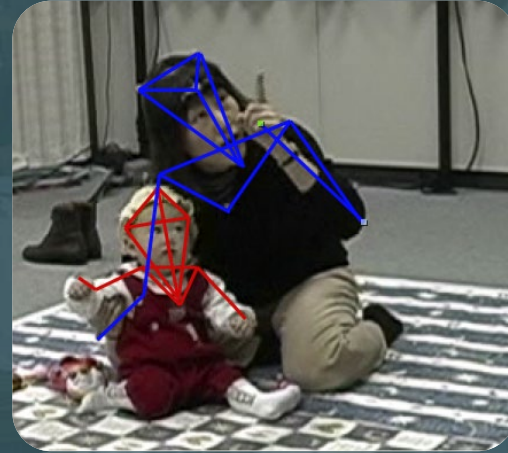




Social Timing, Attention, and Learning

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Dept. of Cognitive Science and Program in Neuroscience;
Co-Founder Global Science of Learning Education Network

OUR LEARNING IS SOCIALLY MEDIATED AT THE OUTSET



Infants time their smiles to make their mothers smile
Ruvolo et al., 2015

TIMING IS A PERVASIVE FEATURE OF SOCIAL LEARNING

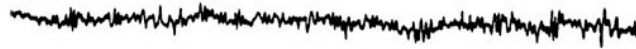


CORTICAL STATES AND SENSORY PROCESSING

Information
processing and
learning take place
on a background of
distinct cortical
activity states
defined by
electrical patterns

Human EEG

Excited



Relaxed



Drowsy



Asleep



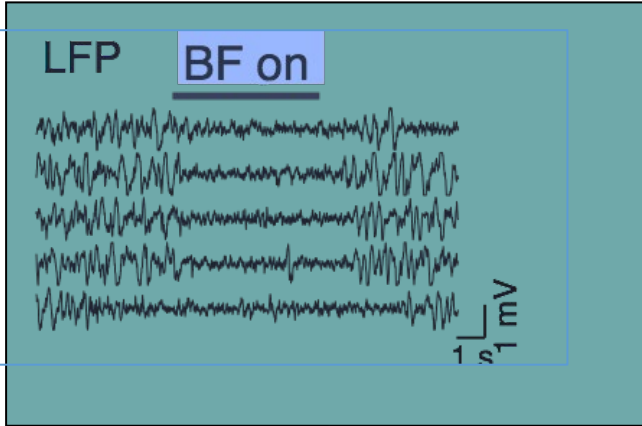
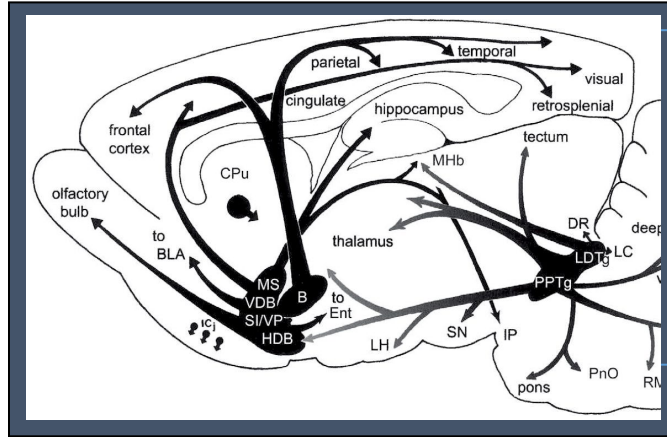
Deep sleep



