

# Neurodevelopmental Impact of Childhood Trauma

A ChildTrauma Academy Presentation

## Adaptive Responses to Childhood Trauma

Focus on Dissociation

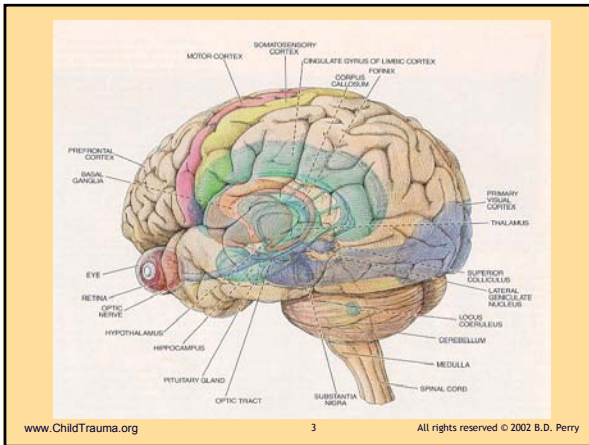
Bruce D. Perry, M.D., Ph.D.

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Traumatic Event

Prolonged Alarm Reaction

Altered Neural Systems

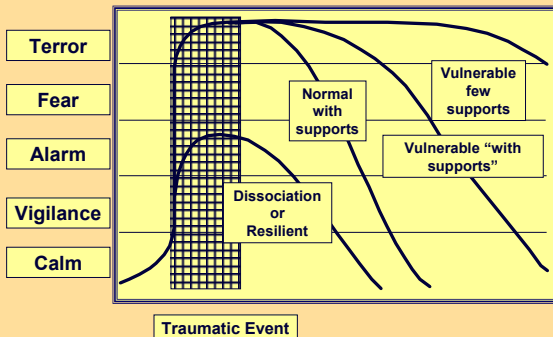


## Core Functions of the Brain

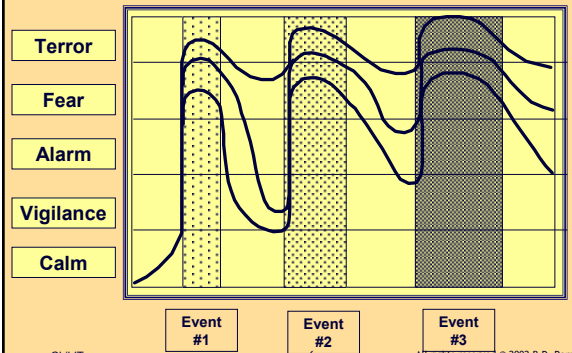
SENSE  
PROCESS  
STORE  
PERCEIVE  
ACT

On information from the external and internal world all to -  
*Promote Survival and Procreation*

## Acute Response To Trauma



## Multiple Traumatic Events



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### Response to Trauma

#### Heterogeneity of response patterns

Adaptive changes in *cognition*

Adaptive changes in *affects*

Adaptive changes in *behavior*

Adaptive changes in *neurophysiology*

Adaptive changes in *physiology*

### Dissociation

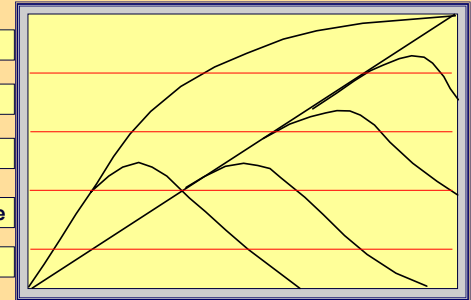
Terror

Fear

Alarm

Vigilance

Calm



Stress

Trauma

### Heterogeneous Threat Responses

#### Hyperarousal

- Classic "fight/flight"
- Noradrenergic - locus coeruleus
- Increased heart rate
- Older children and males, participatory trauma

#### Dissociative

- Endogenous opioids
- Increased vagal activity and decreased heart rate
- Younger children, females, inescapable or painful trauma

### Response to Threat

#### Dissociation

Opioids  
Mesolimbic dopamine  
GABA  
Mesocortical dopamine

#### Hyperarousal

Norepinephrine  
Epinephrine  
Serotonin  
Nigrostriatal dopamine  
Acetylcholine

### Response to Threat

#### Dissociation

Disengage outside  
Numb  
Compliant  
Suspension of time  
De-realization  
'Mini psychoses'  
Fainting

#### Hyperarousal

Hypervigilance  
Reactive  
Alarm response  
Tachycardia  
Freeze: Fear  
Flight: Panic  
Fight: Terror

### Threat

(real or perceived)

Arousal  
Continuum

Dissociative  
Continuum

- 1) NOREPINEPHRINE  
locus coeruleus
- 2) DOPAMINE  
nigrostriatal/mesolimbic
- 3) GABA
- 4) SEROTONIN

- 1) OPIOID PEPTIDES  
mesolimbic/mesocortical
- 2) SEROTONIN
- 3) DOPAMINE

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### Pathologizing Dissociation

DSM IV: A disruption in the usually integrated functions of consciousness, memory, identity or perception of the environment.

