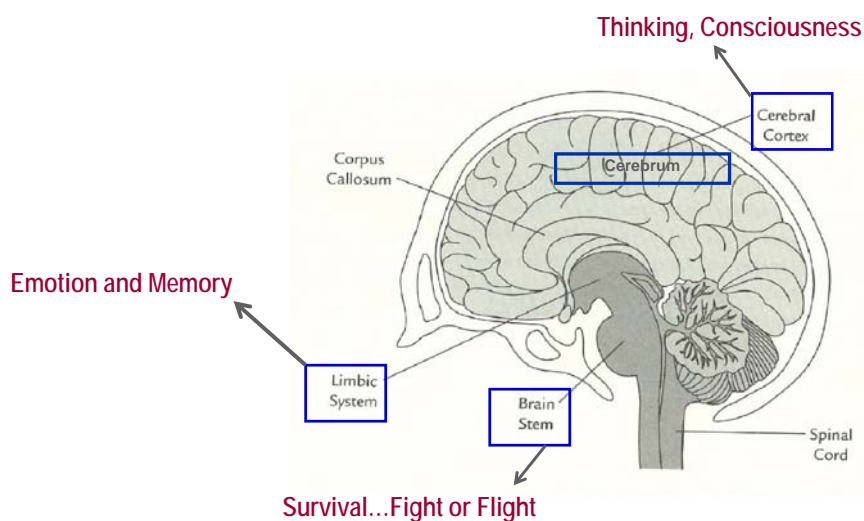
A Take Home Message!

**Brain Development in Early Life
Sets Trajectories for
Development Throughout Life!**

Experiences in the early years of life set neurological and biological pathways that affect:

- **Health**
 - Autonomic Nervous System: Blood pressure, respiration, digestion, salivation, sexual arousal...closely linked to the HPA system.
- **Behaviour**
 - Hypothalamus Pituitary Adrenal Axis (HPA) – regulation of cortisol: Cognition, emotion, behaviour, memory, diabetes, *heart disease!*
- **Learning**
 - Sensing Pathways: Key for language and cognition and play an critical role in vision, sound, touch, etc.

Imagining the unimaginable!



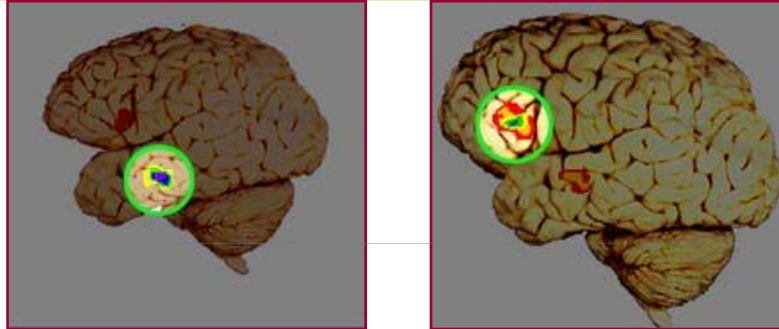
10 things we should remember about today's adolescents!

1. They're decent people
2. They love their friends and music
3. Their tech toys are new means to old ends
4. They've said goodbye to the monoculture
5. Their ties with parents are the best in decades
6. They enjoy school – strain and all
7. Their quality of life is a solid upgrade
8. They're into relationships more than sex
9. They're morally flexible, but some things are no-no's
10. They're post-religious and pre-spiritual – they are finding out who they are in the greater scheme of things



Size doesn't matter!





Adolescents use less of the prefrontal cortex than adults when reading emotions.

Confronted with a feeling, say, somebody looks at them with an expression of fear an adolescent will have more of an emotional response. The part of the brain that has more of that gut reaction will respond to a greater extent than the adult brain will.

One of the implications of this is that the brain is responding differently to the outside world in teenagers compared to adults

What's happening within an adolescent brain?



