The Brain-Behavior Connection

Neurobiological & Neurodevelopmental Impact of Traumatic Stress & Prenatal Alcohol Exposure in Children & Adolescents: Understanding Challenging Behaviors

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Power of the Transdisciplinary Model
It’s all the same elephant!
Fasten your seatbelt:

It is time for science class!!
Mind (Brain)-Boggling Numbers

- **100 BILLION** Neurons in the human brain
- **1000** Potential connections for single neuron
- **100 TRILLION** Total possible neuron connections
YIKES!!!

(This is already overwhelming!!)
This is why...

I *always* start with the big picture...
So...........

How can we really understand our challenging kids???
Let’s start with the brain!!!
“Let’s Build a Brain”
2010 Paradigm Shift: (Yes...another one!)

BEHAVIOR

MIND \leftrightarrow BRAIN

Siegel 2009
Driving Miss-Behavior
Vehicle-Brain Metaphor

- Accelerator
- Brakes
- Steering
Floorin’ it: 0 to 60 in 4.3 seconds!

Importance of the \textit{accelerator}
Accelerator Components

- **Brain Energy / Arousal - Alertness**
- **Anxiety / Panic**
- **Anger / Explosiveness / Mania**
Wake up!!!

Let’s talk about arousal ...
Optimal "Goldilocks" Arousal

Way too wound-up / “wild” (“Tigger - on crack”)

Too wound-up (Tigger)

Bored / Low energy / Tired & sleepy (Ee-yore)

Total shut-down (via parasympathetics) “Ee-yore on Quaaludes”
The Anxious World of Piglet
Fight-Flight-Freeze is in the breeze

“It’s not easy being brave when you’re only a Very Small Animal”
The Confusing Picture of Anxiety

Fight-Flight-Freeze in the school / DHS / JJ system

• Anxiety / Panic as source for reactive anger/aggression

• Anxiety – Attention – Language interplay in kids / teens / bullies with aggression

• False machismo in anxious kids / teens / bullies
Anger / Explosiveness: Critical Link to Aggression

- Many faces of anger
- Anger as coping skill
- Aggression = Anger *plus* “bad” brakes
So..., let’s talk about the...
The Prefrontal Cortex: The home of Executive Function

Executive Function: The "brakes" of the brain

- Working memory / memory recall
- Focusing (locking, shifting & sustaining)
- Planning / organizing
- Self-monitoring of behavior/action
  - Impulse control
- Regulation
Executive Function: Promotes regulation of:

• Attention / arousal / energy

• Behavior / action

• Mood / emotion / frustration
The Delicate Balance: Brain control of emotion / behavior

Top-Down "Brakes" (Prefrontal Cortex)

Bottom-Up "Accelerator" (Brainstem / Limbic System)
Don’t Forget About the Steering

- Conscious control of behavior
- Importance of **tight structure** for optimal behavior management
- Willfulness misconceptions
  - It’s not **all** willful!
  - Fading control at the “edge of the cliff”
    - Behavioral “curve balls” in homes, schools, detention...
Neurobehavioral “Secret”
Life in the “Comfort Zone”

Optimal Mood / Arousal Regulation =

Optimal Learning, Behavior, Attention, Memory
Neurobiology of Development

- Brain "sculpts" itself in response to the environment **AT THE SAME TIME** it is developing (via genetic blueprints)
Experience alters brain structure

• These sculpted *structural changes* allow the child’s brain to become the *best brain* for the given surroundings
  – Implications for traumatic stress
  – Implications for foster care placements
Streams of Development: Importance of Connectedness
Building (& Rebuilding) the Brain

Neural systems can be changed / treated but some systems are *easier* to change.
The Miracle of Neuroplasticity: The Brain That Changes Itself (2007)

- “Biggest advance in neuroscience in 400 yrs”: Norman Doidge, MD (Columbia psychoanalyst)
- Occurs in all age groups (even in adults!)
- Wide variety of activities (positive & negative) result in structural brain changes:
  - Learning (academic / procedural / traumatic)
  - Memory enhancement (therapeutic / traumatic)
  - Psychotherapy
  - Psychotropic medication  

Doidge 2007
More Neuroplasticity: Exercise & Learning

- **Spark** by John Ratey, MD
- Exciting new book by Harvard ADHD researcher
- **Miracle-Gro** for the brain
  - Brain-Derived Neurotrophic Factor (BDNF)
- The Naperville, IL Story
- The next chapter(s) in Michigan
- Trauma / FASD treatment implications
When development veers off course...
The Brain-Behavior connection: 3 major & intertwined components

