

# The impact of touchscreen on early child development: Is it really all bad news?



**Annette Karmiloff-Smith**  
**Professorial Research Fellow**  
**Birkbeck Centre for Brain & Cognitive Development**  
**University of London**

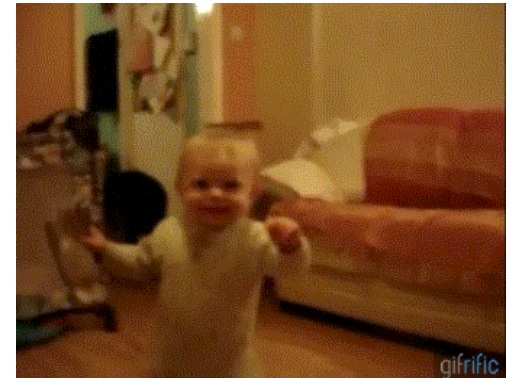
# Humans are born early in their developmental trajectory



< 1 day



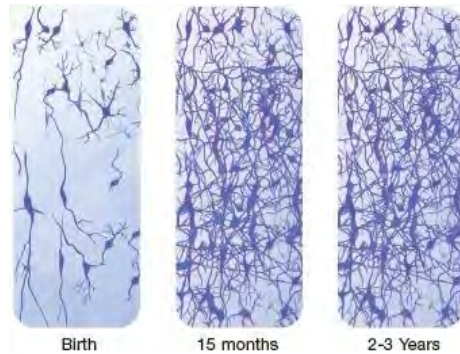
~ 2 weeks



~ 1 year!

**So brain remains plastic, and interaction with social and physical environment (e.g. TV/tablet use) can have significant impact on human neuro-cognitive development over time**

# Neural plasticity

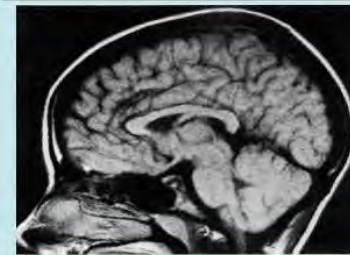


**Dynamic process of strengthening of some connections and pruning of less used ones, as a function of processing environmental stimuli (sound, vision, touch, smell)**

MRI scan of a newborn



MRI scan of a teenager



# Which environmental factors might influence neuro-cognitive development?



**Sleep**

**TV/DVDs**

**Tablets**

# **Sleep: Previous assumptions**

**1. Apart from gross body movements, foetus is asleep waiting passively to be born**



**2. When newborn and young infant go to sleep, their brain takes a long rest to replenish energy stores**



**3. Sleep comes naturally to infants**

**Now established importance of intrauterine sleep for breathing practice of foetus.**

**Active auditory learning from 7<sup>th</sup> month of intrauterine life**

**Importance of sleep for foetal learning??**



# Clues to importance of sleep for learning

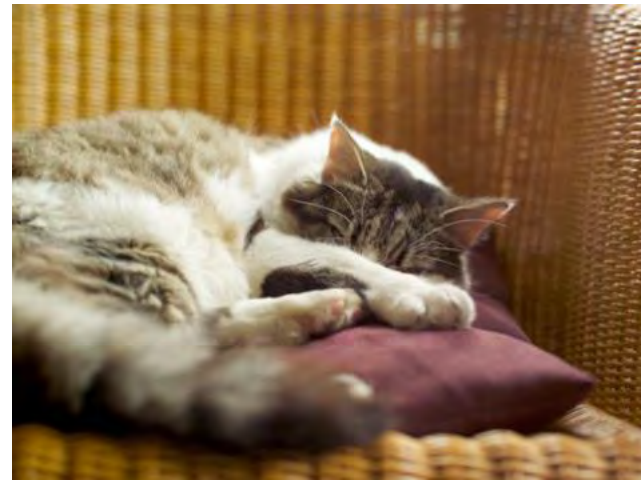


Resting group *without* sleep

Resting group *with* sleep

**Sleeping birds:** Learn faster and more accurately  
Bird's brain activity *during sleep* is similar to when bird  
is singing during wakefulness





**Two groups of cats received same environmental training.  
Then, one group *slept* 6 hours;  
Other group was kept awake & received *6 extra hours* of training.**

**Sleeping cats with less training developed *twice the amount of brain connectivity* than non-sleeping group with twice the training**

**Attention! Exams....**

# What about sleep in infants and toddlers?

**Paradoxically, sleep is the main 'activity' during early development**

**By age two:**

**10,000 hours spent asleep**

**7,500 hours spent awake**



# Why do infants sleep so much?

**When awake, baby can't switch off from multiple stimuli from outside world (hear, see, feel, smell)**

**With sleep, baby's ears and eyes are at rest, with lowered state of consciousness, enabling the brain to self stimulate, concentrating on what's going on *inside* rather than outside.**



**Some parts of brain (e.g., prefrontal cortex) are inhibited by neuro-chemical changes during sleep, whereas other parts of brain (particularly brainstem and midbrain) are more active during sleep than during wakefulness.**

***Brain auto-stimulates during sleep, brain activity almost doubling during REM sleep = lighter and from which infants awaken easily***



**So sleep plays critical role in brain and socio-cognitive development**



# **What about the role of media?**

- **TV and DVDs**
- **Tablets**

# Parents, Policy Makers & Media concern

Google infant tablet use

Web Shopping Images News Videos More Search tools

About 3,470,000 results (0.36 seconds)

**Doctors issue warning over infant use of computer tablets ...**  
www.naturalnews.com/042977\_computer\_tablets\_infants\_developmenta...  
20 Nov 2013 - Doctors issue warning over infant use of computer tablets. ... Tags: computer tablets, infants, developmental problems. eTrust Pro Certified.

**Our baby sleeps in our bedroom, is it safe to use a laptop or ...**  
www.babycentre.co.uk/.../our-baby-sleeps-in-our-bedroom-is-it-safe-to-...  
Can radiation from laptops, tablets or WiFi harm your baby? Our expert answer.  
BabyCentre.