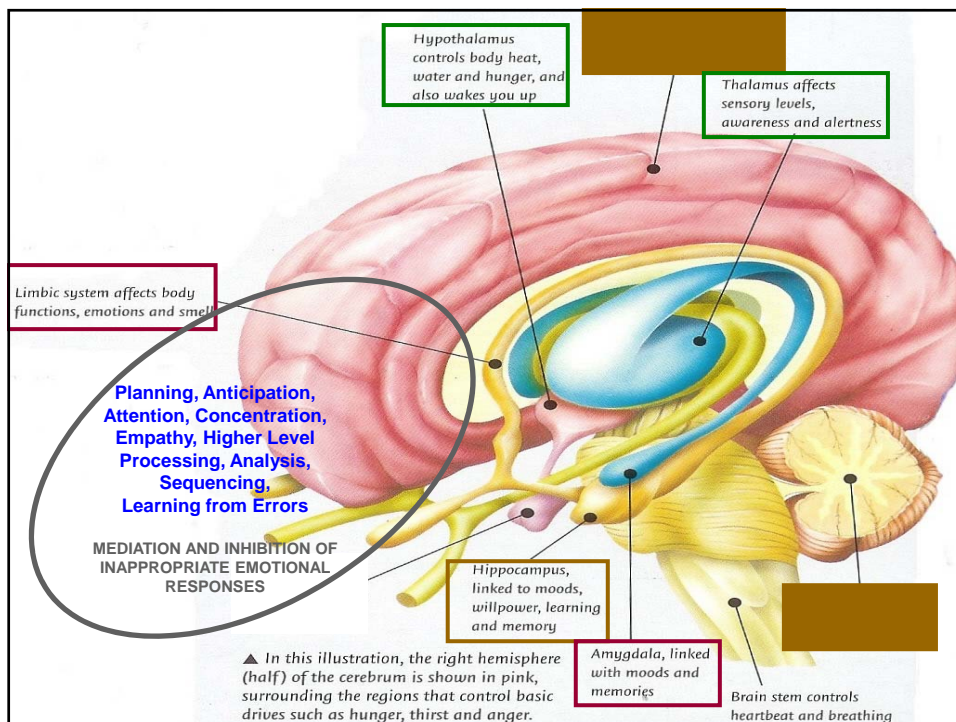
Young adults (age 22-28)



Adolescents (age 12-17)

What's happening within an adolescent brain?

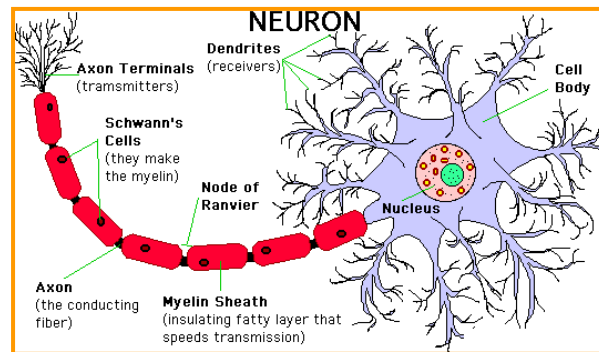
- Structurally
 - Frontal Lobes



What's happening within an adolescent brain?

- Structurally

- Frontal Lobes
- Myelination



What's happening within an adolescent brain?

- Structurally

- Frontal Lobes
- Myelination

- Plasticity

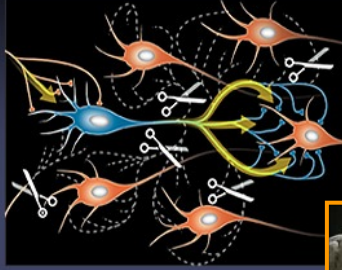
- Altered States (Strauch 2003)
- Synaptic Pruning



Nerve Proliferation... ...and Pruning

■ By age 11 for girls and 12 for boys, the neurons in the front of the brain have formed thousands of new connections. Over the next few years most of these links will be pruned.

