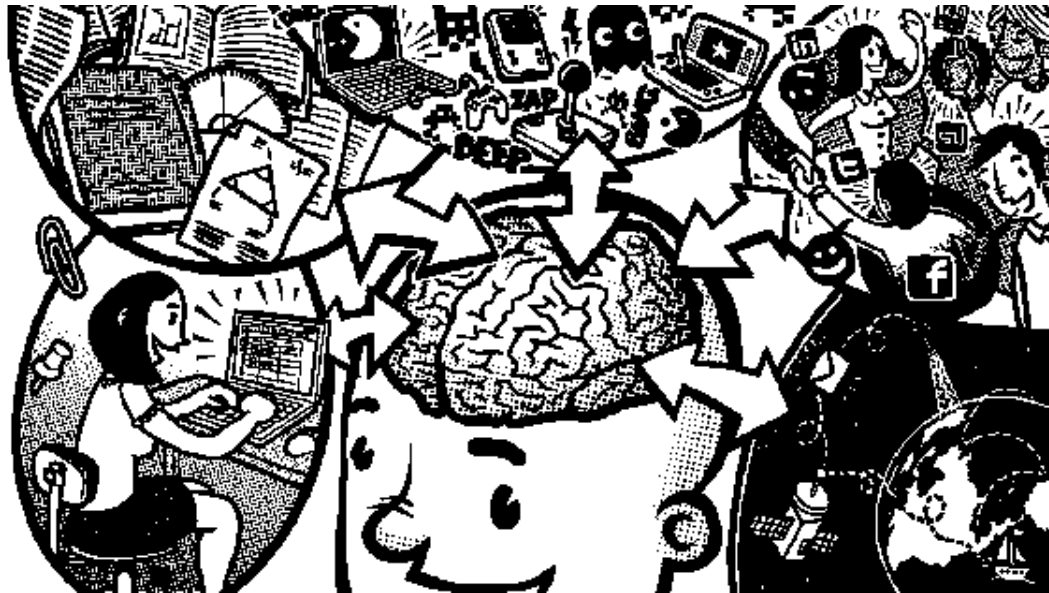


The Impact of Digital Technologies on Human Wellbeing

Paul Howard-Jones



Nenet *Neuro*Educational Research network

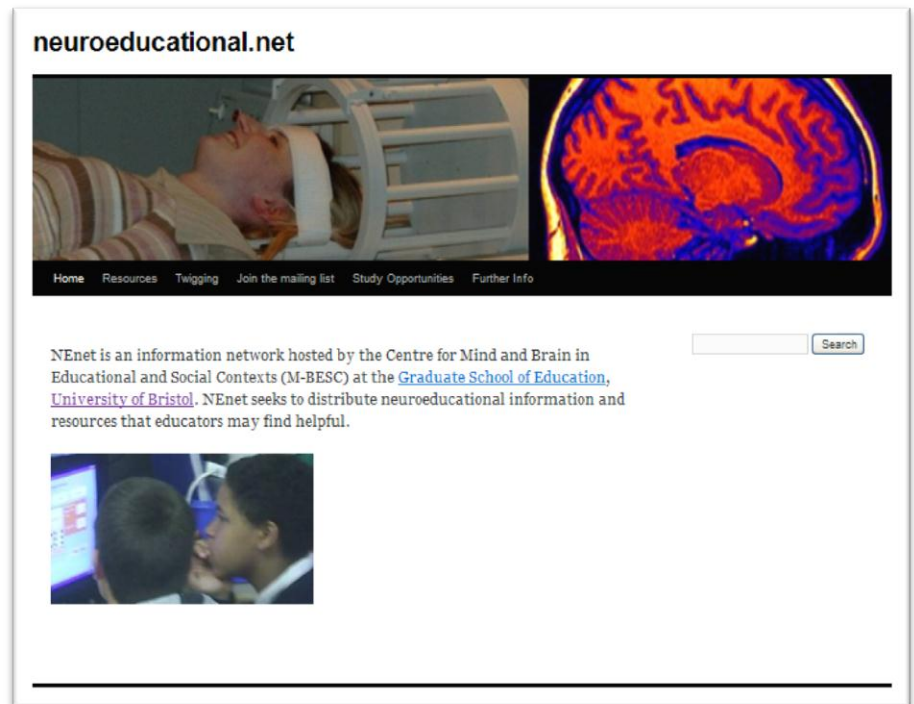
www.neuroeducational.net

- NeuroEducational Research:

- Basic neuroscience
- Bridging studies
- Developing classroom practice

- Public communication

- Consultation with teachers



Some headlines.....