**Is screen time good or bad for babies and children? ...**  
www.babycentre.co.uk/.../is-screen-time-good-or-bad-for-babies-an-...  
Touch-screen technology makes it very easy for babies to use tablets. ... Time spent playing with a tablet or smartphone means your baby is missing out on ...

**Infants 'unable to use toy building blocks' due to iPad addiction**  
www.telegraph.co.uk/.../Education/...  
15 Apr 2014 - Rising number of infants unable to use motor skills needed to play with building blocks because of an "addiction" to tablet computers and ...

**Tablets and Smartphones: Not for Babies - HealthyChildren ...**  
http://www.healthychildren.org/.../Tablets-and-Smartphones-Not-for-Ba...  
5 May 2015 - The connection between tablets or smartphones and infant learning. ... Unfortunately, when the use of tablets, smartphones, and computers is ...

**Are iPads and tablets bad for young children? - The Guardian**  
www.theguardian.com > Society > Children  
8 Jan 2014 - BabyLab – note the hi-tech intercapital – is Australia's first infant ... The difficulty for parents is that the dangers of tablet use for children – if ...

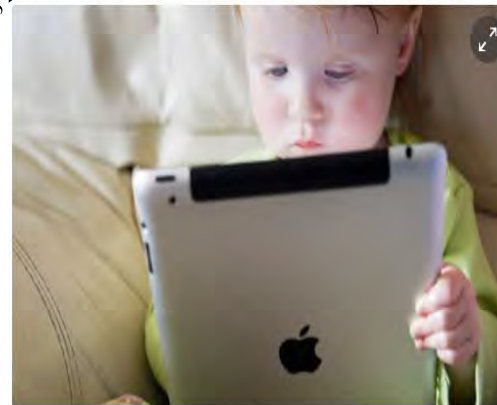
**Tablets and smartphones may affect social and emotional ...**  
www.theguardian.com > Technology > Tablet computers  
1 Feb 2015 - Journal findings warn that using a tablet or smartphone to divert a child's attention could be detrimental to ... Baby girl with her iPad2.

**Should Your 2-Year-Old Be Using an iPad? | TIME.com**  
healthland.time.com/.../no-screen-time-for-2-year-olds-do-ipad-apps-cou...  
20 Oct 2011 - From "Baby Touch: Peekaboo" to "Moo, Baa, La La Lal," iPad apps for ... Tablets used like a TV should fall under the same guidelines, says ...

## Tablet computers

### Tablets and smartphones may affect social and emotional development, scientists speculate

Journal commentary warns that using a tablet or smartphone to divert a child's attention could be detrimental to "internal mechanisms of self-regulation"



Researchers at Boston University School of Medicine found that use of interactive screen time under 30 months could also impair a child's development of the skills needed for maths and science. Photograph: Alamy

Joanna Walters in New York

@Joannawalters13

Monday 2 February 2015 16:28 GMT



Shares 44,074 Comments 279

Using a smartphone or iPad to pacify a toddler may impede their ability to learn self-regulation, according to researchers.

In a commentary for the journal Pediatrics, researchers at Boston University School of Medicine reviewed available types of interactive media and raised "important questions regarding their use as educational tools", according to a news release.

News Society Autism

### Research linking autism to internet use is criticised

A row erupts between Lady Susan Greenfield, a fellow academic and autism campaigners over 'unsubstantiated claims'

Tracy McVeigh

The Observer, Saturday 6 August 2011 22:23 BST

Jump to comments (302)



Lady Susan Greenfield's suggestion that the rise in autism may be linked to increased internet use has sparked controversy. Photograph: Marco Secchi/Getty Images

Controversy has erupted over comments made by the leading neuroscientist Lady Susan Greenfield suggesting links between the increase in internet usage and the rise in autism.

“Giving tablets to infants/toddlers is tantamount to child abuse” (House, 2015)

# American Association of Pediatrics (AAP) guidelines

(2015)

- AAP Council on Communications and Media issue guidelines on media use
- Adopted by Australia, Canada, UK
- 1999: *blanket ban* on screen-time < 2 yrs  
2015: softened to ‘*discouragement*’  
2016: indication that guidelines will shift to watch in ‘*moderation*’

## PEDIATRICIANS SHOULD RECOMMEND THE FOLLOWING TO PARENTS

- Limit the amount of total entertainment screen time to <1 to 2 hours per day.
- Discourage screen media exposure for children <2 years of age.
- Keep the TV set and Internet-connected electronic devices out of the child's bedroom.
- Monitor what media their children are using and accessing, including any Web sites they are visiting and social media sites they may be using.
- Coview TV, movies, and videos with children and teenagers, and use this as a way of discussing important family values.
- Model active parenting by establishing a family home use plan for all media. As part of the plan, enforce a mealtime and bedtime “curfew” for media devices, including cell phones. Establish reasonable but firm rules about cell phones, texting, Internet, and social media use.

# What is the *scientific* evidence?

- TV and DVDs
- Tablets





# Background



- Strong reactions against TV/DVDs for infants, but based on emotion, not scientific evidence

Don't park your baby in front of a TV  
but OK to park baby under a mobile...??



