Early-Life Screen Time, Social Engagement and Childhood Development

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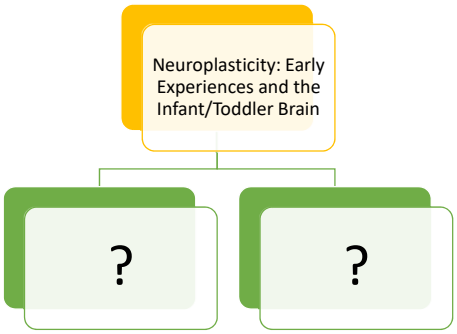
What This Talk will Cover

- Background Science Impacting Research on Early-Life Screen Time and Social Engagement
- Our Drexel Research Studies
- Review of the Literature:
  - Association Studies
  - Intervention Studies

Autism Risk/Protective Factors

Autism Prevalence 1980: 4 in 10,000, 2020: 1 in 36 children in US

- Awareness/diagnostic criteria
- **Genetic**, 50-80%, does not determine outcome except in syndromes
- **Modifiable Environmental Exposures**



Parent-Child Interactions that Predict Positive Developmental Outcomes:

A. Parental responsiveness to child
B. Verbal Stimulation
C. Parental involvement in child's toy play

Hedenbro et al., 2014
Page et al., 2010
Smith et al., 2006
Tamis-Lemonda et al., 2001

Screens (background, child oriented and parental mobile use) disrupt social experience:

- **Parent responsiveness** to child and child's interests (Kirkorian et al. 2009)
- Both **parental language** and **child verbalizations** (Christakis et al. 2009)
- **Parental involvement** with play (Kirkorian et al; Courage et al. 2010)
- **Parent responsiveness, eye contact** with parent mobile device use (Radesky, 2014)

Young Children Do Not Learn Well From TV/Video (Video Deficit)

- **Imitation** (Barr et al. 1999)
- **Finding hidden objects** (Schmidt et al. 2007)
- **Language learning** (Kuhl et al. 2003)

What predicts learning?

- **Joint Attention:** Child looking back and forth between adult's eyes and object of interest (Conboy, 2015)

Early TV/Screen Media Viewing Associated with Developmental Outcomes

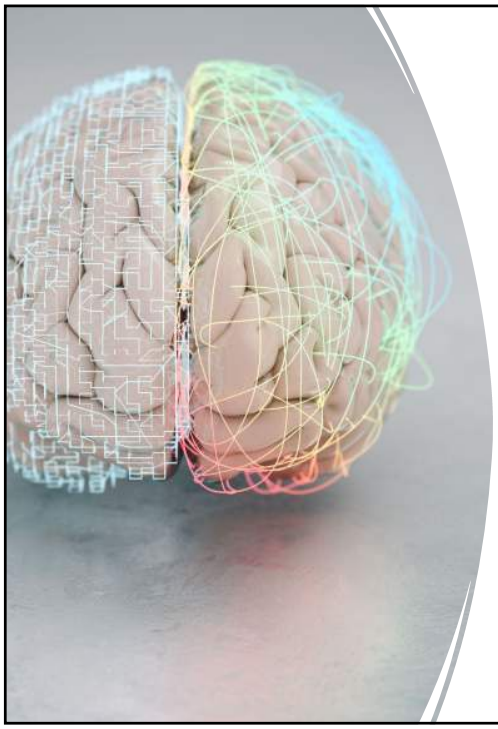
- **Language Delay** (Karani 2022; Van de Heuvel 2019 – mobile devices; Collet 2019; Zimmerman 2007)
- **Attention Problems-ADHD** (Tan & Zhou 2022; Sriwaranun 2023; Christakis 2004)
- **Cognition, Executive Function** (Law 2023; Corkin 2021; Walsh 2020; Supanitayanon 2020;
- **Behavior Problems** (Eirich 2022; Kahn 2021; Chonchaiya et al., 2015)
- **Negative Brain Changes** (Hutton et al, 2020;Zivan 2019; Takeuchi et al 2015)

How are brains different in ASD?