Google is “degrading our intelligence”

Carr, N. in *The Atlantic* Vol. July/Aug (2008).

Facebook is “infantilizing” us

Wintour, P. in *Guardian* (2009).

Technology is the “21st-century addiction”

Roberts, D. in *The Telegraph* (2010).

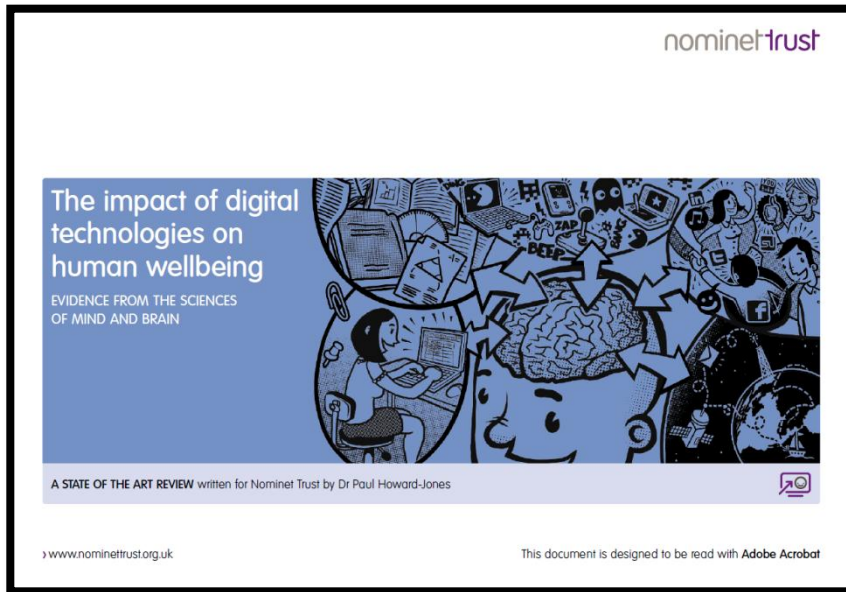
“Facebook and Twitter are creating a vain generation of self-obsessed people with child-like need for feedback, warns top scientist”

Sarah Harris, *Daily Mail* (2011)

“More activity, less screen time urged for young kids”

Dave McGinn (March 2012) in

nominettrust



Cartoons by Sam Bevington

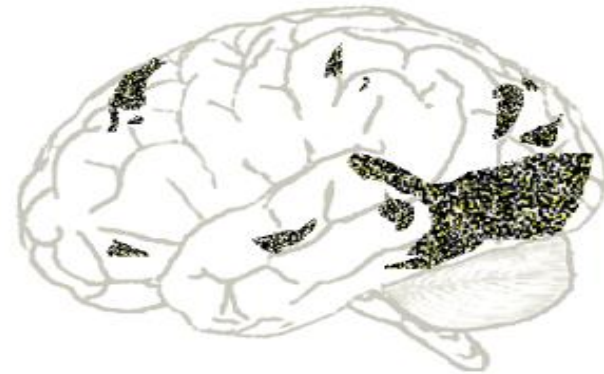
Is Google rewiring our brains?

Activity for internet searching, relative to reading:



a)

a) Naive users



b)

b) Experienced users

Small, et al. (2009)

The brain is plastic: Learning involves changes in

- * neural connectivity

- * shifts in regional activity

Activity after adults practise difficult multiplication:

a) Decreases

b) Increases

Delazer et al. (2003)

Structural change over only 3 months

Draganski et al. (2004)

1: before training

2: After 3 m practise

3: 3 m since practised

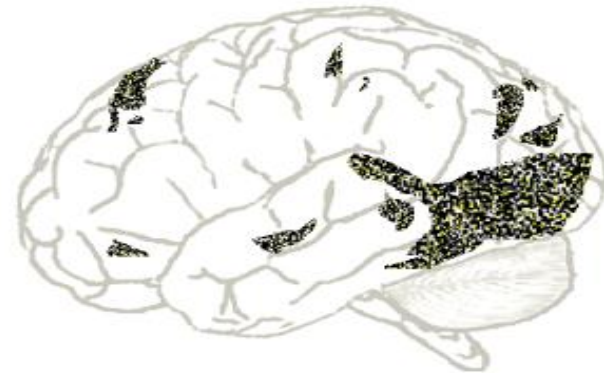
Is Google rewiring our brains?

