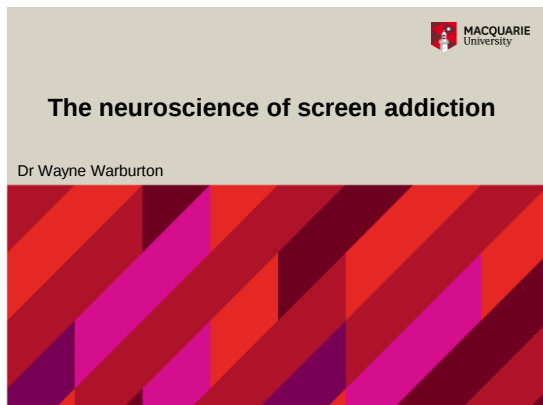




1

What we will talk about



- Neural development in children
- How big is the problem?
- Screen addiction
- Persuasive design – hijacking our time
- Neuroscience of screen addiction
- Screens and the body
- Healthy use

2

What we will talk about



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3

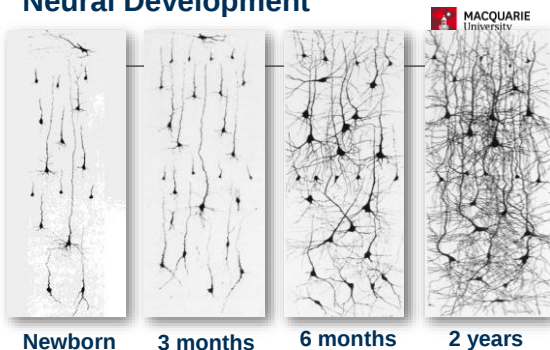
The developing brain



- The human brain wires up every second of every day in response to what we experience.
- That is, our neural network of thoughts, feelings and memories constantly changes to incorporate what we learn, second by second
- The crucial times are early childhood and the teenage years
- Lets have a look:

4

Neural Development



Golgi-Stained Sections of Middle Frontal Gyrus Showing Growth of Pyramidal Neuron Soma and Dendrites: Courchesne et al., 2007

5

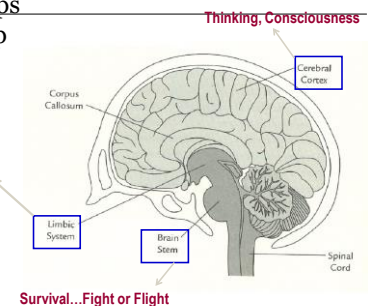
Neural Development



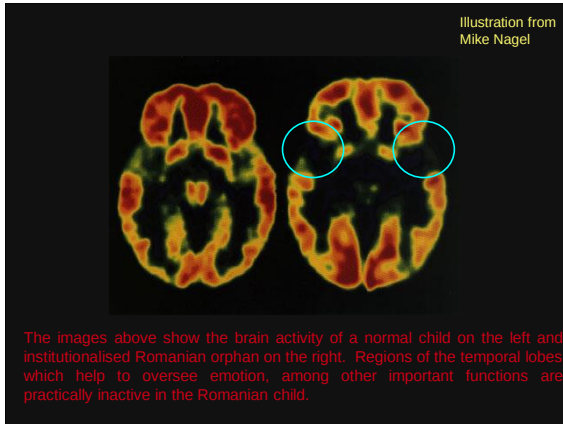
Brain develops
bottom to top
and from the
inside out

Emotion and Memory

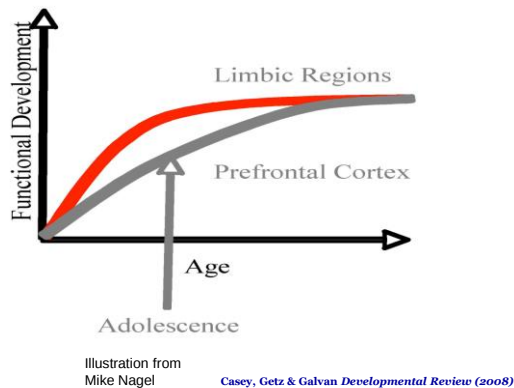
Illustration from
Mike Nagel



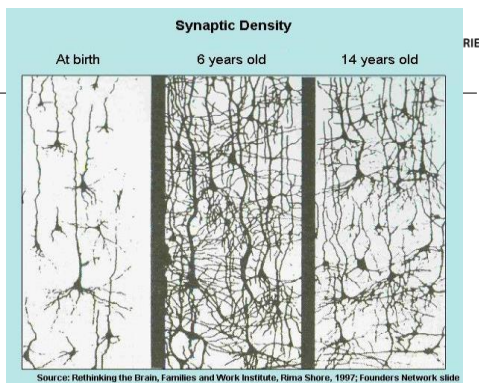
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7