- **Visual Discrimination** (Kaldy, 2011
- **Movement** (ability to see if something is moving) (Foss-Feig 2013)
- **Auditory** Better pitch perception (Bonnel, 2003)

Visual Ability at 9 months predicts worse autism sxs at 15 months and 2 years (Gliga, 2015)

Visual Brain activity during auditory testing associated with autism symptoms (Keehn 2017)



Abnormal Sensory Brain Wiring in ASD may Interfere with Social Learning

- Pay attention to **audiovisual synchrony** rather than biological motion (Klin, 2009)
- **Cortical surface hyper-expansion in visual processing areas** (middle occipital gyrus, cuneus, lingual gyrus) at 6 to 12 months of age first finding of altered trajectory of development in ASD. (Hazlett, 2017)

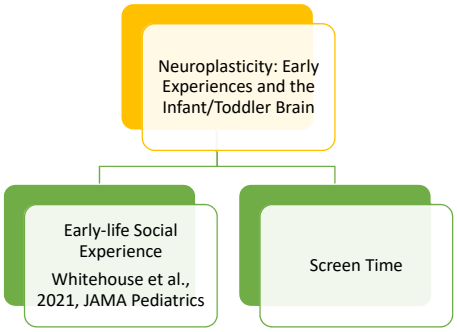
Brain Plasticity (How the Brain Responds to the Child's Experiences)

Experience-dependent plasticity:

- **Brain connections** are formed based on what the individual is seeing, hearing, feeling and experiencing
- **Social Factors** such as people and their eyes, voices, and smiles respond to a young child and likely promote development of social brain pathways
- **Non-Social Factors** such as screens and electronic toys do not have a social response to a baby and would likely promote highly sensory-oriented brain connectivity

Autism Risk/Protective Factors

- **Modifiable Environmental Exposures**



Experience Matters in Autism

JAMA Pediatrics

Effect of Preemptive Intervention on Developmental Outcomes Among Infants Showing Early Signs of Autism

Whitehouse et al. 2021

Why is High Screen Viewing Concerning in Early-Life?

Electronic Screen Media

- Distracts the child from paying attention to people
- Distracts the parents/caregivers from paying attention to the child
- May directly affect brain connectivity and attention mechanisms

Recommendation (AAP)

- No screen viewing before 18-24 months
- No more than 1 hour daily through age 5 years

Screens Include the Following:

- TV, Video
- Mobile Apps with viewing on
  tablet or smart phone
- Electronic Toys may impart similar qualities

Video chatting with friends or relatives *is* social and considered differently

Association of Early-Life Social and Digital Media Experiences with Development of ASD-Like Symptoms

JAMA Pediatrics 2020

Heffler, KF, Sienko DM, Subedi K, McCann KA, Bennett DS

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NIHCD - National Children's Study

THE NATIONAL CHILDREN'S STUDY

- Authorized by the Children's Health Act of 2000
- Planned to be the largest long-term study of environmental & genetic exposures on health in U.S. hx
- Goal: Recruit 100,000 subjects and follow to age 21
- Actual: Recruited ~5600 children prior to birth in a pilot across 40 sites from 2009-2013
  - Stopped due to recruitment challenges, questions about its ability to meet scientific goals, and fiscal reasons in 2014

Q1: *Is TV/DVD exposure associated with later ASD sxs?*

- 12-months
  - "Does your child watch TV/ DVDs?" [yes/no; 65% "yes"]
- 18-months
  - "Over the past 30 days, on average, how many hours per day did your child watch TV and/or DVDs?"
  - Coded 3 hrs or less vs. 4 hrs or more (cf. Chonchaiya et al., 2011); 4% had 4 hrs or more

Q2. *Is Social Experience associated with fewer later ASD sxs?*

12-months: Play with child

- "How often does participant play with child with toys?" [less than daily vs daily]

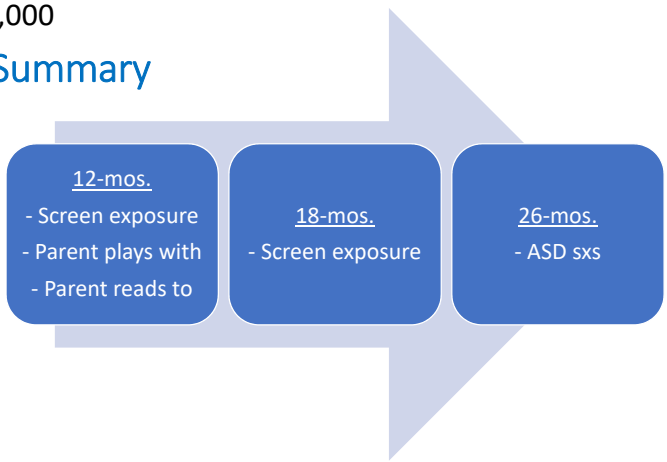
12-months: Read to child

- "How often does participant read or look at books with child?" [once a week or less; 2-4 days a week; 5-6 days a week; or every day]