Activity for internet searching, relative to reading:



a)

a) Naive users



b)

b) Experienced users

- Experienced users using more search strategies
- Additional activity: decisions making, reasoning

Some brains more plastic than others...



Research in 90's : greater internet use linked to **reduced** social-connectedness and well-being

So is Facebook “infantilising” our brains?

49% of UK children 8-17 profiled on a social network site (SNS)

OfCom (2008)

The 90's digital teen: What sort of lifestyle?

World Wide Web

The WorldWideWeb (W3) is a wide-area [hypermedia](#) information retrieval initiative aiming to give universal access to a large universe of documents.

Everything there is online about W3 is linked directly or indirectly to this document, including an [executive summary](#) of the project, [Mailing lists](#), [Policy](#), November's [W3 news](#), [Frequently Asked Questions](#).

[What's out there?](#)

Pointers to the world's online information, [subjects](#), [W3 servers](#), etc.

[Help](#)

on the browser you are using

[Software Products](#)

A list of W3 project components and their current state. (e.g. [Line Mode](#), [X11 Viola](#), [NeXT](#), [Library](#))

[Technical](#)

Details of protocols, formats, program internals etc

[Bibliography](#)

Paper documentation on W3 and references.

[People](#)

A list of some people involved in the project.

[History](#)

A summary of the history of the project.

[How can I help?](#)

If you would like to support the web..

[Getting code](#)

Getting the code by [anonymous FTP](#), etc.



Recent Social Network Site Research

- SNS's generally stimulate teenage social connectedness and psychosocial well-being
- Cyberbullying and abuse appear linked to issues beyond SNS's – suggesting children need general awareness and avoidance skills (serious crimes against children are only rarely internet related, 2% in a 2006 U.S. study)
- But it is about **how** the technology is used:
Benefits if supporting existing friendships

Grey matter increase with number of SNS friends

- * Size of online friendship networks correlated with size of intimate real-world social groups.
- * However, brain regions above (e.g. social memory), specifically associated with online social network size, whereas density of amygdala correlated with online **and** real-world social network sizes.

Kanai R et al. (2012)

PH-J: SNS relationships are not the same as offline relationships, but can be a healthy extension

©2012 by The Royal Society

Is the internet bad for us?

Compare technology of fire-making

- GOOD for warmth and toasting muffins
- BAD: if used carelessly
- no panic headlines: “Fire may destroy us”
 - we understand dangers and precautions

it's about **how** we use technology
When, how much, what for....

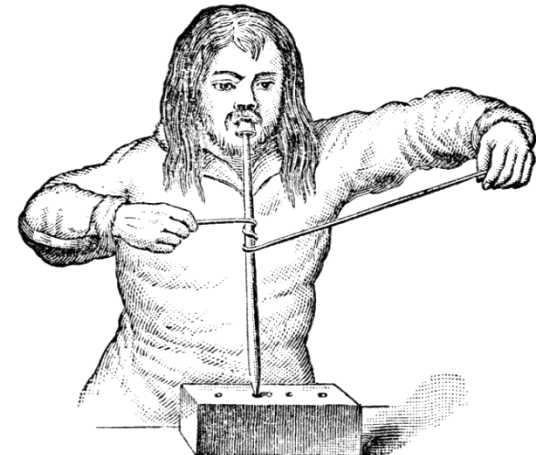


Image: Florida Center for Instructional Technology

The experience of a parent-scientist – not advice (!)



Theo (10) Harvey (14) Finn (5) Dylan (16) Miranda (12)

“Monitor” – easier said than done?!

- friends mostly chatting online by 11 years old
- parental preference for popular SNS's than chat rooms
- Talks about
 - cyber-safety
 - No “new” e-friends

Initially constrained to kitchen-diner area (over shoulder glances)

– but then mobile devices...

And teenagers need more privacy....

- The battle to be “facebook friends”
- Unspoken détente: low profile vs “defriending”



When you use technology

Sleep is for rest and for learning:

Sleep consolidates memory :

<-Activity during wakefulness

<-Activity during when asleep

(Maquet et al., 2000).