### DISSOCIATION

Disengaging from the “external” world cues

Attending to elements of the “inner” world

### DISSOCIATION

	“A”	“B”
Daydreams	✓	✓
Fantasy	✓	✓
Sleep	✓	✓
Hypnagogic Phenomenon		✓
Hysterical Materialization		✓
Hypnosis / Suggestibility	✓	✓
Derealization	✓	
Depersonalization	✓	
Numbing	✓	

### Activity-dependent Neural Differentiation

- Neurons are designed to change in response to patterned repetitive stimulation
- During development, patterns of activity define patterns of synaptic connectivity and, thereby, functional capacity
- In adults, activity can alter pre-existing neural organization - in children, activity literally provides the organizing template for neural systems

### ADAPTIVE ADVANTAGE

#### HYPERAROUSAL

Mobilize body for defense  
Flight  
Intimidation  
Fight

### ADAPTIVE ADVANTAGE

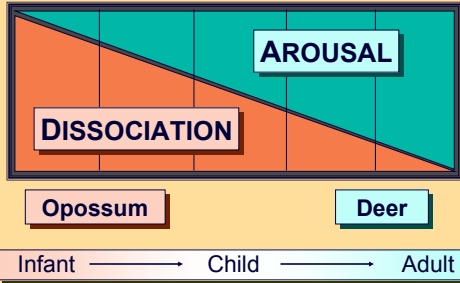
#### DISSOCIATION

Mobilize body to hide (freeze)  
Camouflage  
Compliance increases survival  
Defeat reaction  
Maintain mature cognition and behavior

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## ADAPTIVE MODES



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## USE-DEPENDENT DEVELOPMENT

The more a neural system is “activated,” the more that system changes to reflect that pattern of activation

This is the basis for development, memory and learning

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## States become Traits

Persisting activation of the neurophysiology of threat “re-sets” homeostats

Persisting hyperarousal = altered noradrenergic systems

Persisting dissociation = altered opioid and dopaminergic systems

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## Stress

Unpredictable

Predictable

Severe

Moderate

Vulnerability

Resilience

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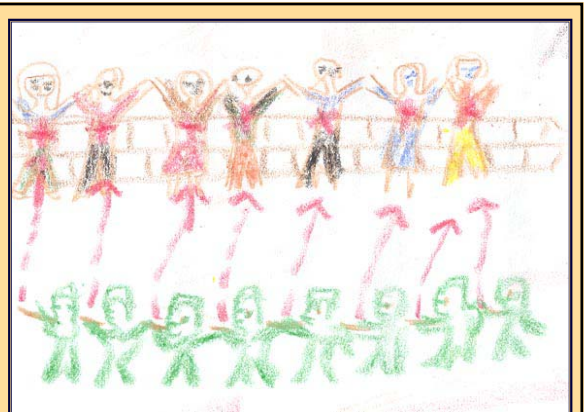
## Resilient

- Marked by the ability to recover readily, as from misfortune
- Capable of returning to an original shape or position, as after having been compressed

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## Malleable

Capable of being shaped or formed, as by hammering or pressure: a malleable metal.

Easily controlled or influenced; tractable.

Able to adjust to changing circumstances; adaptable.

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**Children Are Not Born Resilient.**

**Children Are Born Malleable.**

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## Trauma and Altered Neurodevelopment

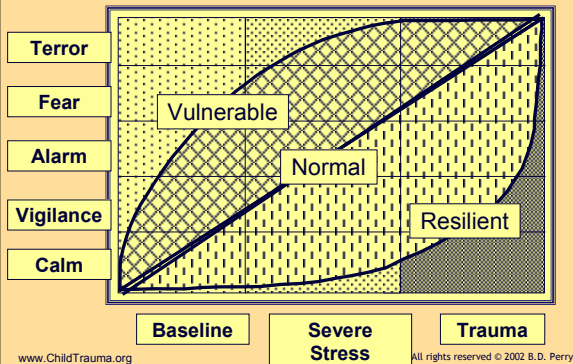
Altered cardiovascular regulation  
Behavioral impulsivity  
Increased anxiety  
Increased startle response  
Sleep abnormalities