- Outcome: ASD-like sxs at 26-months (± 2 mos.)
  - Modified Checklist for Autism in Toddlers (M-CHAT; Robins et al., 2001)
    - Continuous (raw) scores
- Covariates:
  - Gestational age
  - Maternal age
  - Child sex
  - Household income
  - Race/ethnicity
  - English vs. non-English speaking parent (proxy for immigrant status)

Methods

- Sample
  - N=2152 children (51% male) with M-CHATs; 72% White; median household income ~$50,000
- Assessment Summary



Results: Predicting M-CHAT raw scores

- Less than daily play frequency at 12-months associated with an 8.9% increase in M-CHAT scores
- Screen exposure at 12-months associated with 4.2% increase
- Screen exposure at 18-months associated with 10.7% increase but NOT statistically significant.
- Reading to was *not* a significant predictor

Experiential Factors		
Play frequency at 12 mo		
Daily	0 (0 to 1)	−8.9 (−16.5 to −0.9)
Less than daily	0 (0 to 2)	[Reference]
Reading frequency at 12 mo, d/wk		
≤1	1 (0 to 1)	7.4 (−3.5 to 19.5)
2-4	0 (0 to 1)	0.7 (−4.9 to 6.7)
5-6	0 (0 to 1)	−2.2 (−7.8 to 3.8)
Daily	0 (0 to 1)	[Reference]
Screen exposure at 12 mo		
Yes	0 (0 to 1)	4.2 (0.1 to 8.3)
No	0 (0 to 1)	[Reference]
Screen exposure at 18 mo, h/d		
≥4	0 (0 to 1)	10.7 (−2.0 to 23.0)
≤3	0 (0 to 1)	[Reference]

Abbreviations: ASD, autism spectrum disorder; IQR, interquartile range; M-CHAT-R, Modified Checklist for Autism in Toddlers, Revised.

[a] Can be interpreted as the percentage difference in the expected M-CHAT-R score of a given category compared with that of the reference category of a variable.

Study Strengths & Limitations:

Strengths:

- Prospective
- Assessed screen exposure relatively early
- Covariates
- Relatively large N

Limitations:

- Correlational study
- Measures
  - Screen exposure
    - 12-months simply “yes” vs. “no”, not capturing levels of exposure
    - Doesn’t address tablets, computers, or smart phones
    - Doesn’t address quality of content
  - Autism
    - M-CHAT is not a comprehensive evaluation
  - Social engagement

Japanese Findings– Kushima et al. JAMA Pediatrics (2022):

- 84,030 mother-child dyads
- **Exposure** = hrs of screen viewing at 1 year (maternal report)
- **Outcome** = "Has your child ever been diagnosed with autism spectrum disorder?" (maternal report at 3 yrs)
- Among **boys**, using "no screen" viewing as the comparison group, **2 hours to < 4 hours/day, OR=3.48** (*P* < .001)

Kushima, M., Kojima, R., Shinohara, R., Horiuchi, S., Otawa, S., Ooka, T., ... & Katoh, T. (2022). Association between screen time exposure in children at 1 year of age and Autism Spectrum Disorder at 3 years of age: The Japan Environment and Children's Study. *JAMA Pediatrics*, *176*, 384-391.

Summary of Early-Life Screen Time and Autism Association Studies

Study Characteristics (N 147,138)

20 Studies, 12 countries, 2 Prospective, 7 Retrospective, 11 Cross Sectional

Studies included some children age 4 and younger

Greater daily viewing significantly associated with:

- ASD diagnosis (9 studies)
- ASD-like symptoms (7 studies)
- symptom severity in ASD (4 studies)

Earlier First Viewing associated with subsequent:

- ASD diagnosis (5 studies)
- ASD-like symptoms (1 study)

Less Parent-Child Interaction also associated with ASD risk and severity

Screen Media and Social Intervention in ASD: A 6-Month Pilot Study

Heffler KF, Frome LR, Garvin B, Bungert LM, Bennett DS. Screen time reduction and focus on social engagement in autism spectrum disorder: A pilot study. Pediatr Int. 2022 Jan;64(1):e15343.