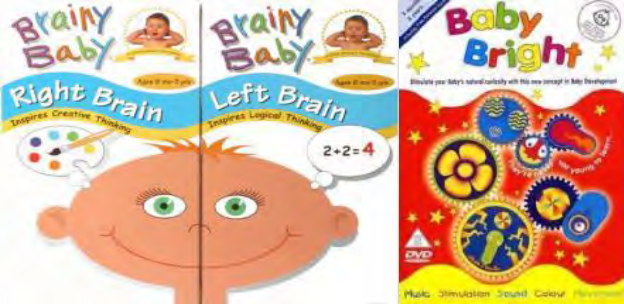
Producers claim that their DVDs provide rich learning environment, but without *any* scientific evidence

# Putting science into a baby DVD

Based on scientific knowledge about infant visual and auditory systems and fact that early on vision reacts to movement

## **Aim: to stimulate developing visual skills**

- lots of repetition
- learning to anticipate where items will reappear
- making corrective saccades
- representing items across modalities (sound/vision) and formats
- reinstating whole objects from partial occlusions
- use of faces and particularly dynamic eye gaze direction
- active tracking of objects from peripheral to central to peripheral  
(vs static books/mobiles that remain in central vision)
- Stimulate auditory system by changes in voices (child/adult/male/female)



# Predictions:

A *science-based* DVD will more likely engage babies' *active participation* than a DVD that is only *aesthetically pleasing* to infants and their parents.

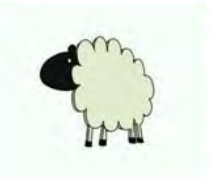
# Approach:

Compare visual responses of infants during a “*science*” and “*non-science*” clip from commercially available baby DVDs



Tessa Dekker

# Example: number

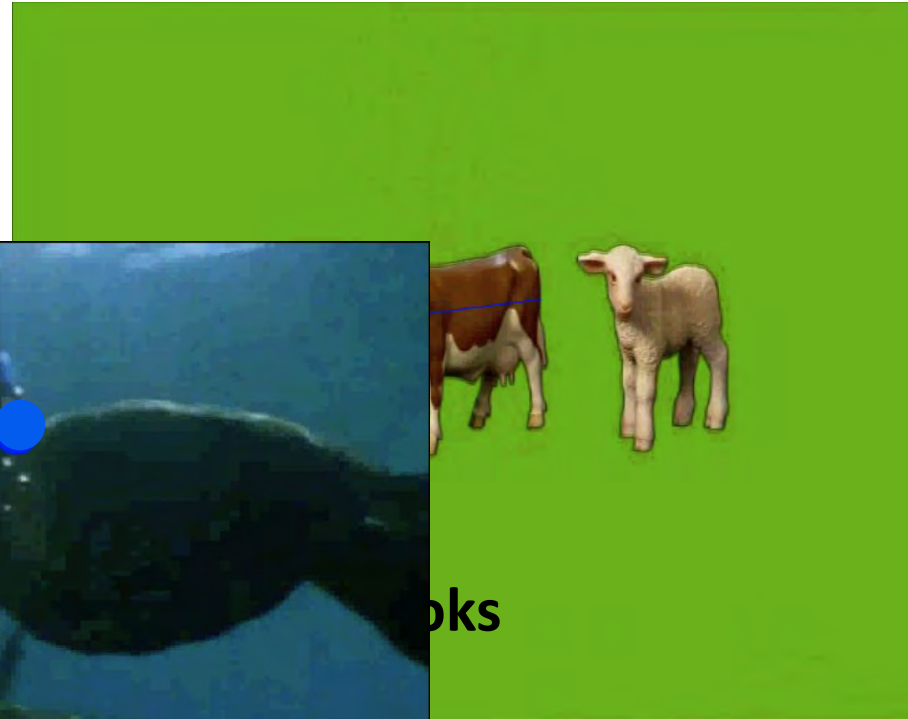
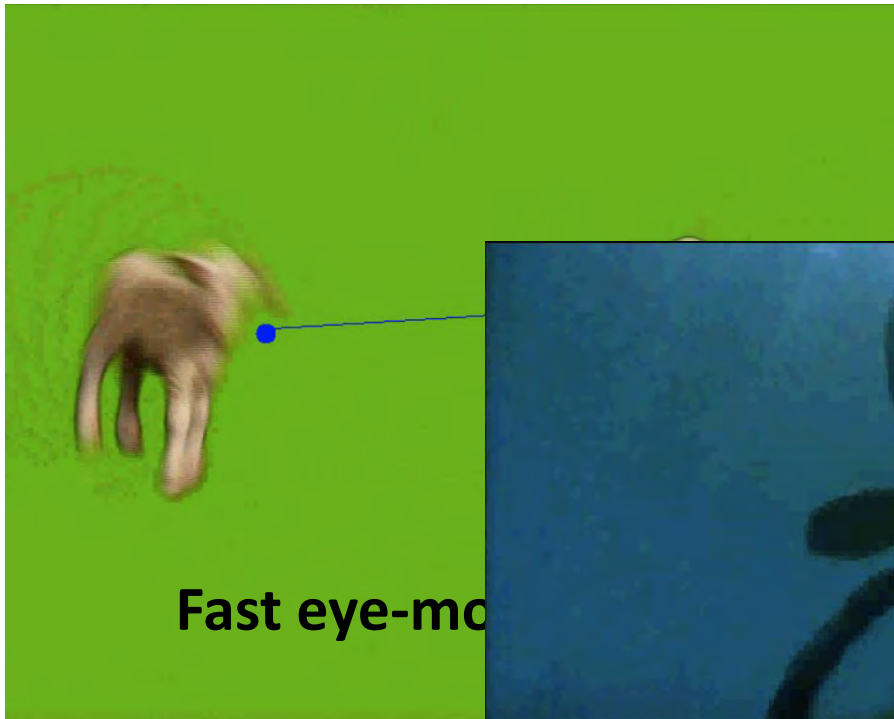