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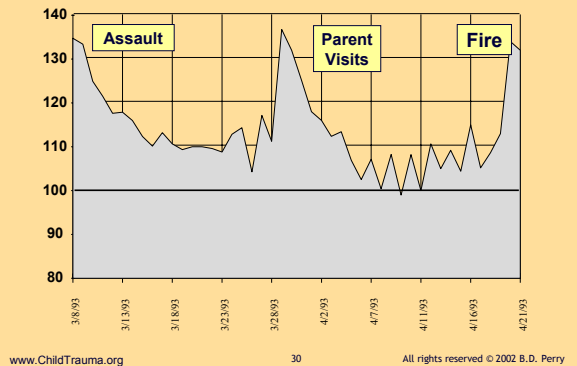
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### Differential "State" Reactivity

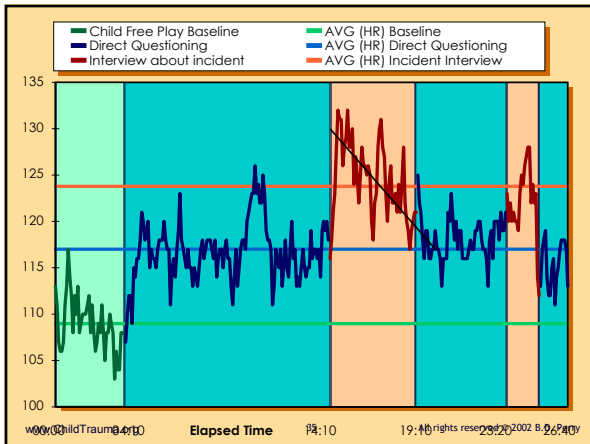
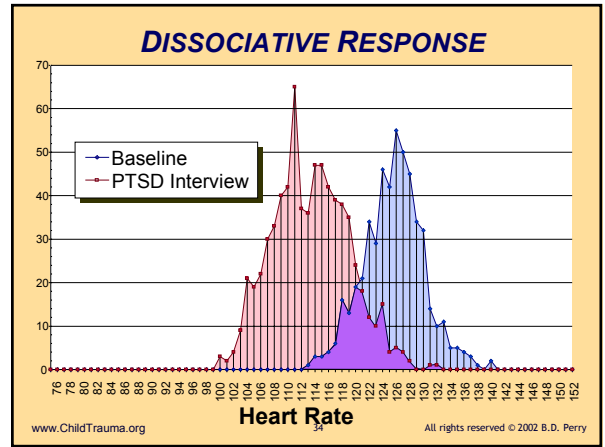
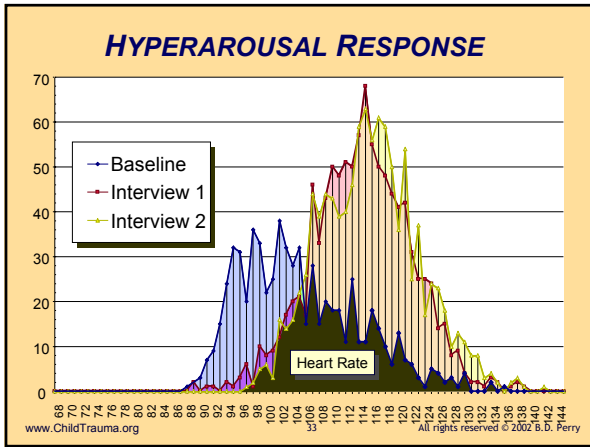
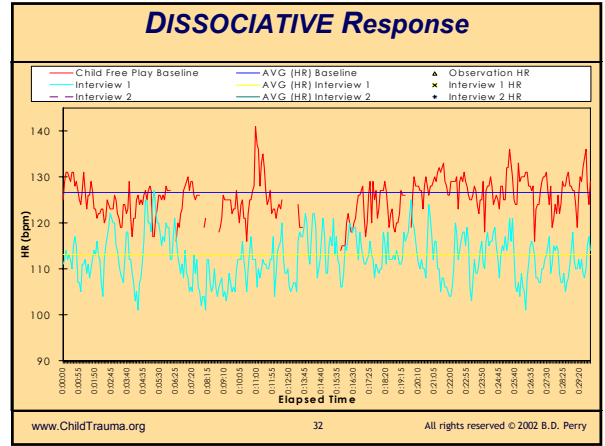
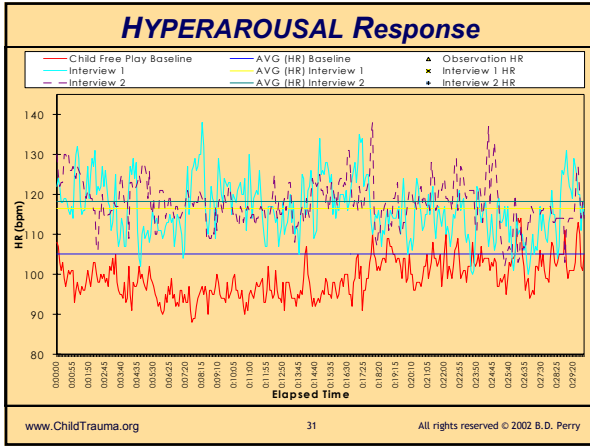