Sleep and teenagers

- We have a circadian rhythm ~24hrs
- the suprachiasmatic nucleus controls the pineal gland's secretion of melatonin – that makes you sleepy, increasing levels 2-3 hrs before bedtime

Sleep and teenagers

- Melatonin secretion slows down at puberty
- So teenagers naturally want to stay up later and find waking up in the mornings more difficult
- BUT this is worsened by the habits that arrive with more freedom
- Teenagers need 8.25, they tend to get 7.5 -> daytime sleepiness
- Chicago study showed teens lose an average 2 hrs a night during term
- Teen sleep loss linked to caffeine & technology

When you use technology

- Small bright screens may reduce Melatonin
- Teens texting after “lights out” 4x more likely to suffer daytime sleepiness
- Disturbed sleep helps you “forget” information



What you use technology for

Sleep disruption – depends on use
(e.g. how mentally taxing the task is)

The internet can heal....

Review of 22 studies of computerised
Cognitive Behavioural Therapy (CBT):
*“effective, acceptable and practical health
care”* (especially when via the internet)

The internet can teach....

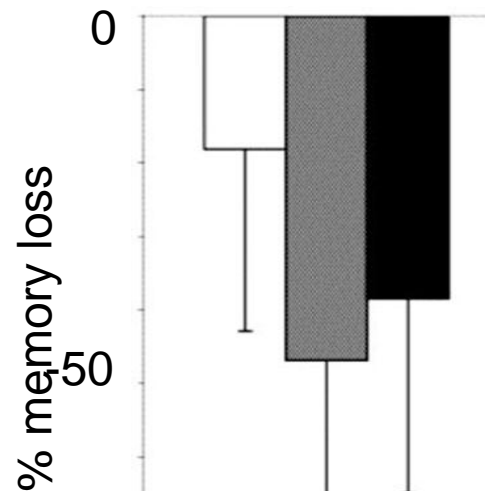
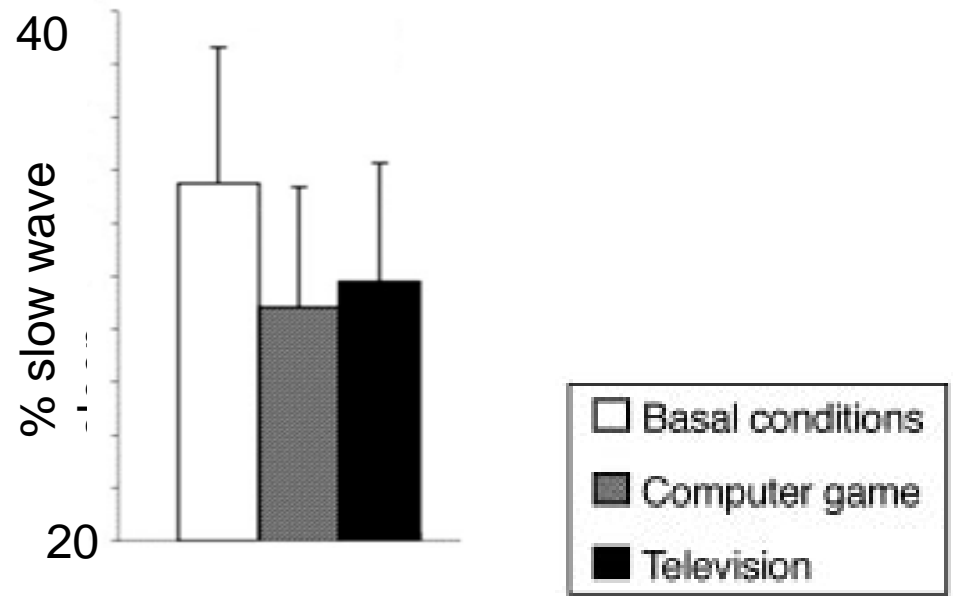


What you use technology for

13-14 yr olds (N=11), 6-7pm

- * playing computer games
- * watching TV or
- * neither (basal condition)

Later in evening asked to memorise 2 mins of facts.



Dworak et al. (2007)

How much you use it

E.g. children's exercise disrupted if use excessive

(8hrs pw of home computer, Attewell, 2003)

AAP guidelines(2009): 2 hrs a day **total** screen time

Very little research evidence of effects below this level of exposure

But “how much” is tied to “what” and “when”



School day rule: no “screens” for more than two hours, excluding homework, educational, creative, musical and physical games

No screens at all after 7pm (>11), 8pm (<14) 10pm (anyone!)