9



From *Rethinking the Brain: New Insights into Early Development* by Rima Shore (NY: Families and Work Institute, 1997)

11

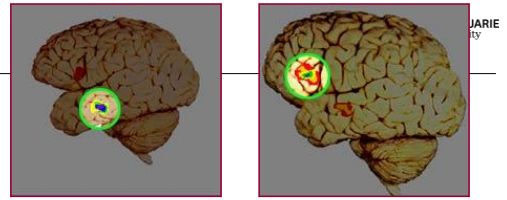
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Neural Development



- Adolescence the second crucial stage.
 - Myelinsation
 - White matter – the cables of the brain
 - Faster processing
 - Pruning
 - Faster and more efficient
 - BUT Frontal lobe far less developed than emotion centres

8

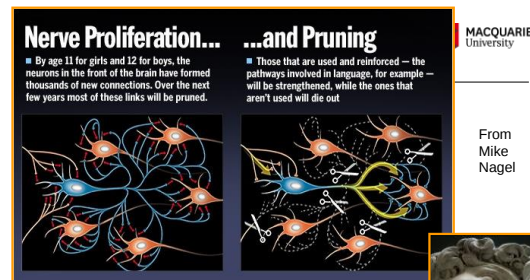


Adolescents use less of the prefrontal cortex than adults when reading emotions.

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

From Mike Nagel

10



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.

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



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Neural Development



- Adolescence thus a vulnerable time
- Due to neural reconfiguration, Jay Giedd and others remark that
- “Adolescence may be one of the worst times to expose a brain to drugs and alcohol or even a steady dose of violent video games” (Strauch, 2003; p. 21).

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- Healthy use

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What do you think?



In the latest Common Sense Media Poll, how much time did kids spend with **recreational** media?

Age group	Media Type	Average time per day
8-12	Media overall	
8-12	Screen time	
13-18	Media overall	
13-18	Screen time	

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What do you think?



In the latest Common Sense Media Poll, how much time did kids spend with **recreational** media?

Age group	Media Type	Average time per day
8-12	Media overall	5 hours & 55 minutes
8-12	Screen time	4 hours & 26 minutes
Teens 13-18		
Overall	Media overall	8 hours & 56 minutes
Overall	Screen time	6 hours & 40 minutes
L v H income	Screen time	8h 7m vs 5h 42m
Black v White	Screen time	8h 26m vs 6h 18m

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2017 APA study (N=3,511)



- 48 percent of parents say that regulating their child's screen time is a constant battle
- 58 percent of parents report feeling like their child is attached to their phone or tablet.
- 45 percent of parents say they feel disconnected from their families even when they are together because of technology.
- 58 percent say they worry about the influence of social media on their child's physical and mental health.

<http://www.apa.org/news/press/releases/2017/02/checking-devices.aspx>

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2018 Common Sense Media survey



Activity – Teens 13-17	% 2012	% 2018
Own smart phone	41	89
Use social media multiple times per day	34	70
Prefer person to person communication	49	32
Use Facebook as main social media	68	15
Main social media is snapchat, instagram		41, 22
Woken up at night by call, text, notification		29
Has taken away from time with friends		42

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2018 Common Sense Media survey



Activity – Teens 13-17	% 2012	% 2018
Own smart phone	41	89
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20

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Screens and 'Addiction'



The American Society of Addiction Medicine (ASAM) in 2011 released a new definition of addiction as a chronic brain disorder, officially proposing for the first time that addiction is not limited to substance use.