■ Those that are used and reinforced — the pathways involved in language, for example — will be strengthened, while the ones that aren't used will die out

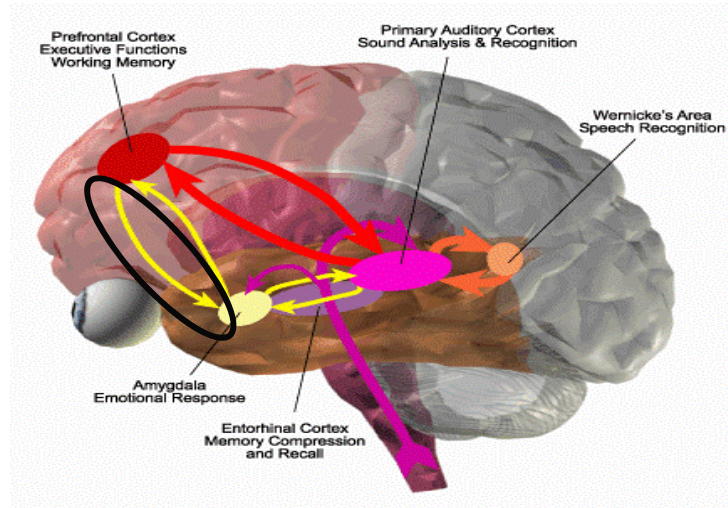


If an adolescent is doing music, sports or academics, those are the connections that will be hard wired. If they're lying on the couch or playing video games or watching MTV, those are the cells and connections that are going to survive.

-J. Giedd (Chief of Brain Imaging – Child Psychiatry Branch, National Institute of Mental Health)



What's happening within an adolescent brain...maturation of feedback loops!



Implications of Arrested Development:

Adolescent Behaviour

Earlier development of the back of the brain and later development of the front of the brain...

- *Preference for physical activity*
- *Less than optimal planning and judgment*
- *More risky, impulsive behaviours*
- *Minimal consideration of negative consequences*
- *Hot wired for emotion!*



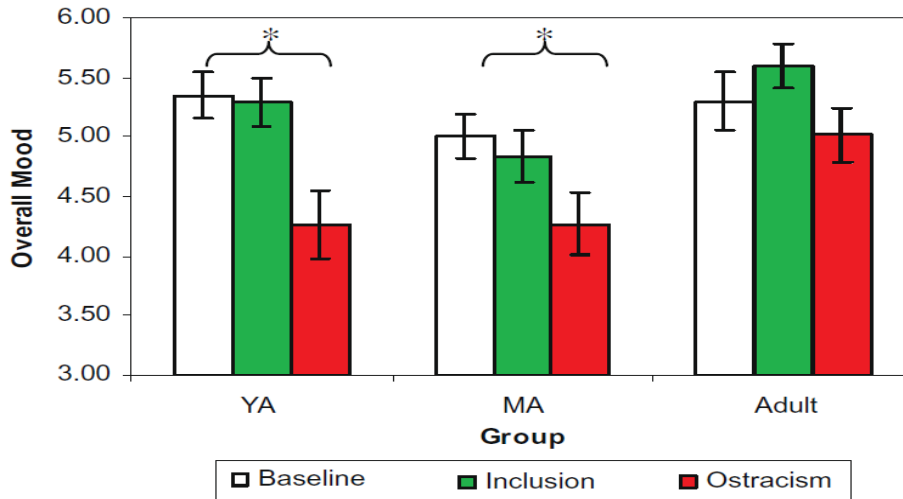
Cyberball Social Rejection Task



The participant is told: - that they will be playing with two other people over the internet - to try and mentally visualise the ball game as much as possible
 N= 26 young adolescents (11-13y), 25 mid-adolescents (14-15y), 26 adults (22-47y)

