

Do computer screens damage eyesight?

Prof Bruce Evans

BSc PhD FCOptom FAAO FEAOO FBCLA DipCLP DipOrth

Director of Research
Visiting Professor
Visiting Professor
Community optometrist
Governor, Brentwood School (since 2008)

Institute of Optometry
City, University of London
London South Bank University



1

PLAN

Introduction

Is there a radiation risk from computer screens?

Is there an eyestrain risk from computer screens?

Will computer use cause short-sightedness?

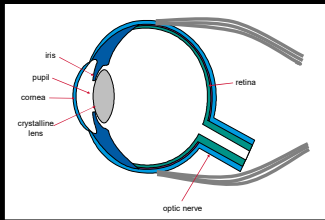
Top tips for comfortable & safe computer use

Conclusions

Full handout of slides from www.bruce-evans.co.uk

4

The human eye



7

PLAN

Introduction

Is there a radiation risk from computer screens?

Is there an eyestrain risk from computer screens?

Will computer use cause short-sightedness?

Top tips for comfortable & safe computer use

Conclusions

Full handout of slides from www.bruce-evans.co.uk

8

Radiation from computers?

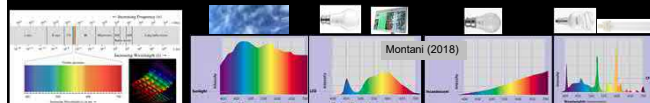
- Public Health England measured light emitted from LED light bulbs and computers (desktop, laptop, smartphones)
- "None of the sources assessed approached the exposure limits, even for extended viewing times"
- Natural exposure (e.g., sky) is far higher than computers
- But note that children will need computer screens to be dimmer than adults
- Conclusion: safe, but let children adjust for comfort

Centre for Radiation,
Chemical and
Environmental Research,
Public Health England,
Chilton, Didcot, Oxfordshire,
UK

Correspondence:
B O'Hagan, Public Health
England, Group Leader,
Laser and Optical Radiation
Dispersion Group, PHE,
Chilton, Didcot,
Oxfordshire, OX11 0BQ, UK

Low-energy light
bulbs, computers,
tablets and the
blue light hazard

© O'Hagan, M Khazova and LA Price
doi:10.1016/j.jphotobiol.2016.05.002



9

PLAN

Introduction

Is there a radiation risk from computer screens?

Is there an eyestrain risk from computer screens?

Will computer use cause short-sightedness?

Top tips for comfortable & safe computer use

Conclusions

Full handout of slides from www.bruce-evans.co.uk

13

Digital eyestrain (DES)/ computer vision syndrome (CVS)

- "ocular complaints as a result of looking at a computer monitor"
 Blehm et al (2005)
- Neck & shoulder problems sometimes included
 American Optometric Association (2015)

14

What is DES?

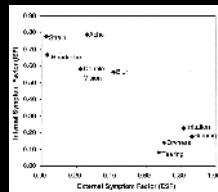
- Validated questionnaire
 - CVS-Q
 Segui et al (2015)
- Score of 6 or more taken to be indicative of DES. E.g.,
 - 6 of these if occasional & moderate
 - 3 symptoms if often & intense

	Frequency			Intensity	
	NEVER	OCCASIONALLY	OFTEN OR ALWAYS	MODERATE	INTENSE
1 Burning					
2 Itching					
3 Feeling of a foreign body					
4 Tearing					
5 Excessive blinking					
6 Eye redness					
7 Eye pain					
8 Heavy eyelids					
9 Dryness					
10 Blurred vision					
11 Double vision					
12 Difficulty focusing for near vision					
13 Increased sensitivity to light					
14 Coloured halos around objects					
15 Feeling that sight is wavering					
16 Headache					

15

Sheedy et al. (2003) Not about computers

- Is all eyestrain the same?
- Found 2 different types of eyestrain
 - External – mostly related to dry eye
 - Internal – mostly related to eye co-ordination & focussing problems
- Eyestrain first described over 100 y ago



18

Are computers the latest thing to be blamed for eyestrain?