### Resting HR: Branch Davidian Children



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### Use-dependent Development of Opioid-mediated Symptoms following Childhood Trauma

“Syncope of Unknown Origin”

“Catatonia”

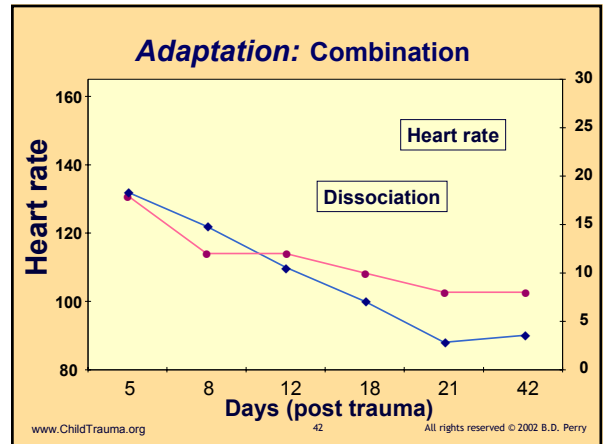
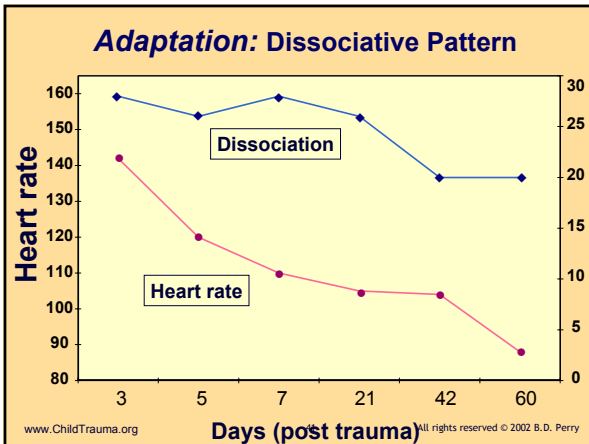
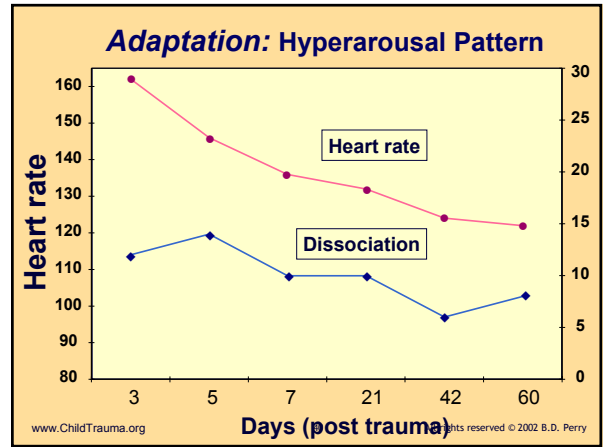
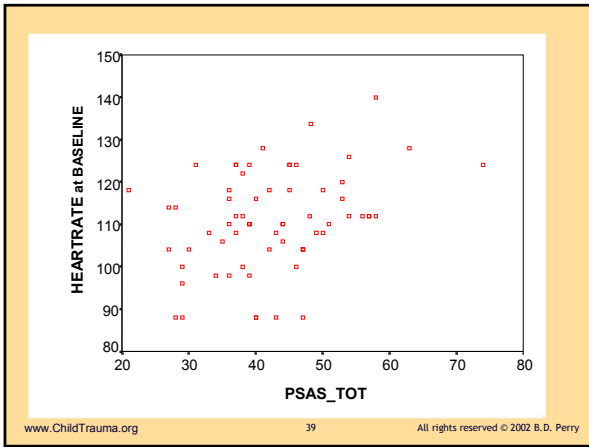
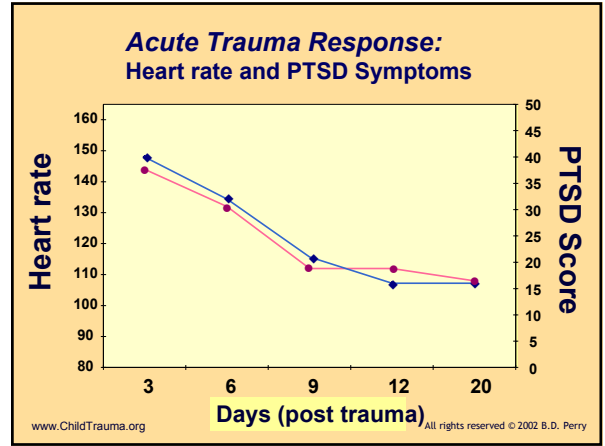
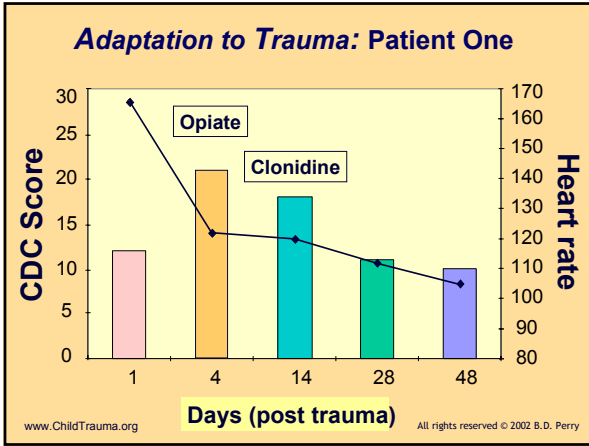
“Conversion Reaction”