All addictions, whether chemical or behavioral, share certain characteristics including salience, compulsive use ... tolerance ... withdrawal, and the continuation despite negative consequences. (Cash et al, 2012, p 292.)

Not about drugs – about brains. More about the reward circuitry in the brain and related brain structures than it is about the external chemicals or behavior that “turn on” that reward circuitry. (ASAM, 2011)

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Screen Addiction



- Two levels
 - Problematic use
 - Pathological use/addiction-like
- How many kids have problematic screen use?
 - 5-10% cross culturally – problematic use
 - 1-2% pathological use/screen ‘addiction’
- In the brain
 - Screen addiction, pathological gambling and substance addictions all look similar

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Gaming Disorder and IGD



- *Internet Gaming Disorder* – DSM-V ‘Disorders requiring further study’, 2013
 - Diagnosis similar to gambling disorder
 - Many studies have followed
- *Gaming Disorder* – WHO: ICD-11
 - Endorsed by World Health Assembly, May 2019
 - Will take force January, 2022

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Proposed IGD criteria



- PREOCCUPATION WITH THE INTERNET and or VIDEO GAMES
- WITHDRAWAL as INDICATED by symptoms of irritability, anxiety, or sadness
- TOLERANCE as evidenced by increasing amount, level, type of use to achieve satisfaction
- UNSUCCESSFUL ATTEMPTS TO CONTROL, stop or change the behavior
- LOSS OF INTEREST, previous hobbies, entertainment as a direct result of, and with the exception of, Internet use

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Proposed IGD criteria



- CONTINUED USE despite psycho-social/physical problems likely to have been caused or exacerbated by use
- DECEIVING or LYING TO OTHERS regarding the amount of time engaged in Internet or Video gaming
- USES THE INTERNET TO ESCAPE or relieve a negative or dysphoric mood (e.g. feelings of helplessness, guilt, anxiety, stress, worries)
- LOSING or JEOPARDIZING A SIGNIFICANT RELATIONSHIP/job/educational opportunity

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Proposed IGD criteria



- Five of the nine criteria
- Over a 12 month period
- Impairment must be significant

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Gaming Disorder in ICD-11



- Defined as a pattern of gaming behavior ("digital-gaming" or "video-gaming") characterized by
 - impaired control over gaming,
 - increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities, and
 - continuation or escalation of gaming despite the occurrence of negative consequences.
- For gaming disorder to be diagnosed, the behaviour pattern must be of sufficient severity to result in significant impairment in personal, family, social, educational, occupational or other important areas of functioning
- Would normally have been evident for at least 12 months.

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- Healthy use

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Persuasive design – WHY?



Addiction is a deliberate ploy

- Games, social media, most tech is about **advertising** and **in-app purchases**. Need viewer's **attention**
- Fortnite, free game, **\$2.4b** in 2018. **\$318m** in May 2018 alone.
- Want you exposed for hours, not minutes
- Davidow, 2012: "either they hijack neuroscience to gain market share and make large profits, or they let competitors do that and run away with the market". "Addiction is good for business".

30

29

Persuasive design – HOW?



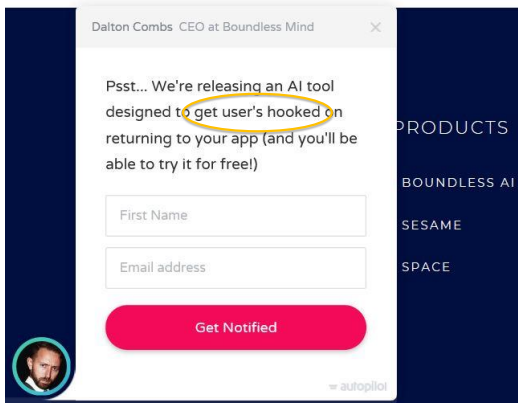
- Hire persuasive design experts to make screen tech more addictive
- Bogost, 2012: Smartphones – *‘the cigarette of the century’*.
- Ramsay Brown, founder Dopamine Labs: *“Your kid is not weak-willed because he can’t get off his phone ... Your kid’s brain is being engineered to get him to stay on his phone.”*
<http://www.cnn.com/2012/07/14/youre-addicted-to-your-smartphone-this-company-thinks-it-can-change-that/>

WHO?

