

# Thoughts and challenges on interventions related to brain and behavior:

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I have no conflict of  
interest to report  
and no financial  
relationship with any  
commercial interest  
mentioned in this  
talk

# WHAT DO WE KNOW?

- **Brain and Behavior can certainly be impacted by prenatal alcohol**
  - This can vary from structural anomalies (e.g. callosal or cerebellar dysplasia) to functional deficits (e.g. connectivity or network problems) to subtle microstructural changes (e.g. oligodendrocyte number), to inflammatory processes, changes in the gut microbiome and so forth.
- **Neuroplasticity, or brain plasticity, refers to the brain's ability to CHANGE throughout life.**
  - The human brain has the amazing ability to reorganize itself by forming new connections between brain cells (neurons).

# SO WHAT ARE WE CURRENTLY DOING?

## **Medical Care**

### **Medication**

Stimulants, Antidepressants, Neuroleptics, Anti-anxiety drugs

### **Behavior and Education Therapy**

Good Buddies – *A children's friendship training to teach appropriate social skills (12 weeks – group format)*

Families Moving Forward (FMF) *program to provide support for families (9-11 months)*

Math Interactive Learning Experience (MILE) *program to help with mathematics (6 weeks – 1 on 1)*

Parents and Children Together (PACT) *a neurocognitive program to improve self-regulation and executive function (12 weeks)*

### **Parent Training**

### **Alternative Approaches**

Biofeedback, Auditory training, Relaxation therapy, visual imagery, and meditation, Art therapy, Yoga and exercise, Acupuncture, Massage, Reiki, and energy healing, Vitamins, herbal supplements, and homeopathy, Animal-assisted therapy

Adapted from <https://www.cdc.gov/ncbddd/fasd/treatments.html>

# WHERE ARE WE GOING?

## ■ Big Data

- Allows for precision medicine, predictive analytics, and machine learning
- Allows health care providers to accumulate and analyze a much larger population base
- Data can often be acquired remotely

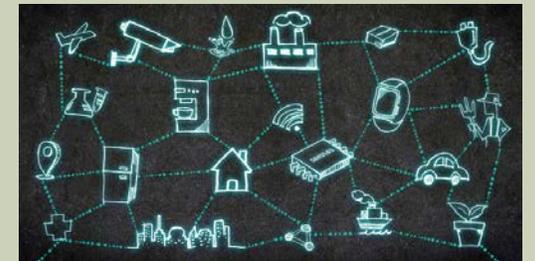
## ■ The internet of things

- Internet-connected devices, including wearables, implants, skin sensors, home monitoring tools, and mHealth applications connecting patients with providers. e.g. Smart dispensing monitors, planning activities, etc.