1 sec

NEUROMODULATORS IN SUBCORTICAL STRUCTURES ACTIVATE CORTEX

Cholinergic projection systems



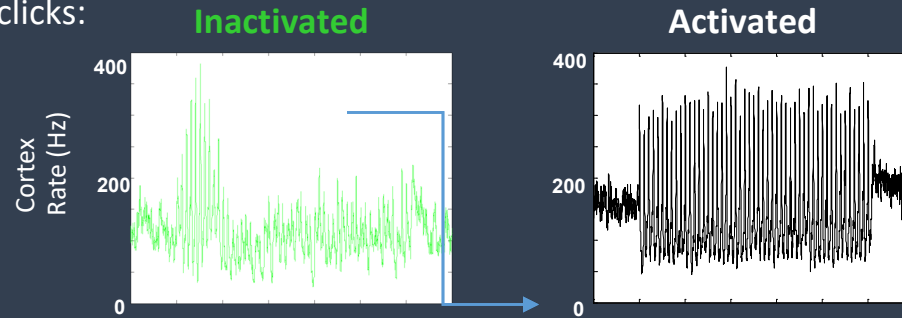
Attention
Is
Enhanced

Cholinergic system rapidly desynchronizes cortical state, improving sensory coding accuracy.

THE BRAIN'S SUCCESS IN "FOLLOWING" THE OUTSIDE WORLD IS DEPENDENT ON THE CORTICAL STATE

Recorded from auditory cortex:

Auditory clicks:



State for effective coding and learning of temporal patterns?

Ability to perceive temporal patterns



and generate expectations

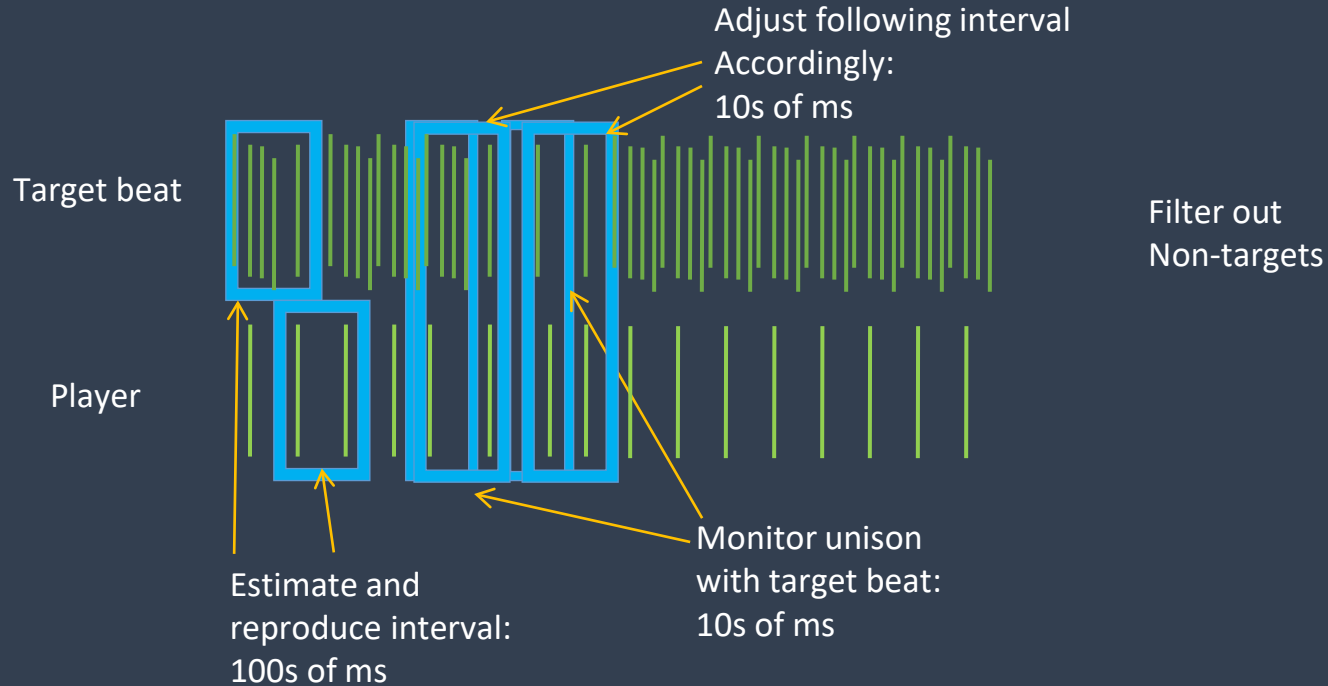


guides action



Matching the state of the brain to the dynamics of the world is important for attention and learning.