- **Dr. B.J. Fogg** (Stanford) – psychologist
father of persuasive technology (aka persuasive design)

"We can now create machines that can change what people think and what people do, and the machines can do that autonomously." <https://www.youtube.com/watch?v=117.627920>

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Persuasive design – WHO?



Dopamine labs (now **Boundless Mind**) in Venice, LA

- Neuroscientists specialising in persuasive design and addictive tech
- Use **Als** and **persuasion profiles** to change behaviour in ways the **user is unaware** of, or which they think are their own choices.
- *"Neuroscience has shown us that habits are programmable, and data has shown us that **each person requires their own unique program**"*
- *"Sesame makes returning to your app **irresistible** for your users."*

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Tech titans reveal the truth



- **Tristan Harris** (ex **Google**): “*The job of these companies is to hook people, and they do that by hijacking our psychological vulnerabilities.*”
<https://www.143magazine.com/news/the-scientists-who-claim-apps-addictive>
- **Marc Benioff**, CEO of the cloud computing company **Salesforce**: “*product designers are working to make those products more addictive*”. Such technologies are not “*understood by parents*” which gives social media firms an “*unfair advantage.*”

34

Tech titans reveal the truth



- **Former Facebook president Sean Parker:**

*"The thought process that went into building these applications, Facebook being the first of them... was all about: **How do we consume as much of your time and conscious attention as possible?**"*

Facebook exploits “*vulnerability in human psychology*”

“God only knows what it’s doing to our children’s brains”

children's brains." <https://www.axios.com/hean-parker-unloads-on-facebook-god-only-knows-what-its-doing-to-our-childrens-brains-1513306792.6855e7b4-4e99-4d60-8d51-2775559c2671.html>

35

Targeting vulnerability



- People are wired to seek basic needs – social belonging, control/mastery, self –esteem
- Screen products exploit this by generating a temporary sense of belonging, competency and achievement.
- Girls – social media: Boys - video games
- Facebook, 2017: leaked documents obtained by The Australian: Facebook showed advertisers how it has the capacity to **identify when teenagers feel “insecure” and “worthless”**
- Boast: can **micro-target ads** down to *“moments when young people need a confidence boost.”*

36

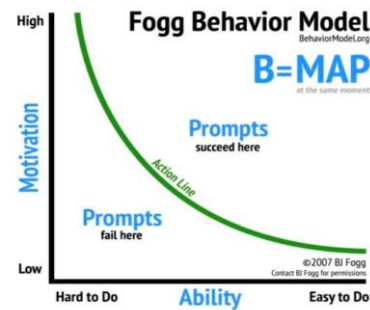
The Fogg Behaviour Model



- **Motivation:** Key motivator: desire for “social acceptance”; powerful desire to “avoid being socially rejected”
- **Ability:** Digital products should be designed so that users don't have to “think hard” and are easy to use
- **Prompts:** Should be triggered to use a site. Many attention grabbing tricks here:
 - Incessant notifications
 - Reminder someone is missing out (FOMO)
 - Check to see if anyone liked your post or photo
 - These demand the users' attention and compel users to stay on the site and return again and again

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The Fogg Behaviour Model



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Dopamine



- **Aim:** Release dopamine into the brain's pleasure centres: a very complex system but a key part is dopamine to nucleus accumbens via mesolimbic pathway
- In addiction, dopamine to prefrontal cortex is reduced
- When a reward is unpredictable, dopamine is released when anticipating the reward
- Compulsion to continually check email, social media etc, is driven in some cases by dopamine releases that occur in anticipation of receiving good news.
- Phantom phone notifications

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The big lie:

Pleasure versus happiness



See Lustig, 2017

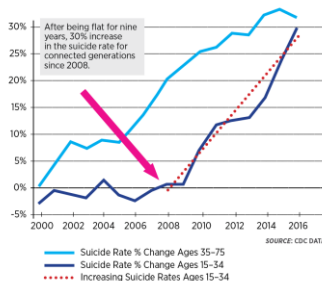
- Happiness/contentment linked to the neurotransmitter serotonin.
- Due to the interplay between dopamine and serotonin in the addiction process, serotonin levels can become reduced
- Thus seeking pleasurable, rewarding sensations that increase dopamine can come, to some degree, at the expense of serotonin, and, potentially, happiness
- Addicts unhappy – tolerance reduces pleasure and serotonin deficits further impact happiness/depression
- People want to be happy; Big Tech want you to equate pleasure (which can be addictive and commercially valuable) with happiness (which people desire).
- Message: you can buy happiness (with our digital product).