How much you use it

SO much on the internet, why do anything else?

- 1.5% to 8.2% of general population have problematic internet use
- Significant predictors: low self-esteem, anxiety
- Is this a special psychiatric disorder, along with shopping, working, football....?

In almost all respects, no evidence of digital technology's "special" influence on the brain.

Well-being in our new digitised environment requires transferring offline everyday wisdom :

- * choosing activities with obvious benefit
- * moderation and variety of activities
(2hrs entertainment screen time-AAP)
- * healthy scheduling

...in almost all respects...but..

1.5% to 8.2% of general population have problematic internet use.... so what are they doing?

- Adults: pornography, illicit relationships
- Young people: gaming

.....video games are very engaging:

When players viewing images from internet games, similar neural activities as when addicts of drugs or gambling view images of cues

(Han et al.,2011)



Restrict video game play to particular parts of the day? (but different bed-times, after school clubs, etc.)



At one point: were they only interested in computer games?

*Summer ban on **all** video games May -> September (trees were climbed, books read, musical instruments played)*

Games (like many pleasures) stimulate the brain's reward system

- Rapid schedule of rewards stimulates midbrain regions (Koepp et al., 1998)
- Rewards are uncertain
- Significant dopamine release comparable to the effects of psychostimulant drugs (Weinstein, 2010)
- If you apply DSM addiction criteria, 1 in 5 teens addicted in '98 (Griffiths et al., 1998)

Games embedded in culture – so some system of rationing needed.

We tried a commercial product that would automatically turn off a PS2 games console. Appeals/arguments arose when:

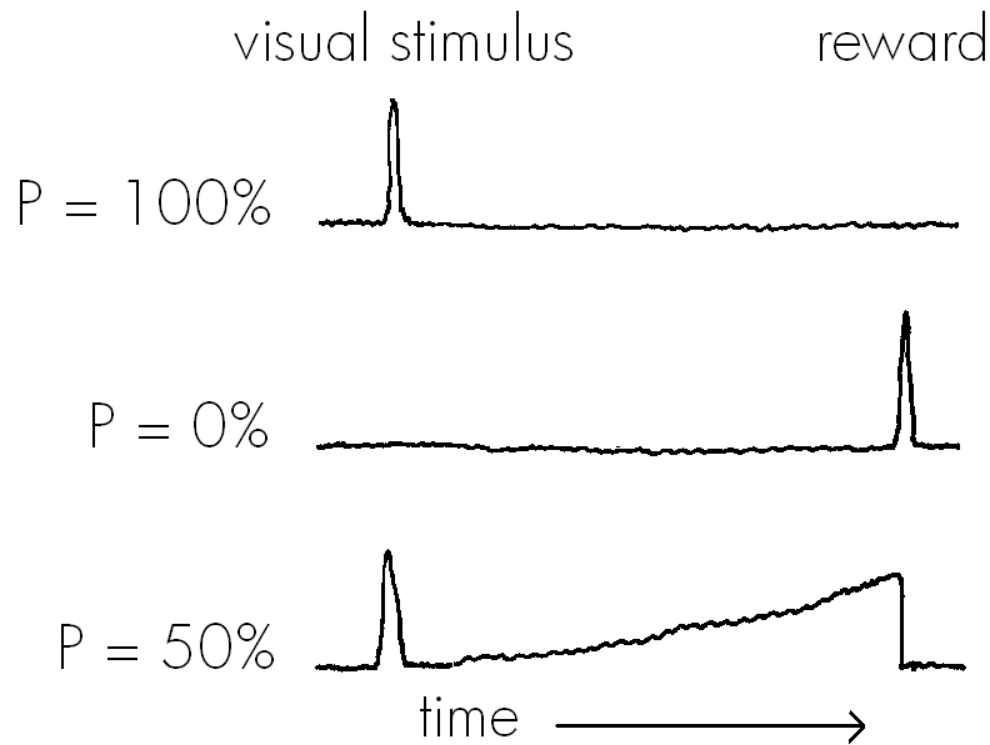
- * timings needed resetting at the start
- * the 1 minute warning light flashed
- * passwords got “hacked”

A DIY solution consisted of a mains feed to a multisolet block – all locked up in a plastic box. All mains-powered technology automatically shuts down at a pre-defined time every weekday night (with a different program for weekends).