Bradycardia

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# Neurodevelopmental Impact of Childhood Trauma

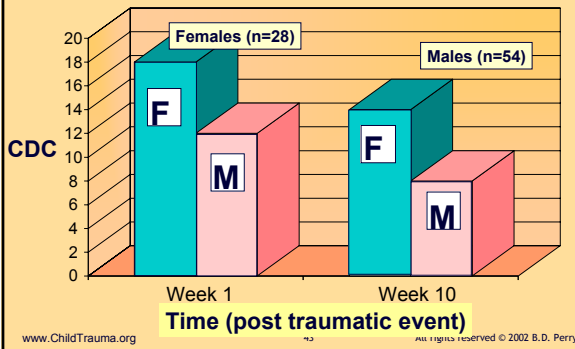
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### Dissociation: Gender Differences

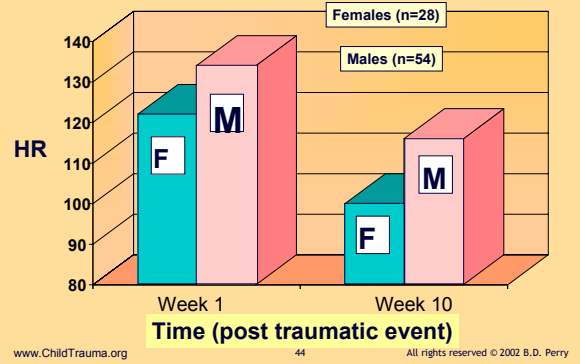


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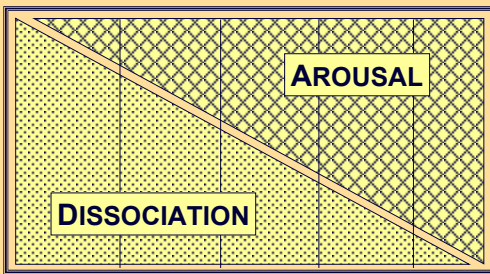
### Hyperarousal: Gender Differences



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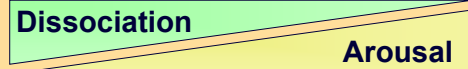
Dissociation	Dissociation and Hyperarousal	No Chronic Symptoms	Hyperarousal and Dissociation	Hyperarousal
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### DISSOCIATIVE/AROUSAL BALANCE