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The big lie: Pleasure versus happiness



U.S. Suicide Rates % Change: Comparison of Most Digitally Connected Generations vs. Less Connected 2000–2016.



Increases in suicide rates and depression coincide with the smart device revolution

Ryan, 2018; see Twenge et al 2018

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Twenge et al 2018

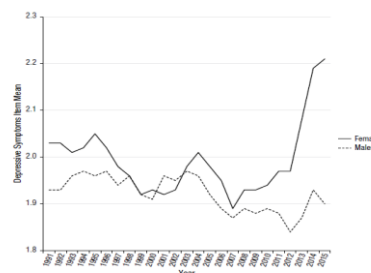


Fig. 4. Depressive symptoms (from mean), 8th, 10th, and 12th graders, by sex, MIF, 1993–2015.

Depression increasing for females

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Twenge et al 2018

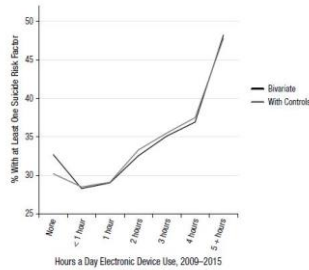


Fig. 2. Exposure-response relationship between electronic device use and having at least one suicide-related outcome, bivariate and with demographic controls for race, sex, and grade, 9-12th graders, Youth Risk Behavior Surveillance Survey (YRBBS), 2009-2015.

Having at least one suicide risk factor increases with device use

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What we will talk about



- Neural development in children
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- **Neuroscience of screen addiction**
- Screens and the body
- Healthy use

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Neurological impacts of screen overuse



Taken together, studies show screen addiction is associated with:

- Structural and functional changes in the brain regions involving:
 - Executive function
 - Emotional processing
 - Decision making
 - Cognitive control

(See Dunckley, 2016)

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Neurological impacts of screen overuse



Grey matter atrophy (shrinkage, loss of tissue volume) in grey matter areas where cognitive processing occurs.

(see See Dunckley, 2016; Zhou et al., 2011; Yuan et al., 2011; Weng et al., 2012, 2013)

- Frontal lobe – executive functions
 - Planning
 - prioritising
 - organising
 - Impulse control

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Neurological impacts of screen overuse



Grey matter atrophy (shrinkage, loss of tissue volume) in grey matter areas where cognitive processing occurs.

(see See Dunckley, 2016; Zhou et al., 2011; Yuan et al., 2011; Weng et al., 2012, 2013)

- Striatum
 - Reward
 - Suppression of antisocial impulses

Neurological impacts of screen overuse



Grey matter atrophy (shrinkage, loss of tissue volume) in grey matter areas where cognitive processing occurs.

(see See Dunckley, 2016; Zhou et al., 2011; Yuan et al., 2011; Weng et al., 2012, 2013)

- Insula
 - Development of empathy, compassion
 - Ability to integrate physical signals with emotions
 - Links to violent behaviour
 - Impacts depth and quality of relationships

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Neurological impacts of screen overuse



Reduced cortical thickness in frontal lobe

(Hong et al., 2013; Yuan et al., 2013)

- Impairment on cognitive tasks
- Less efficient information processing
- Reduced impulse inhibition

(Deng et al., 2013).

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Neurological impacts of screen overuse



Dopamine and reward system

- Key part of the reward system; Heavily implicated in the formation and maintenance of addiction
- Extensive gaming and screen use may produce long-term changes to reward circuitry, similar to drug dependence
- Dopamine released during gaming (Koepp, 1995; Weinstein, 2010) – pleasure
- Not the huge increase as with drugs (up to 1400% increase) BUT increases within normal range (50-100%); can cause addiction (see ASAM earlier).

