Brain Function's Influence on Behavior and Performance.

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Grants:
NIH 1 R01 HD073202-01
NIH R43 HD062072
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NIH R01 DC005994-01
NIH R01 HD17860-15
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Research Areas

Human & Animal Models of TBI
Concussion Assessment & Intervention
Neural Modeling
Neuropsychological Assessment
Cognitive & Social Neuroscience
Endocrine System
Attention, Perception & Memory
Vestibular/Balance, Biomechanics
Genetics, Genetic
Cognition, Language & Performance
Lifespan Development - Infancy to Aged
Therapeutic Interventions
Magnetic Resonance Imaging (MRI, fMRI, DTI, SPECT) + 256-high density electrodes + eye tracker + Photogrammetry

Siemens 3 Skyra 70 cm bore

Structure

Function

HD ERP

DTI
Event-Related Potentials

- ERP
- Portion of Ongoing EEG
- Time-Locked to Stimulus Onset
- Dynamic Temporal-Spatial Information
Rapid Temporal (time) Information (1/1000 Second) Correlates with Cognitive Skills
Newborn Testing
Learning Alters Brain Organization for Acquisition of New Information

Shape Matching Task

- Same
- Different

**Low GRTR**
[GRTR less than 11]

**High GRTR**
[GRTR more than 11]

Discrimination Occurs 400 ms Earlier in Children With Better Pre-Reading Skills.

Molfese et al, 2008
**SCALE**

**Microsecond processing**
- sound localization
- echolocation

**Millisecond processing:**
- Speech generation/recognition
- Motion detection
- Motor coordination

**Second processing:**
- Conscious time estimation

**Circadian rhythms:**
- Appetite
- Sleep-wake
Two-Back Memory Task

Numbers Match

Match
Non-Match

Control Group
mTBI Group

200 ms
P3b: Target

N2: Non-Target

Controls n=22

TBI n=22
Adult Head Injury

20%-40% With TBI Experience Vision-Disorders

Normal Visual World  World at an Angle

Post-Trauma Vision Syndrome (PTVS)
Visual Midline Shift Syndrome (VMSS)

Hudac, Kota, Nedrow & Molfese, 2012
Intervention With & Without Prisms

With Prisms

Without Prisms

Post-Trauma Vision Syndrome
Visual Midline Shift Syndrome

Hudac, Kota, Nedrow & Molfese, 2012
Prisms eliminate disagreement between visual and Auditory inputs.

Eliminates engagement of large areas of cortex to resolve discrepant AUDITORY and VISUAL input, returning visual processing to visual cortex
Vision: Source Estimation

Hudac, Kota, Nedrow & Molfese, 2012
TBI History vs Normal Neural Aging

TBI history: Faster decline in cortical thickness with age correlated with memory loss (red line)
Brain Model For Successful (& Unsuccessful) Performance

Multiple Processes Required for Normal Learning & Performance:

1. Detection & Perception of Stimuli
2. Neural Network Reduction
3. Near & Far Network Memory
4. Increased Speed of Processing
5. Shorter Process Duration
6. Acquisition Changes Organization
Normal Neural Development

[Diagram of neural development stages with numbered connections between nodes.]
Normal Neural Development

Normal readers - same brain areas active one instant to next (stable, faster, less effort).
TBI: Impaired Neural Processing
TBI: Impaired Neural Processing

TBI patients invent new ways to process from one instant to next (unstable, slower, more effort).
TBI Processors

Difficulty making transition to automated, consistent, faster processing.
Future Possibilities

Use brain imaging procedures to identify distortions produced by brain injury.

Identify intervention that produce more normal neural processing.

Use the successful intervention to enable individual to perceive & interact with the world in more normal fashion.
QUESTIONS?

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