C. D. Fiorillo et al,(2003).

When reward is 50:50 uncertain, it generates maximum dopamine in the reward system:

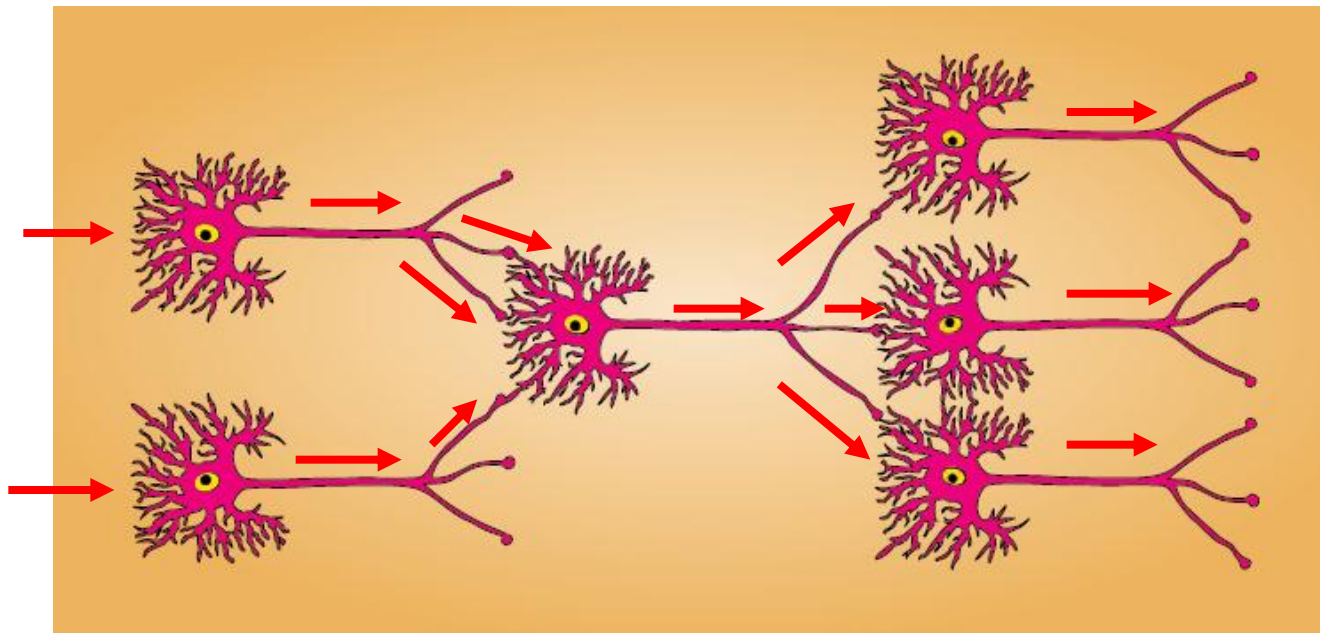


Reward response peaks in adolescence

Caudate activity for gain versus no-gain outcome in high risk gambles

- Midbrain dopamine helps explain engagement
- Midbrain dopamine also predicts learning
 - via increased **synaptic plasticity** beyond midbrain

Synaptic plasticity = the efficiency of the connections (or synapses) between neurons can change -> basis of learning



Video games are incredible teachers

Action **video games** improve:

- Performance on many visuomotor tasks
- Switching of visual attention
- Suppression of visual distraction
- Inference of an action's probable outcome
- Contrast sensitivity (primary factor limiting sight)



all with transfer

Not a self-selection effect

- 10+ hours of play can generate transferable benefits in non-game players.
- Longitudinal studies track improvements in relation to game play
- Of the few studies undertaken, effects found to transfer to some professional activities:
 - Laparoscopic (key-hole) surgery
 - Piloting jet fighters & (reportedly) drones



Action video games can also teach **affective response**

Converging data: Violent games teach aggression

- *correlation (violent gamers more aggressive)
 - *experiment (non-gamers' aggression increases)
 - *longitudinal (aggression varies with game habits)
(again, "*how much*" is a factor)
- also neurophysiological desensitization