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Neurological impacts of screen overuse



Attention deficits

- Christakis et al 2014 longitudinal study
 - 2613 children aged 1 and 3 years
 - Followed till 7 years
 - For every hour of television watch per day, 9% increase in subsequent attentional problems consistent with ADHD
- Doulton et al 2007 longitudinal study
 - Level of TV viewing at ages 5 and 11 years predicted attentional problems in adolescence
 - A range of possible confounding factors held constant

51

Neurological impacts of screen overuse



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 - For every hour of television watched per day, 9% increase in attentional problems consistent with ADHD
- Doulton et al 2007 longitudinal study
 - Level of TV viewing at ages 5 and 11 years predicted attentional problems in adolescence

Executive functions

- Lillard & Peterson, 2011.
 - 4 year olds have 9 minutes of watching popular, fast-paced, fantasy TV
 - Immediate impairment to executive functions
- Recent brain studies suggest both violent media and screen overuse cause reduced executive function, including longer-term effects.

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Neurological impacts of screen overuse



Empathy deficits

- Normally empathy activates affective pain regions (dorsal anterior cingulate cortex, insula) associated with having experienced such suffering yourself.
- With repetition, empathy is learned
- During internet use, such areas show almost no activation (Sigman 2012).
- 40% drop in empathy from 1979-2009 (Konrath, et al., 2011). Most of this from 2000 onwards

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Neurological impacts of screen overuse



REMEMBER

- In teenagers, emotion- and reward-sensitive areas develop faster than inhibitory, regulatory mechanisms such as the prefrontal cortex
- This makes teenagers more likely to struggle to inhibit the seeking of behaviours they find rewarding – to do what feels good.

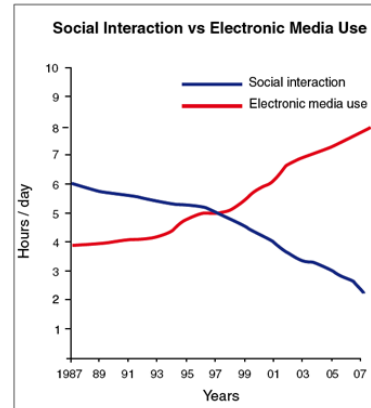
54

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- **Screens and the body**
- Healthy use

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Sigman, A. (2009). Well connected: The biological implications of social networking. *Biologist*, 56(1), 14-20.

Data abstracted from a series of time use and demographic studies.

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Social isolation



- Despite the technology and communication revolution, rates of loneliness have doubled since the 1980s
- Cigna (health insurer) 2018 report: N=20,000, loneliness scale
 - 46% of Americans are considered lonely.
 - Generation Z (adults ages 18-22) and Millennials (adults ages 23-37) are lonelier and claim to be in worse health than older generations.
 - Students have higher loneliness scores than retirees.
 - "Loneliness has the same impact on mortality as smoking 15 cigarettes a day, making it even more dangerous than obesity". (Cigna 2018 report).
- Former US Surgeon-General Vivek Murthy: social isolation is associated with a reduction in lifespan "even greater than that associated with obesity". <https://hbr.org/cover-story/2017/09/work-and-the-loneliness-epidemic>

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Social isolation



- Humans need face to face interaction and human touch
- Social isolation linked with global alterations to genes
- Key hormones not released (eg oxytocin)
- Greater risk of:
 - Inflammatory diseases such as diabetes, cardiovascular disease, high blood pressure
 - Autoimmune disorders such as arthritis, lupus.
 - Reduced immune function, susceptibility to illness
 - Weight gain and smoking more
 - Higher mortality
 - Reduced memory and mental performance
 - Depression (Holt-Lunstead, 2017; Sigman, 2009; Tate, 2018)

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Physical Health



Leon Straker

- Physiological load of playing video games similar to resting or watching TV - heart rate, respiration rate, estimated energy expenditure, trunk and limb muscle activity and movement
- Screen use is sedentary; displaces activity; tracks to adulthood; links to serious illness
- Poor posture – muscular-skeletal risk
- Enhances fine motor skills at expense of gross motor skills

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Obesity



- Meta analyses show that increased TV time is linked with a greater prevalence of overweight/obesity (McKetta & Rich, 2011)
- Equivalent to consuming an extra 100 calories per hour of television watched
- Not just about being sedentary
- Stronger for TV than other screen use because of the influence of advertising and snacking while watching.
- Important moderators – context of use, family environment and limit setting, SES, gender and sleep.