- **Genetics / Epigenetics**
  - What you inherit from both parents

- **Intrauterine environment**
  - During pregnancy

- **Extrauterine environment**
  - After pregnancy
Influence of Prenatal Alcohol Exposure
FAS: not the whole story
Fetal Alcohol Spectrum Disorders (FASD)

- Fetal Alcohol Syndrome
- Partial FAS
- Alcohol-related Neurodevelopmental Disorder (ARND) ("mild-moderate" FAS)
- Prenatal Exposure to Alcohol (clinically suspected to have FAS but appear physically normal)

Adapted from Streissguth
Fetal Alcohol Spectrum Disorder

- “Mild – Moderate” FASD is still very problematic
- It is all about *when* the drinking occurred (during the pregnancy) and *how much* alcohol was consumed
- Maternal blood alcohol level = fetal blood alcohol
- “Swiss cheese brain” issues
- Confusion over why *all* fetal ETOH exposure is not created equal (*fetal resiliency*).
Recognition / Screening / Assessment of FASD
FASD: Critical Facial Abnormalities

- Palpebral fissure (small eyes)
- Smooth philtrum
- Thin upper lip
Fetal Alcohol Syndrome:  
It doesn’t always look like this
...It can look like this!...clinical examples of FAS: transcending race
Lip-philtrum guides

Measurement of palpebral fissures


Copyright ©2005 American Academy of Pediatrics
Measuring palpebral fissure length

Chudley, A. E. et al. CMAJ 2005;172:S1-21S
FASD: Impact on Brain Structure
Severe brain damage caused by prenatal alcohol exposure

5-day old infants

Severe FAS
Normal Brain

photo: Clarren, 1986
Corpus Callosum

- 100 million neurons!!!
- Connects the two brain hemispheres
- Allows the left side to communicate with the right side
- Assists the individual child to calm down during / after “meltdown”
- Is often damaged by prenatal alcohol exposure / traumatic stress
Corpus Callosum
Corpus callosum abnormalities in FASD

Mattson, et al., 1994; Mattson & Riley, 1995; Riley et al., 1995
FASD Secondary Disabilities: Recent research findings

- A recent L/T study of individuals with FASD:
  - Mean age: 14 yrs (range 6-51 yrs)
  - N = 415
  - Mean IQ = 86 (Range 29-126)
  - 80% of the sample *not* raised by biological parents
  - 60% had trouble with the law
  - 50% were in confinement
  - 49% had repeated inappropriate sexual behavior
  - 35% had drug / alcohol problems
  - Early diagnosis 2-4 times more likely to *prevent* or *lessen* impact of these secondary disabilities

Streissguth 2004
Harsh Reality: Combined Brain Impact of FASD + Traumatic Stress

- CTAC Assessment Data: 37 % of sample had trauma + FASD (Henry, et al 2007)
- Essential to factor-in both of these issues when dealing with at-risk children
- So...
Child Traumatic Stress & the Developing Brain
“Trauma Trumps Everything!!!”

Sandra Bloom, MD
Traumatic Stress & the Child’s Developing Brain

- Research reveals a strong link between all types of child abuse /neglect and the subsequent development of psychiatric illness in adulthood.

- New findings link child traumatic stress with variety of adult medical illness.

ACE Study by VJ Felitti, MD
Traumatic Stress & the Child’s Developing Brain

• Early childhood traumatic stress to the developing brain results in:
  – Physical neuroplastic brain changes that:
    • Cause abnormal functioning (including memory)
    • Contribute to problematic behaviors
    • Contribute to developmental delays
    • Result in child being unable to realize potential
So...what about neglect???
But...this case *only* involves neglect!
Neglect: The *Worst* Offender

![Brain scans of 3-year-old children: Normal vs. Extreme Neglect](image-url)
Developmental Impact of Neglect

- Physical growth delays ("failure to thrive")
- Language delays
- Cognitive / learning delays
- Regulatory (arousal / emotional / behavioral) issues
- Social communication problems
- Attachment dysfunction
- Immune dysfunction

De Bellis 2005
Complex Trauma: Summary

- Affects the *structure & function* of the brain in ways that negatively affect *all* stages of development:
  - Social
  - Emotional
  - Cognitive