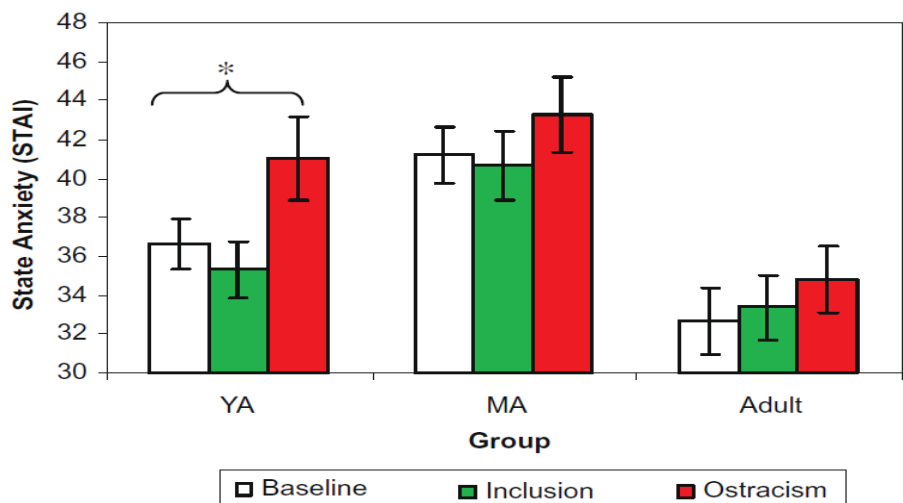
Sebastian, Viding, Williams, Blakemore, *Brain and Cognition* (2010)

Mood worsened more in the young and mid-adolescents than the adults



* Significant at $p < .05$, corrected

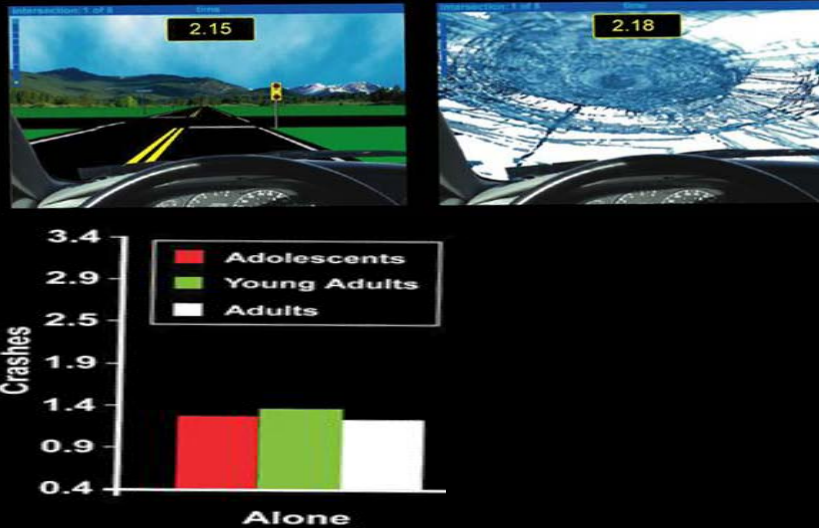
State anxiety worsened in the 12-13 year-olds only



* Significant at $p < .05$, corrected

Hypersensitivity of female adolescents to social exclusion!

More risky impulsive behaviours...



Steinberg et al., (2008)

Animal Data: Alcohol's Effects

When exposed to alcohol, adolescent rats, compared to adult rats, reveal more...

- Disruption in memory
- Impairment of neurotransmission in hippocampus and cortex



Source: Spear, 2002

What's happening within an adolescent brain?