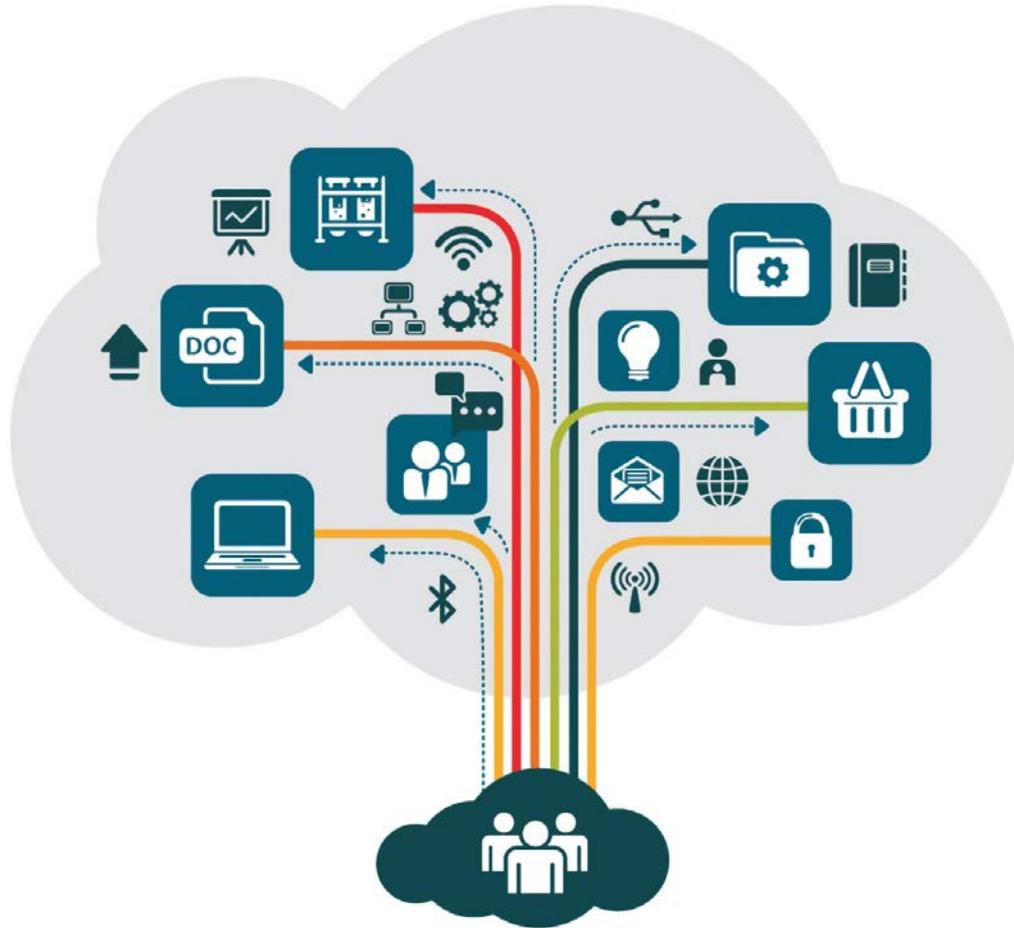
## ■ Wearable Medical Technology

- Remote monitoring of brain activity, sleep, glucose, medication minders, temperature, hormone levels, etc.