Intervention (6 months)

Age 18-40 months, 9 children, with ASD diagnosis

Parent Training

- Digital media & child development
- Digital media & parent-child interaction
- Poor learning from screens compared to in person

Parent Support

1 hr weekly in-home support for reduction of screen time & increase in social interaction

- Strategies to transition from screens
- Strategies to naturally gain eye contact
- Joining child
- Following the child's lead
- Language related to child's focus
- High affect/joy in social interaction
- Including child in all family routines

Heffler et al., 2022

Results

Screen Viewing Reduction

- Screen viewing decreased from 5.6 *hours*/day
  To avg 5 *minutes*/day during study

Social and Developmental Outcomes

- Core Symptoms of Autism (BOSCC): 23% reduction
  T_1 41.33 (10.12) vs. T_2 32.83 (13.08). Effect size *g*=0.69, *p*=.008
- Adaptive Behavior (VABS-3): 19% increase in function
  T_1 59.33 (10.78) vs. T_2 69.33 (15.47). Effect size g=0.71, *p*=.058

Parent Stress (APSI):

- 37% reduction, Large Effect Size
  T_1 21.67 (*SD*=8.89) vs. T_2 13.67 (*SD*=8.26). Effect size *g*=0.89, *p*=.013

Heffler et al., 2022

Study Strengths & Limitations:

Strengths:

- Parent training and intervention were very positively received
- The marked reduction in screen time showed the potential for change in exposure related to parent education
- Decrease in autism symptoms and parent stress suggest potential of intervention

Limitations:

- Very small study, next step is a randomized-controlled trial.
- Children received other therapies during the study, though extent of the other therapies did not predict progress on study outcomes.
- Children all had high screen time at enrollment and parents were aware of the study goals of reducing screen time. Not clear how this will generalize to children with more modest screen time or parents who may be less interested in the intervention

Summary of Intervention Studies

Study Characteristics (N=215)

Six Studies from 5 countries
- Autism Diagnosis (4) intervention 6-8 months
- ASD Symptoms (2) intervention 2 months

5 studies included parent training on social engagement in addition to screen time reduction

Results

- When screen time reduced to < 1 hour/day: reduction of ASD symptoms post intervention
- Screen time > 1 hr/day had negative effects on therapeutic outcome
- Improvement correlated with screen reduction
- Parent Stress was significantly improved
- Improvement in EEG patterns

Case reports of Interest

Dieu-Osika, Bossiere, Osika, 2020

Resolution of autism symptoms over 1 year in a 2-year-old with high Media viewing history when screens were eliminated

Heffler, Frome & Gullo, 2022

Changes in autism symptoms, including repetitive behavior associated with fluctuation in screen exposure.

Gangi et al (Ozonoff), 2023

Autism symptoms in 2-year-old with history of high screen viewing resolve in 4 months with elimination of screens without any other intervention.

What Drives the Screen Time in infants?

Are these children just more drawn to screens or do parents resort to greater screen time with children with greater emotional dysregulation?

These factors impact children at a later age.

Factors driving screen time at 12- and 24-months are:

- Parents view of screen time for children
- Parents own screen time use
- Time screens are on in the household
- Parenting styles (authoritarian or permissive)
- Not child temperament when adjusted for confounders

Barber, S.E., Kelly, B., Collings, P.J. *et al.* Prevalence, trajectories, and determinants of television viewing time in an ethnically diverse sample of young children from the UK. *Int J Behav Nutr Phys Act* **14**, 88 (2017).

Howe AS, Heath A-LM, Lawrence J, Galland BC, Gray AR, Taylor BJ, et al. (2017). Parenting style and family type, but not child temperament, are associated with television viewing time in children at two years of age. PLoS ONE 12(12): e0188558.

Potential Mechanisms of the Association of Early-Life Screen Time with Autism

- Parent-Child Interactions build the social brain
- Screens interfere and displace parent-child interactions
- Young children learn poorly from screens
- Screens directly impact early brain development; Sensory hyper-connectivity may interfere with social brain connectivity

Heffler KF, Oestreicher LM. Causation model of autism: Audiovisual brain specialization in infancy competes with social brain networks. Med Hypotheses. 2016 Jun;91:114-122.

Summary

- Greater screen time in the first year of life is associated with development of autism and ASD-Like symptoms;
- Greater early-life parent-child social engagement at 12-months is associated with decreased risk of ASD and ASD-like symptoms
- Interventions including screen time reduction and focus on social engagement in children 4 years and younger with a history of high viewing are associated with rapid reduction of autism symptoms. We suggest the need for randomized controlled trials.
- We highly recommend global efforts to Raise Awareness of these findings among parents of young children, childcare and healthcare providers and government healthcare officials

Going forward:

- Large controlled study of manualized intervention with parent fidelity measures
- Examine mechanisms at biological (brain) level (e.g., fNIRS)
- Gene-environment interaction
- Potential for community-based parent education study