- Structurally

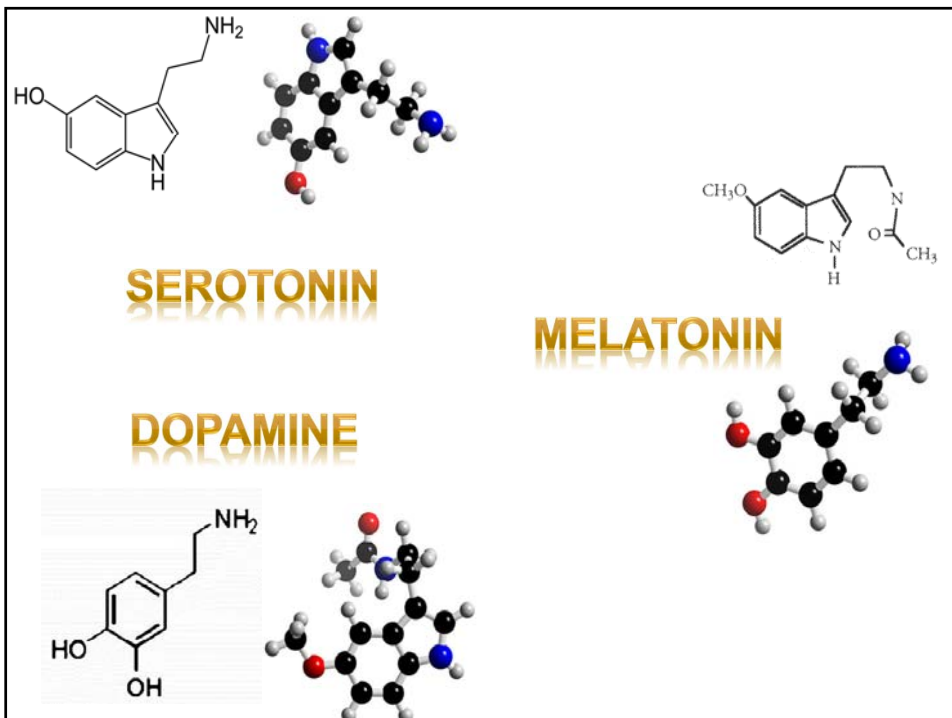
- Frontal Lobes
- Myelination

- Plasticity

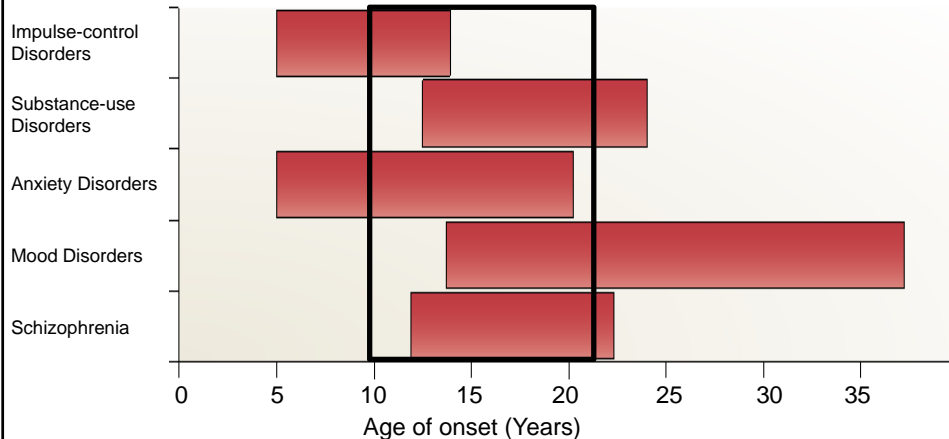
- Altered States (Strauch 2003)
- Synaptic Pruning



Neurotransmitters and Behaviour



Adolescence and mental health



Leading causes of death in adolescence are: 1) accidents, 2) violence and 3) suicide (Patton et al., *The Lancet* (2009))

Some key messages before we move on...

Adolescence is a time of profound change... *focal point...prefrontal lobes*

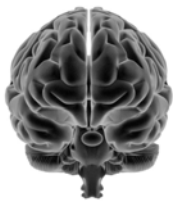
- ✓ Inability to accurately interpret social cues
- ✓ Negative emotions can dominate
- ✓ Heightened sensitivity to rewards
- ✓ Impulsivity and inattention
- ✓ Insensitivity to consequence

- ✓ Not all adolescents are the same but all adolescents will go through the same neuro-maturational process (Young people can do great things...our job is to help them do so!)

Becoming the lighthouse....



Number 1... Understand Sleep!



Sleep is very important during periods of brain maturation!

- Circadian Rhythm Shift – lark to owl
- Increased sleep need
- Increased daytime sleepiness
- Less total sleep time

While many teenagers get **less** sleep than younger children, there is actually an **increase** in sleep needs during the teenage years!



So what can we do?

There are a few first steps, which include:

- Increasing sleep hours by decreasing the amount of stimulating activities late at night (TV, cell phone, computer blue).
- Creating a broader **awareness** of the problem among parents, teachers teens and health providers.