PLAYING MUSIC PRESENTS DIFFICULT TIMING AND PREDICTION PROBLEMS



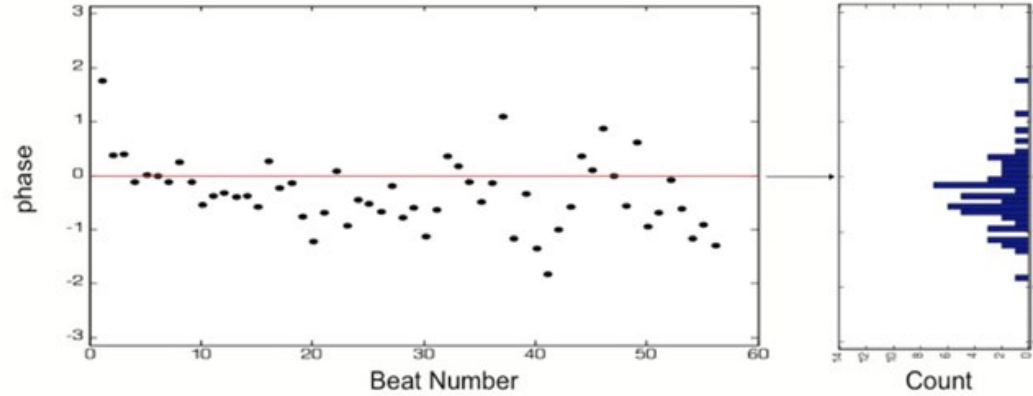
DOES THE ABILITY TO PAY ATTENTION CORRELATE WITH ABILITY TO SYNCHRONIZE IN A GROUP SETTING?



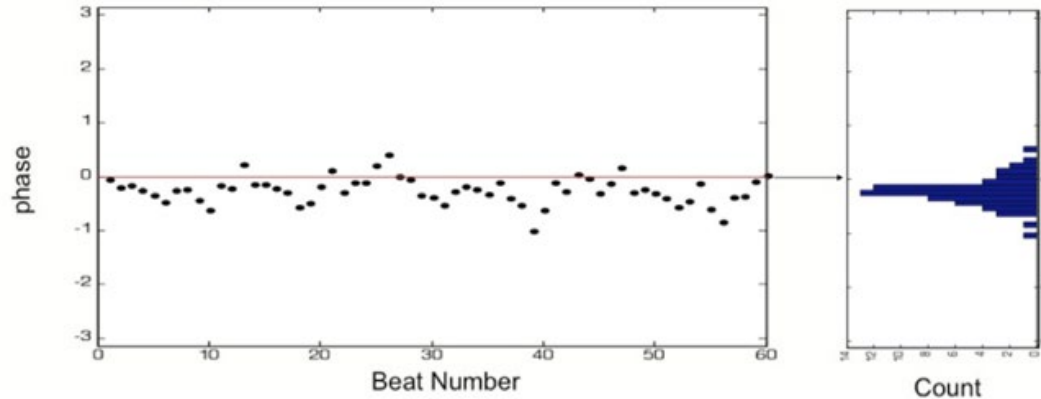
Khalil et al, 2013

Examples of Good and Poor Synchronizers:

Poor Synchronizer



Good Synchronizer



Children's ability to synchronize with a driving beat or a group varies largely

Children's ability to synchronize correlated with their scores on standard attention tasks