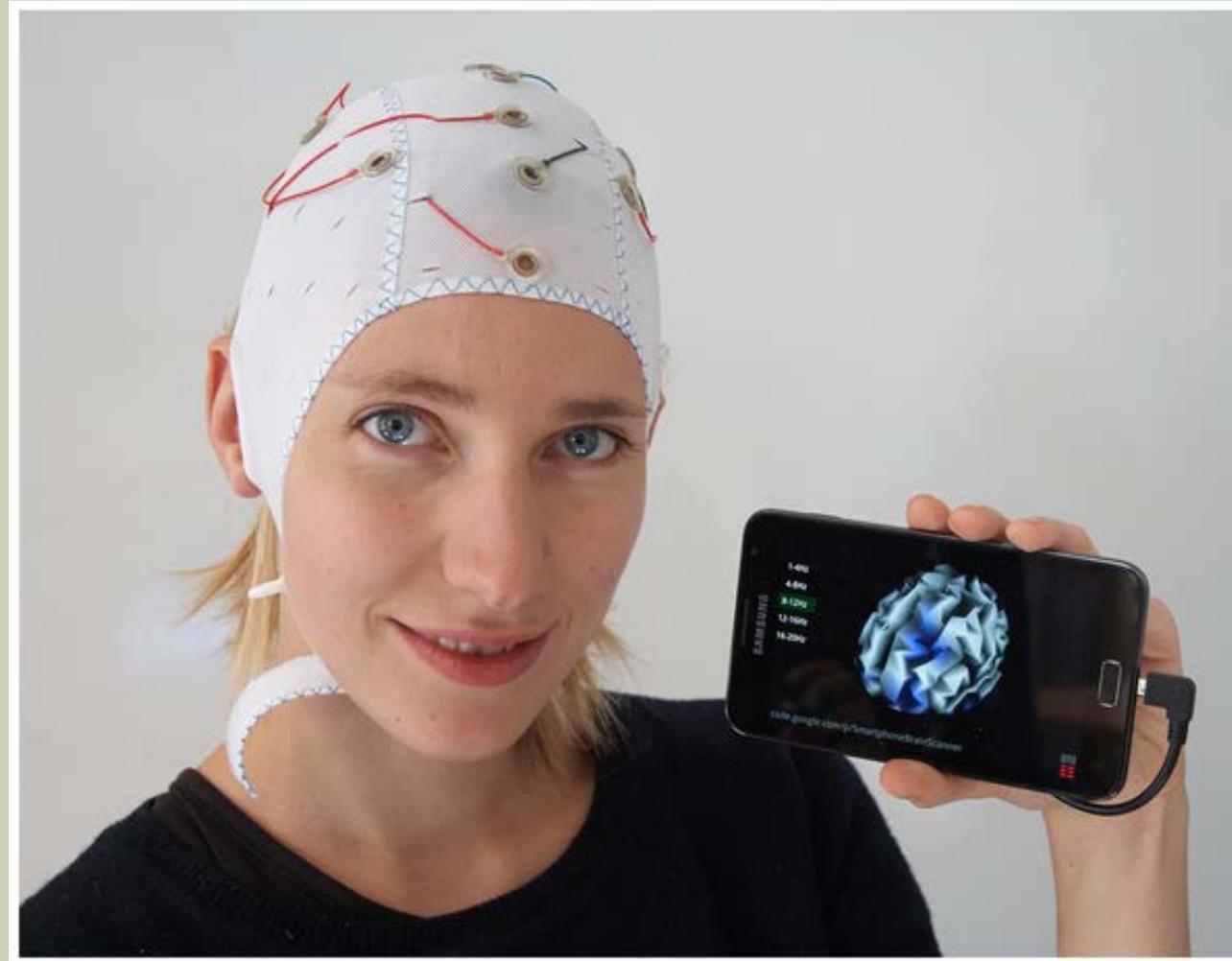
## ■ Patient-centric care and outcomes



# IT IS ALL GETTING SMALLER AND MORE ACCESSIBLE



**Figure 4. Snapshot of the SBS2 real time brain imaging system running on a Samsung Galaxy Note 2.**



Stopczynski A, Stahlhut C, Larsen JE, Petersen MK, Hansen LK The Smartphone Brain Scanner: A Portable Real-Time Neuroimaging System. PLOS ONE 9(2): e86733. <https://doi.org/10.1371/journal.pone.0086733>  
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0086733>

# WHERE ARE WE GOING?

## INTEGRATING NEUROSCIENCE AND PHARMACOTHERAPIES

- Knowing how the brain functions and what anomalies are present will help us understand how to prescribe more targeted treatments including medications
  - Using EEG, brain activation studies, or behavioral methods to understand which drug(s) might work best or reduce side effects
  - Considering genetics in prescribing
  - A big data approach comparing what has worked in individuals with similar brain or behavioral patterns
  - Reduce the “hit and miss” prescription techniques fairly common in FASD
  - More personalized medicine

# WHERE ARE WE GOING?

## INTEGRATING NEUROSCIENCE AND TECHNOLOGY

### DIGITAL MEDICINE



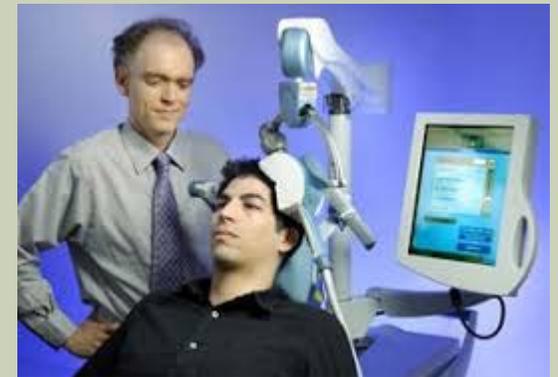
**“targeted prescription digital medicines, delivered through video game experiences.”**