(Dahl et al., 2002; Hansen et al., 2005)

So what can we do?

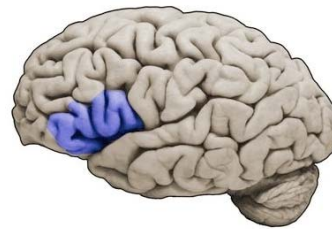
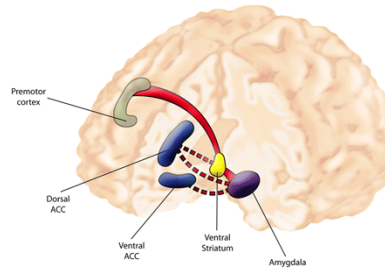
Unfortunately,

many of the things that might help correct the problem involve **BIG** social policy changes:

- **Changing** school curriculum and policy
- **Stopping** early start times in high schools
(some school districts have already done this! – all studies show substantive **POSITIVE** results: less lateness; fewer discipline referrals; better academics; fewer traffic accidents; etc.)

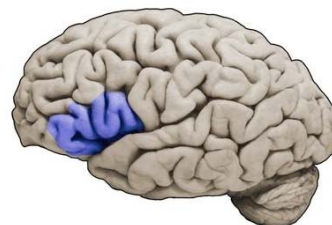
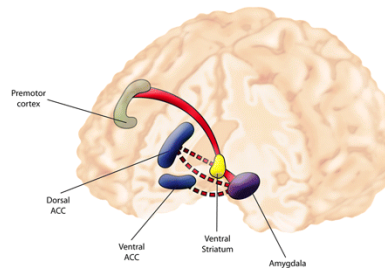
Adolescent Brain and Risk

- Two different but connected brain systems: one for calculating the value of rewards and one for assessing the risks involved in them
- Ventral striatum (highly dopamine sensitive):
 - early teen development and highly active = *bigger responses to immediate rewards*



Adolescent Brain and Risk

- Two different but connected brain systems: one for calculating the value of rewards and one for assessing the risks involved in them
- Ventral striatum (highly dopamine sensitive):
 - early teen development and highly active = *bigger responses to immediate rewards*
- Inferior frontal gyrus: late development (mid – 20ties) helps us evaluate conflicting impulses (holds back short term reward for more important long term rewards)...
 - *we become more circumspect as we age!*
- Teen Brain: ascendancy of the ventral striatum over the inferior frontal gyrus...
 - *heart over head – but both are in the brain*



Motivation: "its complicated"

There also appear to be differences in the relative effects of reward and punishment in youth compared to adults on modification of behaviors

AND... it seems that punishment may have less of a behavioral impact than rewards for teens ...

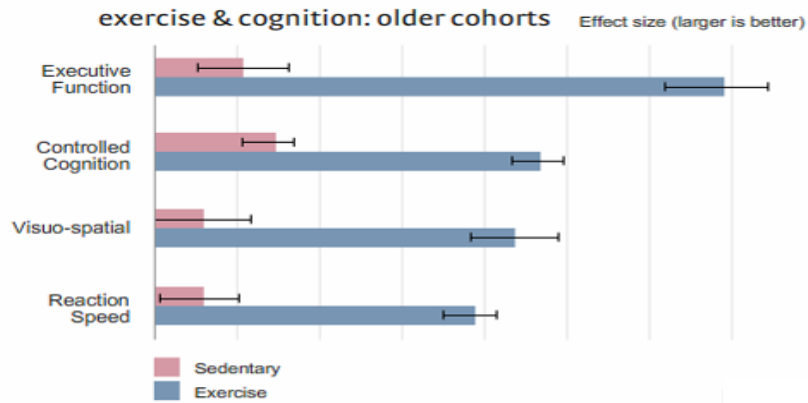
AND... it seems that peer rewards may be more motivating for teens

SO... think positive reinforcement and using friends as motivational tools!

Number 3... Understand the importance of physical activity and exercise!