"To some extent, DES may simply be a manifestation of eyestrain associated with intense use of the eyes"
 (Evans, 2018)



24

Case study

- 52 year old design engineer
- Visual requirements in different eras:
 - 1970s: would have needed reading glasses & eye exercises
 - 1990s: would have needed bifocals & eye exercises
 - 2017: no spectacles & no symptoms




25



26

Reading computers c.f. paper


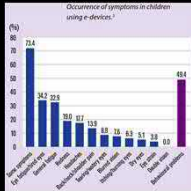


- More incomplete blinks with computers Portello et al (2013)
Chu et al (2015)
Argiles et al (2015)
- More symptoms with computers Chu et al (2011)
Hue et al (2014)
- Slightly slower with computers Hue et al (2014)
- Differences between different displays Hue et al (2014)
- For some, symptoms with computers reduced by coloured filters Rosenfield et al (2015)
- Little evidence to support the use of blue-blocking filters Lawrenson et al (2017)
Rosenfield & Li (2020)

29

What about children & teenagers?



- Study of 715 adolescents found Kim et al (2016)
 - Smartphone overuse associated with more symptoms
 - Recommend less than 2h daily use
- Dry eye is rare in children Alves et al (2008)
- If children do experience dry eye symptoms with smartphone use, on cessation the symptoms resolve after 4 weeks Moon et al (2016)
- Video games particularly likely to cause symptoms Rechichi et al (2017)
- Need more research on DES in children Sheppard & Wolffsohn (2018); Mylona et al (2020)

31

Is anyone particularly prone to DES?





- Eye co-ordination or focussing problems
 - Can be corrected with eye exercises or glasses Evans (2020)
- Sensory visual stress (Meares-Irlen syndrome) Evans & Allen (2016)
 - Controversial condition that may be helped by using coloured filters
 - May affect 20% of dyslexics, and some people with autism, migraine, epilepsy
 - Sensitive to flicker from computer monitors and fluorescent lighting
- Users of 3-D displays or virtual reality Fortuin, Lambool, Ijsselstein, Heyndericks, Edgar, Evans (2011)

32

What to do about DES?

- Regular eye exams Coles Brennan et al (2019)
- Regular breaks, that involve viewing far objects
 - Breaks need to involve viewing far objects Reddy et al (2013)
- 20:20:20 rule – proposed by Anshel in 1991 Chou (2018)
 - Lacks an evidence-base
- Ergonomics <https://www.nhs.uk/livewell/healthy-body/how-to-stay-healthy/>
 - Less light; avoid bright light or window behind computer Osterhaus et al (2015)
 - Feet on floor or box, top of screen at eye level, keyboard straight in front
- Other Reddy et al (2013)
 - Radiation/anti-glare filters over the screen not helpful
 - Dry eye can be helped by artificial tear drops or blinking exercises

33

Circadian rhythm, blue light, computers

- Our body clock (circadian rhythm) responds mostly to blue light
- Naturally, blue light peaks at mid-day, drops in evening
- Smartphone LEDs more blue than is natural in the evenings
- It is argued, viewing bluer light from smartphones & tablets at night interferes with circadian rhythm causing poor sleep
- Growing support for this view, but small effects Oh et al (2015); Grant et al (2016); Nose et al (2017); Heo et al (2017); Mortazavi et al (2018)





34

PLAN

Introduction

Is there a radiation risk from computer screens?

Is there an eyestrain risk from computer screens?

Will computer use cause short-sightedness (myopia)?

Top tips for comfortable & safe computer use

Conclusions

Full handout of slides from www.bruce-evans.co.uk

35

Myopia is increasing

- Common and increasing prevalence
 - 93% of Taiwanese medical students are myopic (Lin et al., 1996)
- Prevalence of myopia in UK has more than doubled in last 50y (McCullough et al., 2016)
- 50-53% of UK university students are myopic (Logan et al., 2005)

Morgan, Ohno-Matsui, Saw (2012), Myopia

37

What causes myopia?