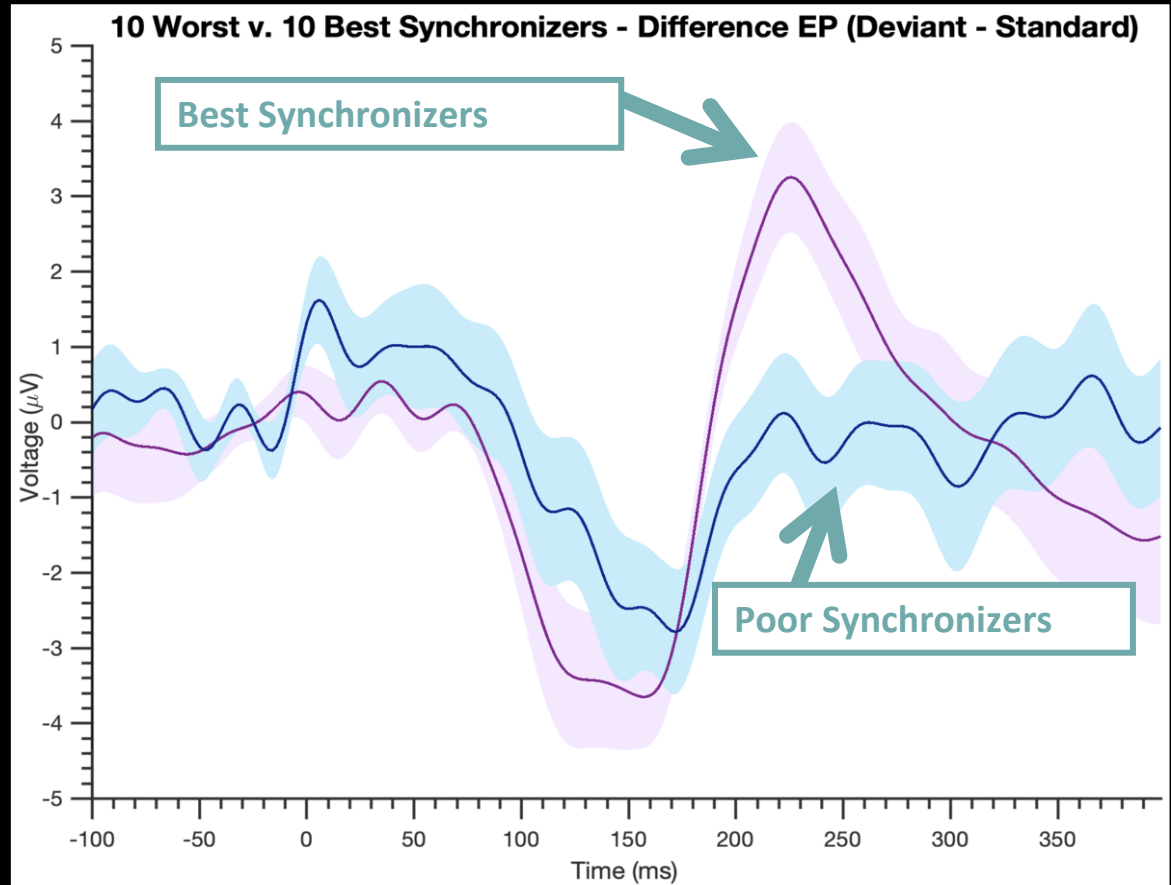
Khalil, et al, 2016

EVOKED RESPONSE TO BEATS AT THE "WRONG" TIME

The summed EEG or Evoked Potentials of the brains of Poor and Good Synchronizers demonstrated large differences.

We are now looking at ways to induce plastic changes in the brain through music and through other methods.

D'Andrea-Penna et al. 2020





- Brain activation varies by individual
- Stimulus fidelity is enhanced by an activated brain state for all modalities.



- A continuously activated state may be biologically expensive!**
- So – We activate as we need it, in order to adapt to the demands of the environment.
- Modulating to the proper state for different types of learning is non-trivial and a major issue for many classroom learners.

Photo Taken at San Diego, California Pharmacy Two Weeks Ago!!



LESSONS LEARNED

Cultural practices should be studied prior to being considered “extra-curricular “

We need to understand how to support fundamental neural properties that optimize learning and contribute to education

Although most academic tasks demand focused attention and resistance to distraction, schools do not teach it explicitly

We need to examine common threads in cultural practices that maximize health and brain health in general



Minces



Khalil

Contributing Scientists



D'Andrea-Penna



Iversen

Thank You

National Science Foundation

National Institute of Health

Kavli Foundation

San Diego Foundation

Temporal Dynamics of Learning Center Members

DREAM



BIG

Let's Help Restore Dreams!



Global Science of Learning Education Network

<https://gsolen.ucsd.edu/>