But similarly, pro-social games teach empathy

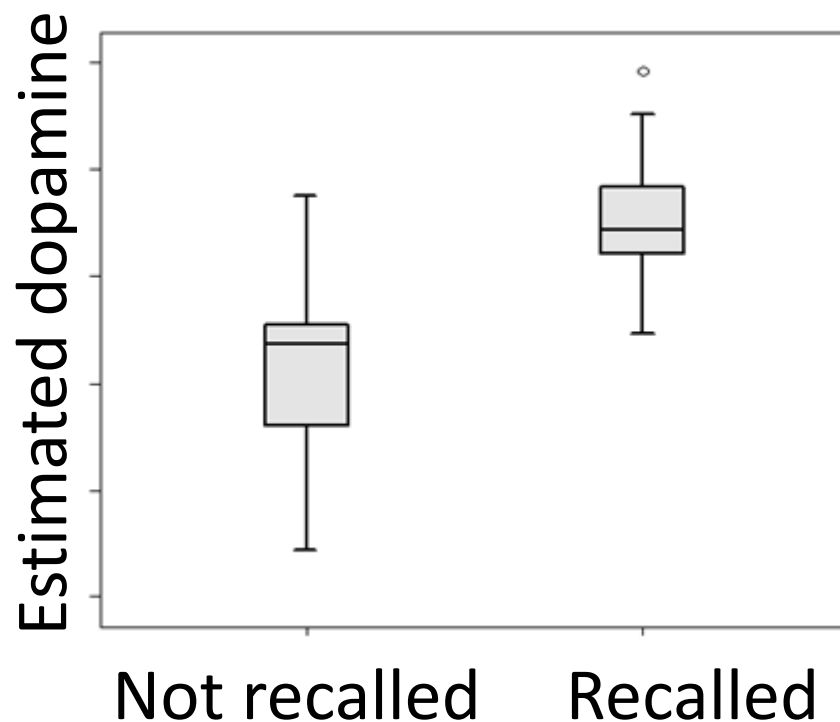
So now....we stick to age restrictions....

But beware the “vicarious player”

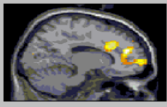


Reward response in a game also predicts factual learning – with potential application in education:

Estimating the brain's *response* to reward predicts factual memory in a learning game (better than the reward).



Howard-Jones, et al. (2011)