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SLEEP AND SCREENS



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Sleep



- Kids need their sleep!
- Chris Seton (2017) notes 4 ways that screens sabotage sleep
 - Takes up sleep time
 - Used in bed, mixed messages – is the bed a place to do wakeful activities?
 - Excitatory to the brain – wakeful neurochemicals like dopamine and adrenaline
 - The blue light effect

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What we will talk about



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- Persuasive design – hijacking our time
- Neuroscience of screen addiction
- Screens and the body
- **Healthy use and management**

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A healthy media diet



- How much
- Content
- Age appropriateness

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Screens and sleep



Dr Chris Seton:

- A screen-free time before bedtime
 - 2 hours recommended but every bit helps
- Establish a routine
- Look for pre-sleep activities that are relaxing rather than stimulating
- Device basket

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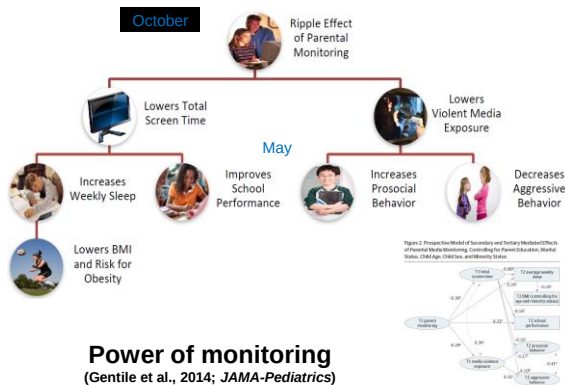
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Active monitoring



In a 2014 study increased parental monitoring of screen use was associated with reductions in screen time, violent media exposure, aggressive behaviour and BMI, and increases in hours of sleep, pro-social behaviour and school performance.

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Access and balance



- Keep screens out of the bedroom
 - This will usually help to lessen the amount of use and moderate the type of use
- Aim for more physical activity time than sitting screen time
 - This isn't easy, but in an ideal world parents would be creating lots of fun opportunities each day for activity, this can include replacing sedentary e-games with active e-games but should also include more real-world activity than e-based activity.

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Exercise



- Cannot overstate the importance of regular exercise (40 minutes 5 times a week of reasonably vigorous exercise) on mental health
- Helps restore homeostasis (cardiovascular system, hormones, brain chemicals move back towards homeostatic levels)
- Double whammy – too much screen time often reduces exercise time and can cause things to get out of whack.

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Looking after the body



- When playing video games, have an active break after 30 minutes
 - This minimises prolonged sitting and sustained close-vision effects and helps to switch to other activity
- Encourage a good safe screen/playing technique. That is, a technique that:
 - Avoids poor postures;
 - Avoids repetitive movements;

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Managing resistance to making screen time changes



From clinical practice, the following can help:
(see Marshall, 2019)

- Control the WiFi – Internet a reward not a right.
- Use software to control WiFi. Profile for each child, allowing you to turn internet access on and off; also set schedules.
 - KoalaSafe
 - Family Zone
 - Parent power
 - Norton Core (and others).
- Content filters *Qustodio*, *Net Nanny*, *Surfie* [good for mobiles] (although most teens can work around them).

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Managing resistance to making screen time changes



- Don't make it a war over devices; control the internet instead.
- Make a family plan and honour it
<https://www.healthychildren.org/English/media/Pages/default.aspx>
- Minimise mobile data so it doesn't undermine the family plan
- Need face to face time with friends for social development. Don't buy into the argument that online interaction is the same – it isn't!

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Be a good role model



- Model appropriate screen use and participation in real world activities
- Children copy their parents, so modelling healthy screen use is crucial;
- Children are more likely to be active if their parents are. For example, a program that replaced screen time with family time was met with initial resistance, but after time family members came to prefer family time.

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Creating a new generation of healthy screen users?



wayne.warburton@mq.edu.au

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Photo: Graham Weule

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