Science DVD



Non-science DVD

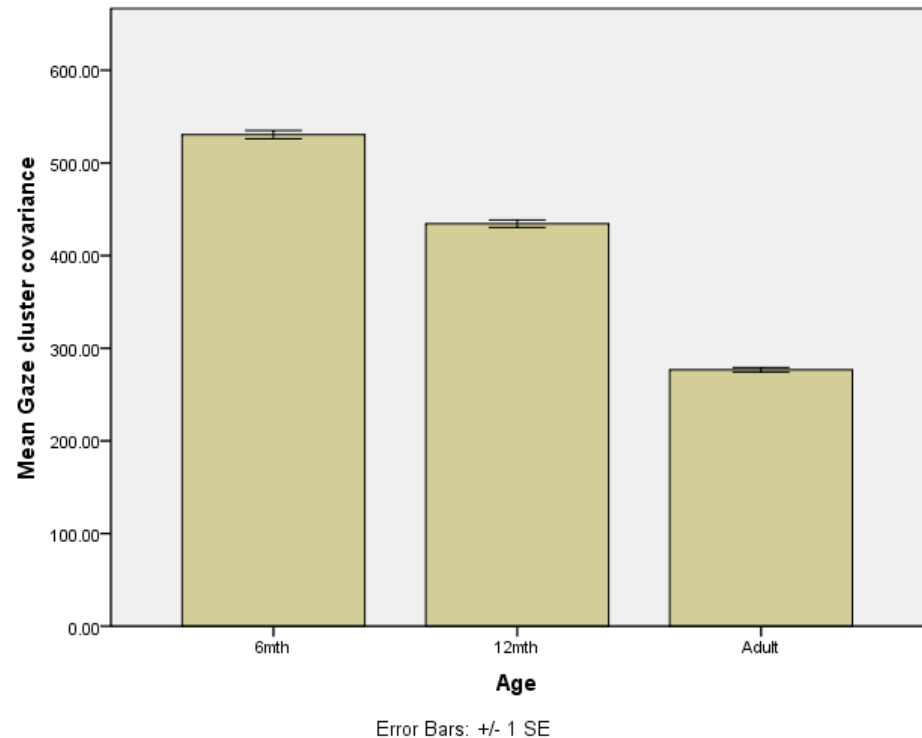
# Infant visual responses:



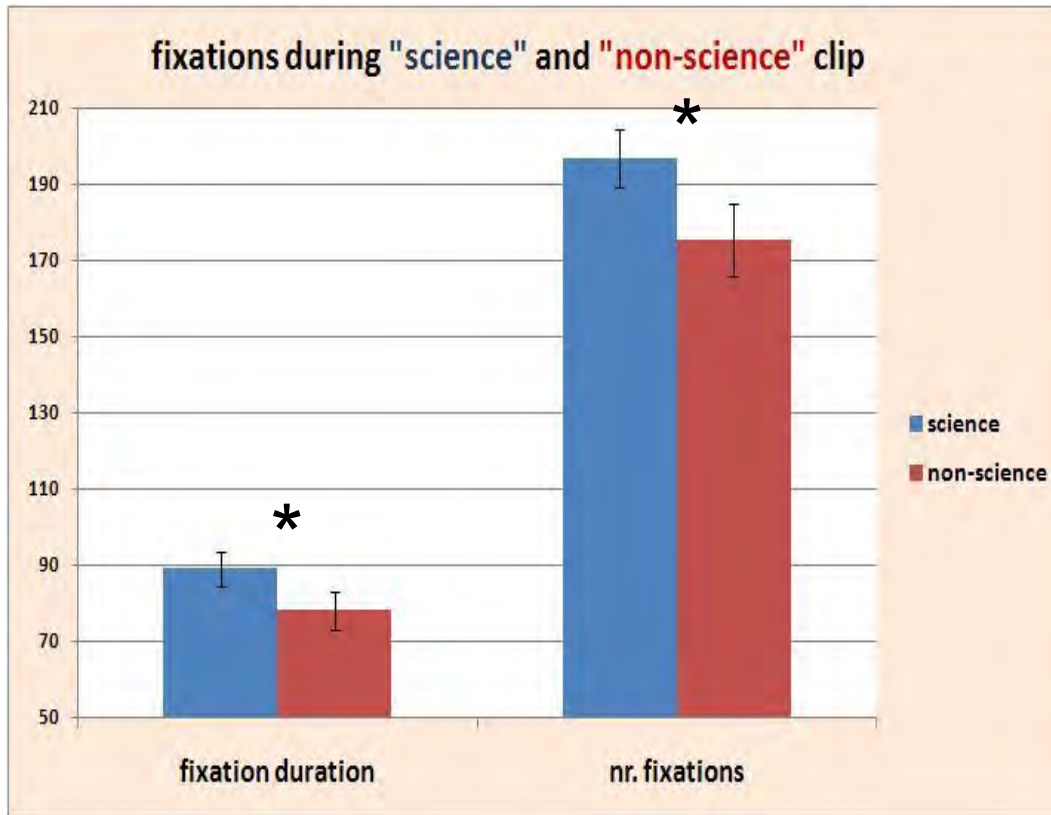
# Results: Attentional Synchrony

- Hypothesis 1: Gaze clusters will get tighter with age, allowing viewers to parse foreground from background, and identify objects of interest.
- Hypothesis 2: Infants will struggle to parse more complex scenes, leading to less attentional synchrony