**Medical devices with or conducting trials to obtain FDA approval**

# WHERE ARE WE GOING?

## UNDERSTANDING AND IMPROVING NEUROPLASTICITY

- **Aerobic exercise**
  - Promotes several neurotrophic mechanisms
  - Improves performance on cognitive tasks, especially executive functioning and memory
- **Repetitive transcranial magnetic stimulation.**
  - Modulates the synaptic efficacy and connectivity of particular brain networks
  - Many deficits result from a dysfunction in brain networks and TMS can alter these patterns. Might be used to alter abnormal pathways or patterns
  - Facilitate performance on cognitive flexibility, working memory, motor learning, and attention



# WHERE ARE WE GOING?

## UNDERSTANDING AND IMPROVING NEUROPLASTICITY

### ■ Nerve stimulation

#### ■ Vagus nerve stimulation

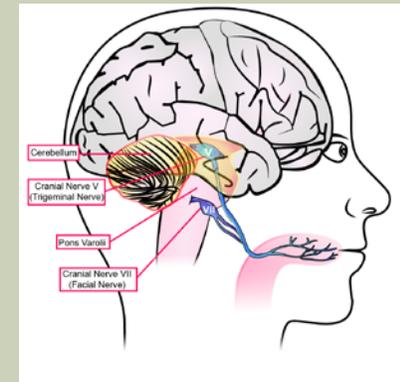
- Currently used to treat epilepsy and depression
- Mediates an anti-inflammatory effect via activation/regulation of the HPA and adrenals and via direct effects on immune cells
- Vagal stimulation demonstrated a positive effect on enhancement of memory processes
- May have an effect on emotional reactivity



# WHERE ARE WE GOING?

## UNDERSTANDING AND IMPROVING NEUROPLASTICITY

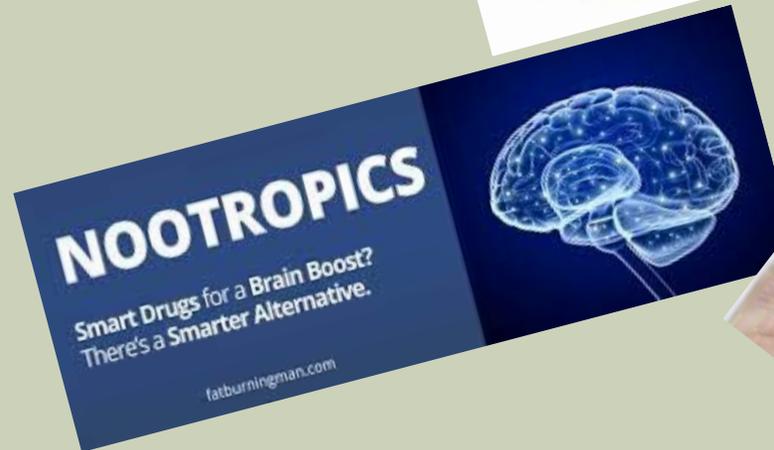
- Stimulation of the tongue (work being done at U of Wisconsin)
  - May enhance neuroplasticity by stimulating two major cranial nerves: the trigeminal (the nerve responsible for sensations in the face, biting and chewing) and the facial (the nerve responsible for motor control of most of the muscles of facial expression).
  - Stimulation of these nerves creates a neural impulses that are delivered directly into the brain stem and then throughout the brain.
  - Results suggest possible use for traumatic and acquired brain injury, Parkinson's, multiple sclerosis and chronic pain.



# WHERE ARE WE GOING?

## UNDERSTANDING AND IMPROVING NEUROPLASTICITY

- Nutrients and drugs as cognitive enhancers
  - Nootropics – a 3-4 billion dollar market
    - Choline
    - ABT-239, a histamine H<sub>3</sub> receptor antagonist
    - Aniracetam, impacts glutamate and cholinergic transmission
    - Piracetam
    - Meclofenoxate
    - Cholecalciferol
    - L-pyroglutamyl-D-alaninamide (LPDA)



# WHERE ARE WE GOING?

## UNDERSTANDING AND IMPROVING SLEEP

- Better Sleep
  - Promotes several neurotrophic mechanisms
  - Improves performance on cognitive tasks, especially executive functioning and memory



**THANK YOU**

**Ed Riley**

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