- There is no one cause
- Partly genetic
 - Too little time outdoors
 - Too much near vision
- Partly environmental

- Emmetropia (normal vision)** - image shell focused on retina
- Hypermetropia (long-sighted)** - image shell focused behind retina
- Myopia (short-sighted)** - image shell focused in front of retina - eyeball too long - distance vision blurred

39

Time outdoors

- Time spent outdoors protects against myopia development
 - but probably not helpful to control myopia progression or termination (Pan et al (2012); Logan (2015))
- 2% reduction in the odds of myopia for every extra hour per week spent outdoors (Pan et al (2012); Logan (2015))
- Urban environment triples risk of myopia (Rudnicka et al (2016))
- Independent of other risk factors (parental myopia, time reading) (Shah et al (2017))
- Recommendations: 1 to 3 hours a day outdoors (Shah et al (2017); Logan (2015); Gifford & Gifford (2019))
- Mechanism involves light levels, looking in the distance (Pan et al. (2012))

40

Near work

- Most studies find weak association between near work and myopia, independent of time outdoors (Shah et al (2017); ALSPAC)
- Closer viewing distance linked with myopia prevalence (Saxena et al (2015); Hsu et al (2016); Zhou et al (2016))
- Resting after 30min near vision reduces risk
- Additional risks: smaller TV, more TV, more computer games

41

What to do?

British Journal of Ophthalmology 2019

Protective behaviours of near work and time outdoors in myopia prevalence and progression in myopic children: a 2-year prospective population study

Pin-Chen Huang^{1,2}, Yu-Chuan Hsiao¹, Ching-Yao Tsai¹, Der-Cheng Tsai^{1,3,4}, Chia-Hsin Chen¹, Chia-Chieh Hsu^{1,5}, Shih-Chieh Huang¹, Meng-Hui Lin¹, Hsiang-Mei Liao^{1,6,7}

- Huang et al (2019, BJO) find the following reduces myopia prevalence & progression:
 - near vision > 30cm
 - discontinuing near work at least every 30min
 - spending school breaks outdoors
- Simplified to patients as "30:30 OUT rule" & "balanced vision" (Evans (2020))
- No strong evidence that digital screen time contributes to myopia (Lanca et al (2020))

42

Caveats

- No one thing has a large effect on myopia
- A diagnosis of myopia is not very bad news
 - But, it carries a slight risk of eye diseases in later life
 - The higher the myopia, the higher the risk
- This talk has concentrated on environmental factors
- Myopia control is a growing specialty in optometry
 - Specialist contact lenses slow myopia progression by ~50%
 - www.myopiacontrol.com
 - www.globalmyopiacontrol.org
 - Myopia control eye drops & spectacles are likely to come to the UK soon
 - ...but that's another story!

43

PLAN

Introduction

Is there a radiation risk from computer screens?

Is there an eyestrain risk from computer screens?

Will computer use cause short-sightedness?

Top tips for comfortable & safe computer use

Conclusions

Full handout of slides from www.bruce-evans.co.uk

44

The setup

- Fit the workstation to the child, not the child to the workstation
- Room lighting: Avoid reflections & glare
- Computer lighting: let the user adjust
- No prolonged near vision closer than 30 cm
 - Large screen may make 50 cm+ possible
 - Likely to be better than reading a book in class
- Computer games of more concern than schoolwork
 - More engrossing
 - Often, closer distances



45

Breaks & balanced vision

- 30-30-out
 - Near vision at >30 cm
 - Discontinue near vision every 30 mins to look in the distance
 - Breaks OUTdoors
- We all know about balanced diet...consider **balanced vision**
 - Balance time indoors with time outdoors
 - Balance near vision with distance vision
 - Outdoor lighting is good, but use sunglasses if bright
- If sports and outdoor play didn't exist, we would invent them!
- Brentwood Prep Forest School initiative is good for eyes



46

PLAN

Introduction

Is there a radiation risk from computer screens?

Is there an eyestrain risk from computer screens?

Will computer use cause short-sightedness?

Top tips for comfortable & safe computer use

Conclusions

Full handout of slides from www.bruce-evans.co.uk

47

Conclusions

- Computers are not radiation hazards, but use Night Shift/Night Light
- Eyestrain can result from any intense use of the eyes
- Regular eye exams (after lockdown!)
- 1. Keep prolonged near vision at least 30 cm from the eyes
- 2. Vary the distance you look at – balance near with distance vision
- 3. Spend breaks outdoors, especially during lockdown
- 1-3 have a small effect individually, but together may reduce eyestrain and the risk of myopia



48

Questions?

133