Mean gaze clusters

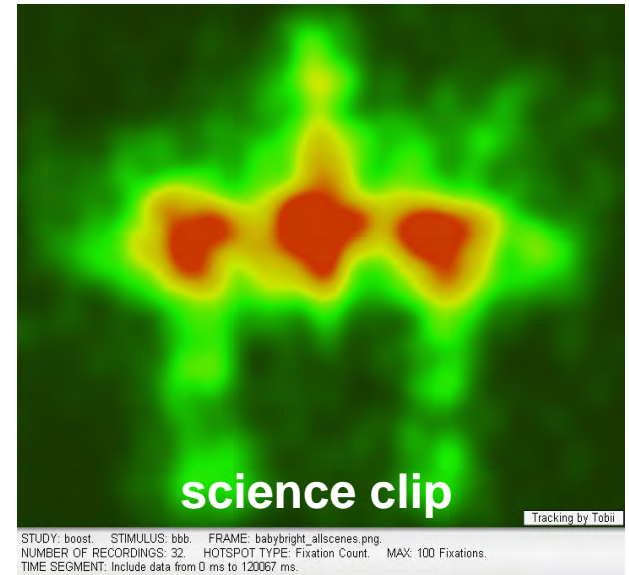


# Results: Visual Fixations

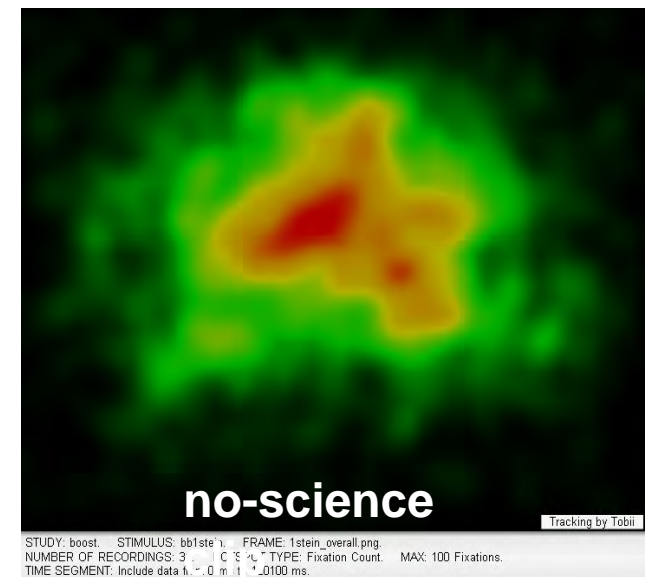


## During "science" clip:

- ✓ More fixation overall
- ✓ More fixations at different locations



"three"



# Conclusions on TV/DVDs

- Scene complexity makes difficult for 6-mth and 12-mth olds to identify focal features in a scene, leading to less gaze clustering than adults.
- Sensitivity to *social features* (*faces, eyes, hands*) helps parse dynamic scenes as early as 6-mths.
- Design of infant-directed videos: minimise scene complexity (via high-contrast backgrounds/repetition/ sequential presentations) and include frequent social features. The Science DVD had more of these features than the non-Science one
- How infants perceive the attended information and how this impacts cognitive development requires further research:
- ? sensitivity to numerosities->number development.



# Conclusions on TV/DVDs

The design/content of a DVD influence the way 6-12 month-olds process it: science clip generated **more visual attention, more sustained attention and more fixations on different screen locations**

Results are in line with prediction that a **DVD that incorporates developmental science** is more likely to engage babies' *active participation* than a DVD that is merely “**aesthetically pleasing**” to parents and infants

**BUT**

Even “Science” DVDs are, like TV, fairly passive: they may stimulate the visual/auditory systems, but not the fine motor system,

and child is **not** in control



→ **TABLETS**

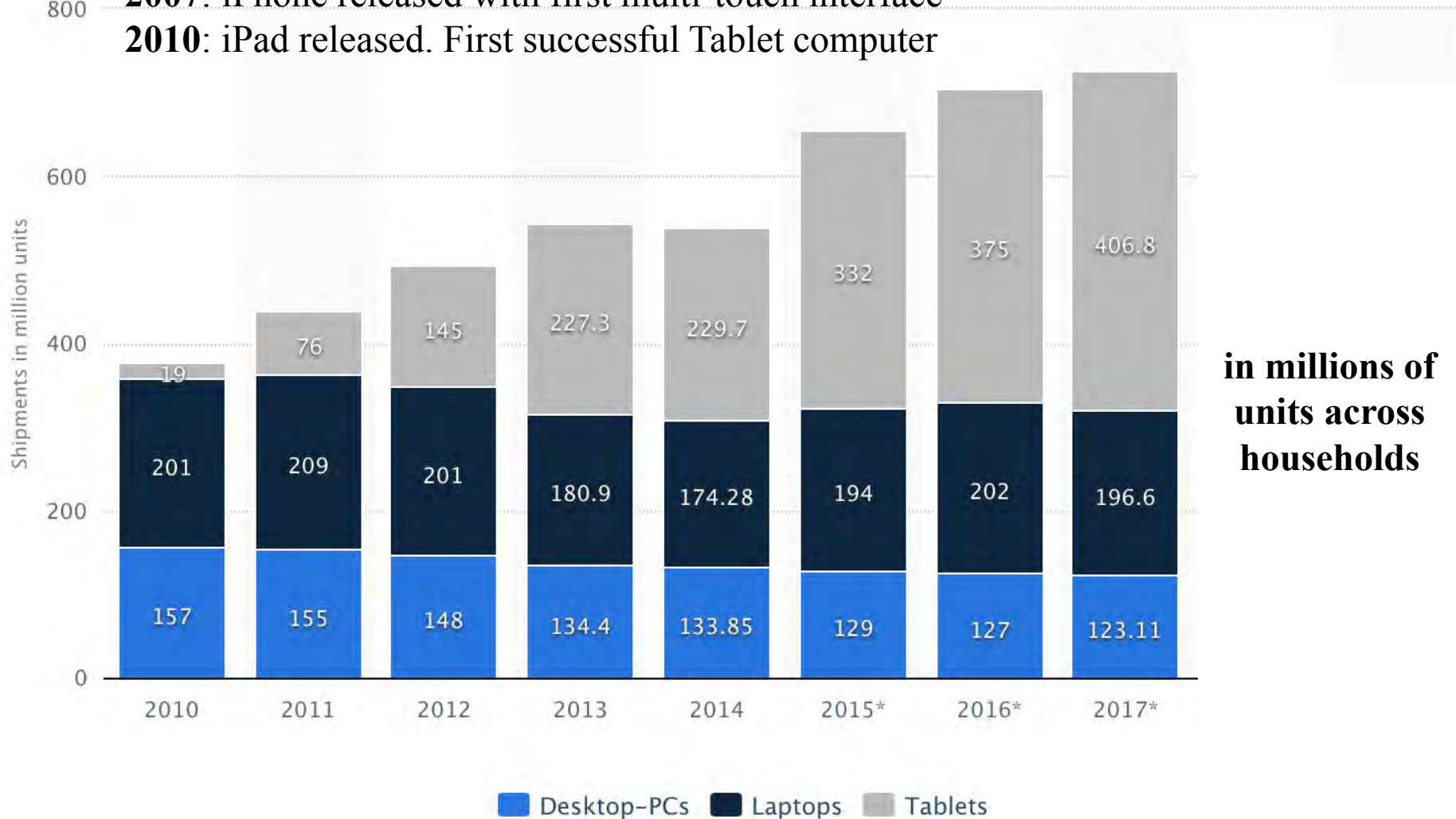


# What is the *scientific* evidence?

- TV and DVDs
- Tablets

# Tablets are taking over....

2007: iPhone released with first multi-touch interface  
2010: iPad released. First successful Tablet computer