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Question



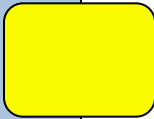
Option 1



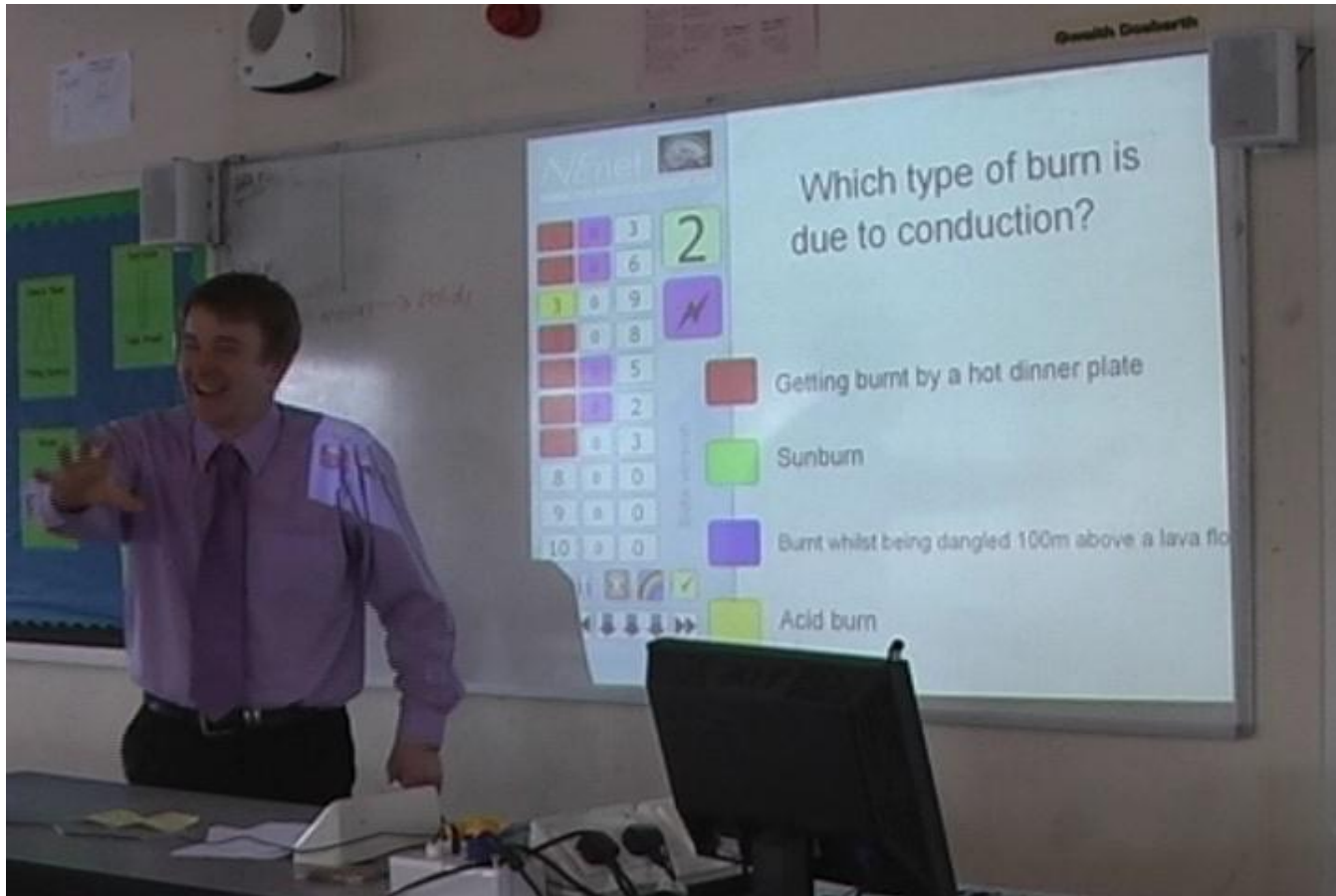
Option 2



Option 3



Option 4



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Many opportunities - Some risks

If risk = likelihood * consequence:

excessive use, disrupted sleep, aggression from violent gaming

Risks are avoidable: about **how** you use it

Information needed about **digital hygiene** for users, parents, developers, schools



Video gaming - “special” influence on the brain.

- * exceptional levels of engagement
- * exceptional enhancement of learning processes or “taking the brakes of adult plasticity” (Bavelier et al., 2010)

Same brain processes are generate technology’s potential for

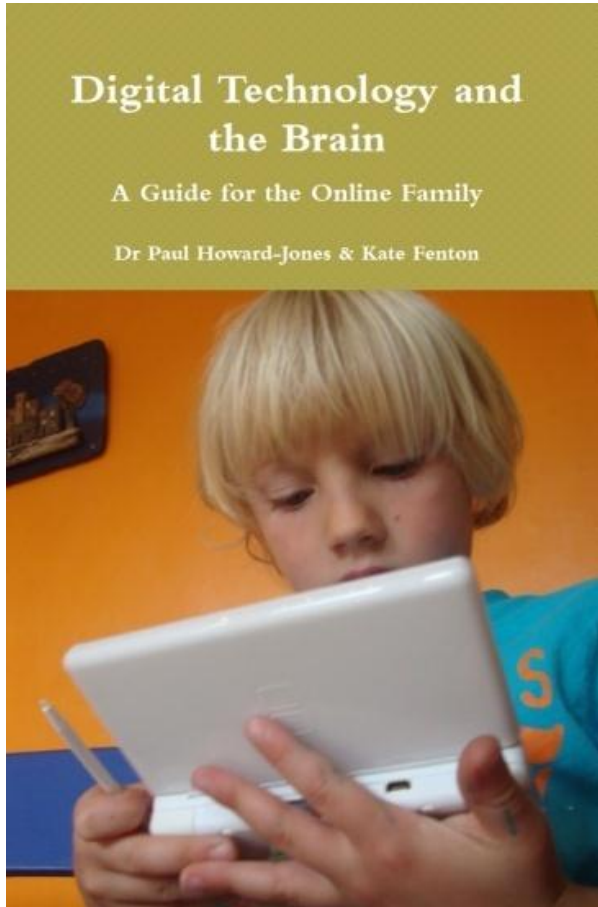
- * **hazard** (e.g. “addiction”, aggression)
and
- * **benefit** (skills, prosocial behaviour, education)

We need to

- * understand more about the neuroscience
- * to fully exploit technology for human benefit



Thanks for listening! 😊



Digital Technology and the Brain (2012)
Paul Howard-Jones and Kate Fenton

www.lulu.com

www.neuroeducational.net