- Exercise has the following effects on our brains:
 - Increases cerebral blood flow increase in cognitive abilities
 - Has a positive effect on neurotransmitters...particularly serotonin
 - Diminishes stress
 - Enhances our mood (there are conflicting theories why our mood is affected but there is agreement that it is affected)
 - Enhances cognition

The cognitive value of exercise



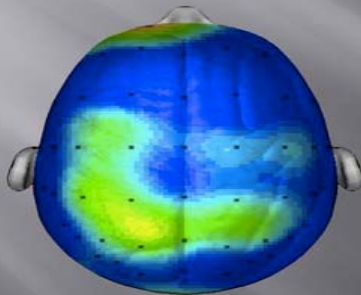
Source: Colcombe, S and Kramer, AF (2003)
 Fitness effects on the cognitive function of older adults: a meta-analytic study
 Psych Sci 14: 125 - 130

Exercise and the Protein Known as BDNF (Brain Derived Neurotrophic Factor)

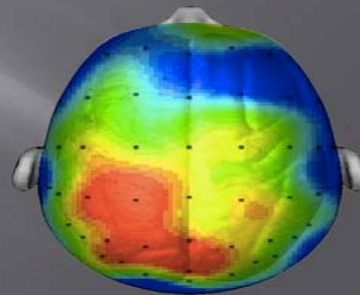
- BDNF plays a key role in how easily your brain can adapt to and learn how to effectively complete new challenges, called neuroplasticity.
- BDNF acts as a fertilizer of the brain's neurons, making them grow more quickly and develop stronger connections, in essence making it the "Miracle-Gro" of the brain.
- Exercise can profoundly increase the levels of BDNF and improve neuroplasticity.....HOW does this happen?!

If you start exercising, your brain recognizes this as a moment of stress. As your heart pressure increases, the brain thinks you are either fighting the enemy or fleeing from it. To protect yourself and your brain from stress, you release BDNF. BDNF has a protective and also reparative element to your memory neurons and acts as a reset switch. That's why we often feel so at ease and like things are clear after exercising. At the same time, endorphins, another chemical to fight stress, are released in your brain

BRAIN AFTER SITTING QUIETLY



BRAIN AFTER 20 MINUTE WALK



Some final thoughts on impacting on behaviour...

- *Set expectations:* You don't have to be liked... Do not focus on being popular as this confuses things. Boundaries and borders are important as long as they are consistent and predictable (Make sure you keep YOUR emotions in check).
- *Be prepared to negotiate trade-offs:* Trade-offs allow you to help build responsible decision making and independence and present an important message...you value their ideas and opinions.
- *Listen, then talk:* Acknowledge anger or emotional upheaval
- *Communicate:* Stay connected and/or be involved...when possible make technology an ally. Extracurricular activities are powerful relationships builders.
- *Pick your battles.* Ask yourself, "Is this battle worth fighting?"

Emotion and Well-Being

Relationships and Attachment

The greatest single determinant in healthy neurological development is that of a positive loving relationship with parents and/or primary caregivers.



Books By Dr Michael C Nagel



Available at most university bookstores or via the link below:

<https://shop.acer.edu.au/acer-shop/product/A5320BK>

Books by Dr Michael C Nagel



IN THE MIDDLE
The adolescent brain, behaviour
and learning

MICHAEL C NAGEL

In the Middle: The Adolescent Brain, Behaviour and Learning
Available at most university bookstores, Amazon or via the link below:

<https://shop.acer.edu.au/acer-shop/product/A5320BK>

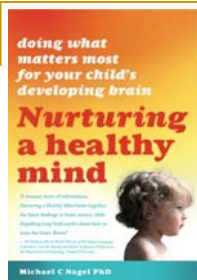


IN THE BEGINNING
The brain, early development
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Available at most bookstores, Amazon or via the link below:

<http://www.exislepublishing.com.au/Nurturing-a-healthy-Mind.html>



Boys Stir Us: Working WITH the Hidden Nature of Boys

Available at most bookstores, Amazon or via the link below:

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It's A Girl Thing

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