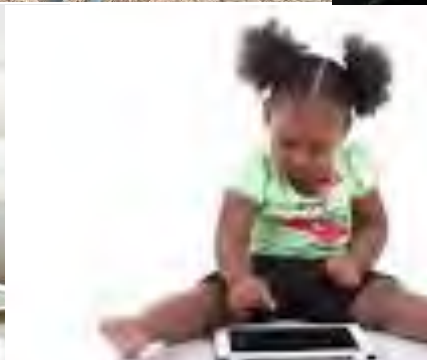
# Touchscreen technology is changing children's sensory environment.

UK family ownership:

7% in 2011

**71% in 2014!**

But what are the *scientifically* established pros and cons? (rather than *emotional* ones)



Touchscreens offer: **intuitive interface**, enabling toddlers to gain **intense contingent sensory stimulation and immediate feedback**.

Introduced during **peak period of brain development** and at an age when the relatively immature motor and linguistic systems have in the past **placed limits on cognitive stimulation**.

**Tablets overcome those limits. How frequent are they?**



# Toddler Touchscreen use

**Cristia & Seidl** (*PLOS One*, 2015)

Online survey of French parents  
re 450 5–40 mth-olds

## Findings

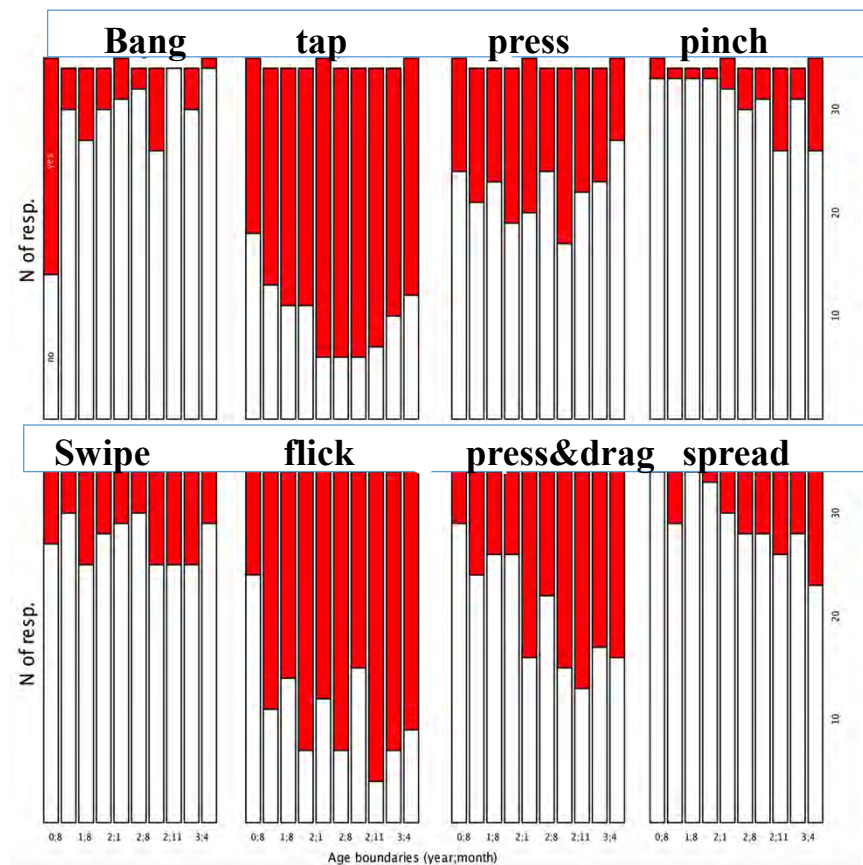
2015: 58% 5-20mth olds had used a  
touchscreen

(up from 33% in 2013; Rideout et al)

Complexity of gesture, apps used and  
use duration increases with age.

Findings broadly replicated in  
Northern Ireland (Ahearne, et al., 2015)

USA (Kabali et al., 2015)



# TABLET: Toddler Attentional Behaviours & Learning with Touch-screens project:



**Tim Smith, Birkbeck (PI)**



**Celeste Cheung, Birkbeck**



**Irati R. Saez de Urabain, Birkbeck**



**Rachael Bedford (KCL)**



**Annette Karmiloff-Smith, Birkbeck**

(much more in depth than the French study)

## **Students:**

Mariam Saeedi, Zuber Mohamed, Ana Maria Portugal Silva, Cathy Rogers, Shaili Shah

# What effect might usage have?

Not all use is the same! (Hirsh-Pasek et al, 2015)

## Research with *adults* and *older children*:

**POSITIVE:** *Actively* playing video games has been shown to predict enhanced visual processing, attention and motor control (Green & Bavelier, 2008)

**NEGATIVE:** *passive* TV viewing has been related to a decrease in language ability (Schmidt et al, 2009) although other factors, e.g. socioeconomic status, need to be controlled.

## What about impact of tablet use on much younger children?





# TABLET PROJECT:

## What is the influence of touchscreen use on *toddler* cognitive development?

**Age ranges:** 6 to 36 mths (+ intense sampling @ 12 & 17 mths)

### Aims

1. Describe usage in a large sample  
→ Online use survey
2. Identify relationships between usage/type of use and parent-report developmental markers  
→ Administering standardised questionnaires online.
3. Identify differences in objective neurocognitive and behavioural markers between Users and Non-Users.  
→ Lab-based experiments.



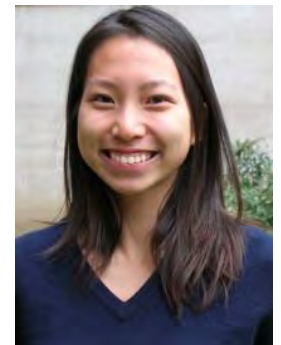
# Specific infant/toddler research questions

- Does *active* touchscreen use increase attention and **executive functioning** (disengagement, inhibition and working memory)?
- Does *active* touchscreen use improve fine but not gross motor control?
- Is *passive* viewing related to lower linguistic and social abilities?
- Does use of tablet delay developmental milestones?



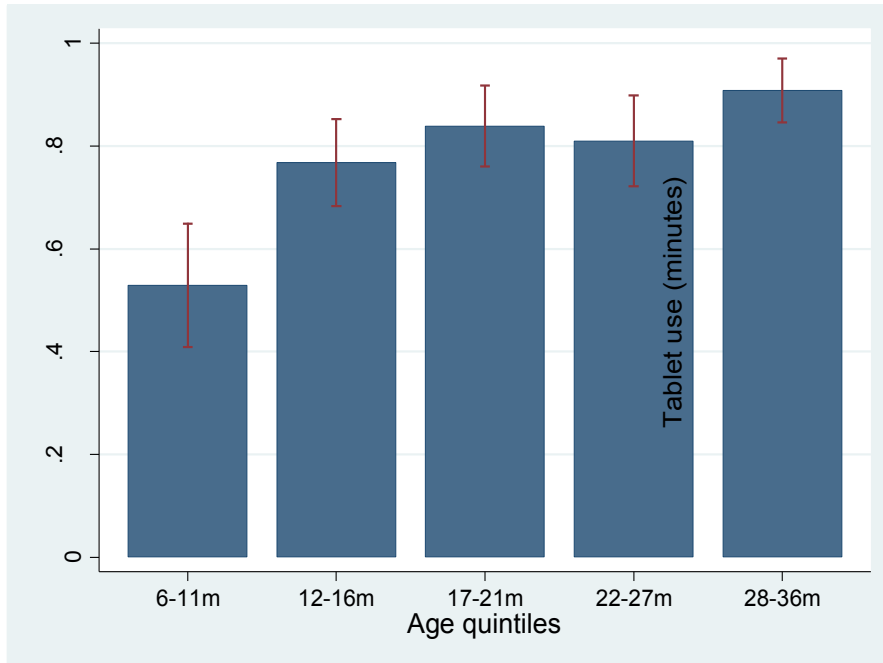
# Outline of TABLET study

1. **Short on-line questionnaire:** Tablet use, Sleep, Temperament (IBQ/ECBQ), Developmental Milestones
  - 1<sup>st</sup> phase now complete
  
2. **Lab study:** Babies split into 2 groups:  
low-use (0 mins)/high-use (>10 mins per day)
  1. Visit 1 (@ 12 mths): on-going
    1. PCI
    2. Mullen Early Learning Scales
    3. Actigraphy
    4. EEG
    5. Eye Tacking
  
  2. Visit 2 (@ 17 mths): Repeat protocol

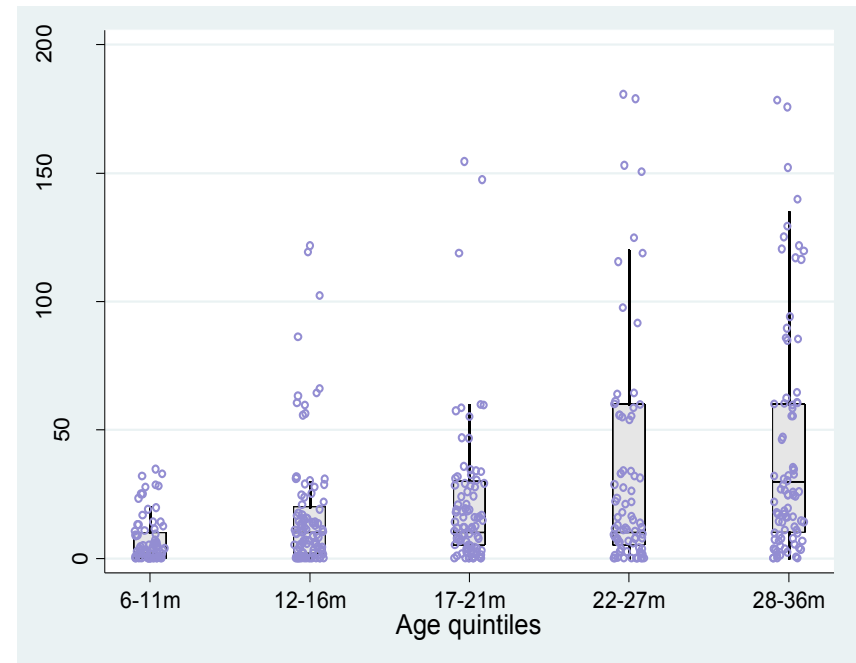


**Celeste Cheung**

# Results: Touchscreen Usage



(a) Proportion of touchscreen users for each age quintile (6 -36 mths)



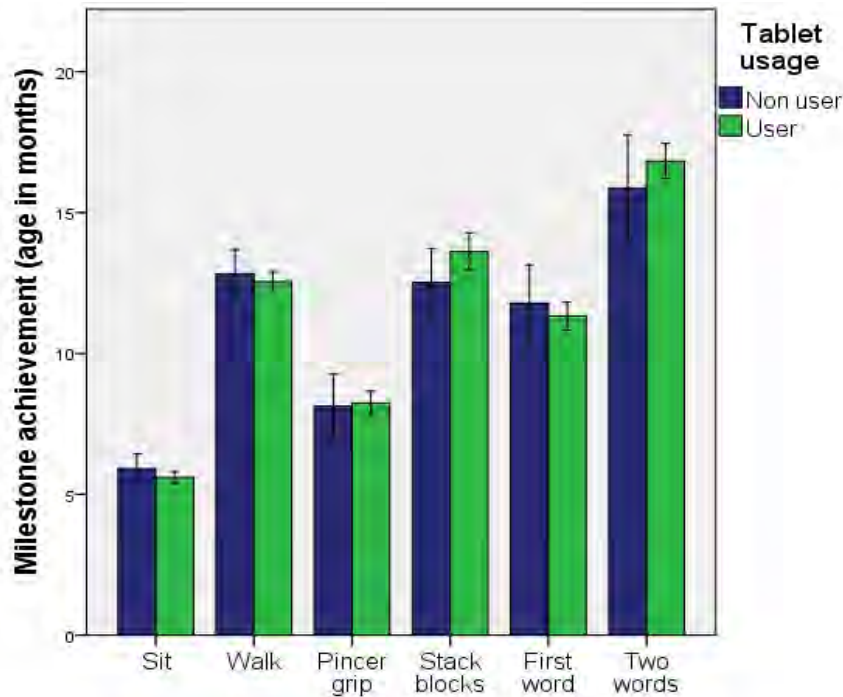
(b) Relationship between age and mean daily tablet usage (minutes).

- Mean ownership = 3.7 devices per household (SD = 1.46, range 0 – 14)
- 10% of 6-36 mth olds actually “own” a touchscreen device. Ownership increased from 0% among 6-11 month-olds to 26% for 28-36-month-olds
- Average use increased from **6.88 mins *per day*** at 6-11 mo. to **40.39 mins *per day*** at 28-36 mo.

# Results: Effect on developmental milestones

## Between USERS/NON-USERS

= No relationship between tablet use/non-use and age of reaching milestones.



## Amongst USERS (active vs passive)

= Age of first *active* scrolling is a predictor of later fine motor milestone (controlling for early fine motor milestone).



= No positive or negative relationships with gross motor or language milestones in tablet users.

= Negative relationship of *passive* users with sleep and temperament measures

# Specific research questions

Does *active* touchscreen use increase attention and **executive functioning** (disengagement, inhibition and working memory)? **Awaiting results of live testing in phase 2 of study**

Does *active* touchscreen use improve fine but not gross motor control? **YES!**

Is *passive* viewing related to lower linguistic and social abilities? **NO!**

Does tablet use delay achievement of developmental milestones? **NO!**



# Summary

- The TABLET sample suggests prevalence and type of touchscreen usage in 6-36 mth olds is similar to other nations.
  - NOTE: by 17 mths 84% of our sample violate AAP guidelines of zero-use!
- No evidence of developmental delay in users vs. non-users. Negative relationships only with *passive* users.
- Earlier *active* touchscreen use (“scrolling”) predicts earlier fine motor milestone (“stacking”).
  - Direction?
- Mechanisms?: Lab-based assessments will provide *objective* measures of cognitive development *longitudinally*.

# TIPS for good use of DVDs/TV/TABLETS in home or nursery school settings (for discussion)

Never have TV/tablet in child's bedroom at night or in nursery school sleeping area

Never leave TV on as background – teach children to turn it off

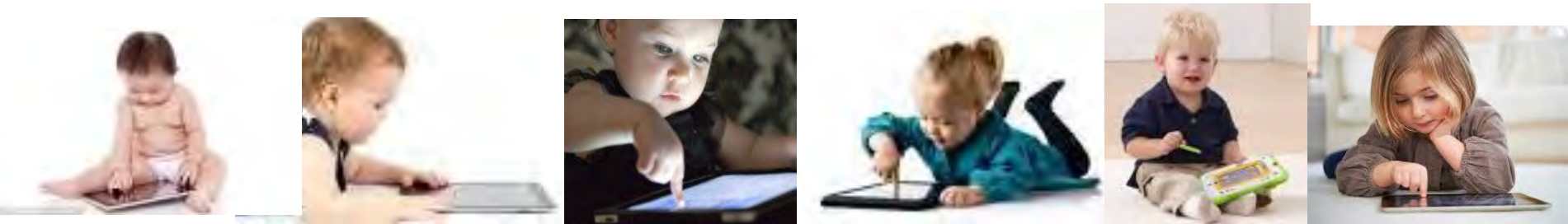
Stand behind/on side of screen and make sure baby's eyes are moving, and baby is actively “thinking” – Not passive (mesmerized) observer!

Never leave baby parked *alone* with DVD/TV/TABLET  
Baby DVDs/TV/tablets obviously don't replace real-life social interaction, but they can be used interactively, just like books



**Infant visual, auditory and motor systems can be actively engaged by DVDs/TV/tablets, *especially* when scientific knowledge about infant development is incorporated into programmes and apps. Important that child is *active***

**Not a plea to replace books/toys with touchscreens, but is a plea to recognise the potentially important influences touchscreens may yield**







@TABLETproj



tablet\_project@bbk.ac.uk

# DO YOU HAVE A CHILD AGED 6 MONTHS - 3 YEARS?

WOULD YOU BE INTERESTED IN HELPING WITH A SCIENTIFIC  
STUDY OF THE EARLY USE OF TOUCHSCREEN DEVICES?



The Toddler Attentional Behaviours and Learning with Touchscreens (TABLET) project aims to investigate how the use of touchscreen devices influences cognitive, brain and social development in children.

We are looking for infants and toddlers who are **users** or **non-users** of touchscreens.

**VISIT US**

**[www.bbk.ac.uk/tablet\\_project](http://www.bbk.ac.uk/tablet_project)**

Twitter: @TABLETProj