Females	>	Males
Young Children	>	Older Children
Torture/Pain	>	Observer
Inescapable Helplessness	>	Action Active Role

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### Primary Dissociative Responses Following Childhood Trauma

- typically observe normal or low resting HR
- when presented with evocative cues related to trauma, an initial increase in HR observed
- if not unable to distract, avoid, or 'tune out' these cues, a plateau and then decrease in HR is observed

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### Primary Dissociative Responses Following Childhood Trauma

- Frequent work ups for absence seizures
- Cue dependent decrease in HR may result in syncope (fainting)
- Frequent somatic complaints-- headaches, muscle aches, abdominal pain, constipation
- All consistent with sensitization and dysregulation of CNS opioid systems

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### **Hopeless and Helpless**

Learned Helplessness

Defeat Reaction

Surrender Response

Capitulation

### **Syncope: Case 1**

- 13 yo female
- s/p physical assault, suffocation, near death
- event amnesia
- sudden recollection associated with syncope
- normal resting HR
- cognitive narrative associated with bradycardia

### **Syncope: Case 2**

- 12 yo female
- s/p disclosure about sexual abuse
- syncope following re exposure
- event specific bradycardia and dissociation
- reversed and controlled by naltrexone

### **Syncope: Case 3**

- 14 yo male
- s/p chronic and severe domestic violence
- s/p physical abuse
- chest pain, bradycardia and syncope
- trauma and stress specific
- reversed by naltrexone

### **“Conversion Reaction”**

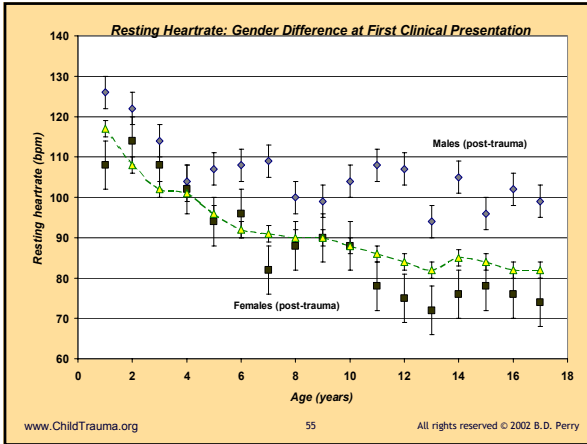
- 15 yo female
- admitted to ER with paralysis and bradycardia
- 45 sec asystole in ER
- sudden onset-- stressors; s/p sexual abuse
- complete neurological-- wnl
- complete reversal of bradycardia and paralysis with naltrexone

### **Catatonia**

- 15 yo male with mild MR
- severe stressors in school with sudden onset of non responsiveness
- LP, MRI, EKG wnl
- in hospital, non responsive for 24 hrs
- reversal with naltrexone within 30 minutes

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Sense of Time	Extended Future	Days Hours	Hours Minutes	Minutes Seconds	Loss of Sense of Time
Primary secondary Brain Areas	NEOCORTEX Subcortex	SUBCORTEX Limbic	LIMBIC Midbrain	MIDBRAIN Brainstem	BRAINSTEM Autonomic
Cognition	Abstract	Concrete	Emotional	Reactive	Reflexive
Mental State	CALM	AROUSAL	ALARM	FEAR	TERROR

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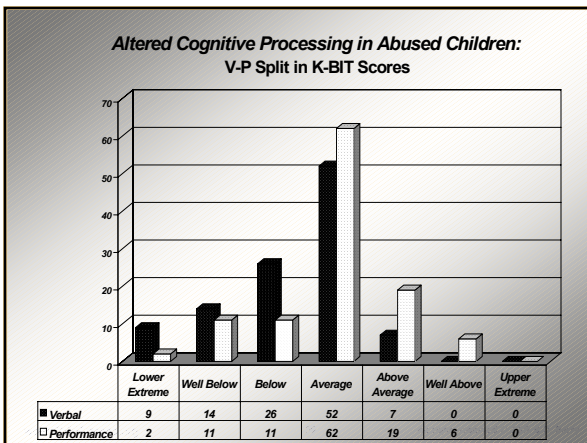
Adaptive Response	Rest (Adult Male)	Vigilance	Freeze	Flight	Fight
Hyperarousal Continuum	Rest (Male Child)	Vigilance	Resistance	Defiance	Aggression
Dissociative Continuum	Rest (Female Child)	Avoidance	Compliance	Dissociation	Fainting
Primary secondary Brain Areas	NEOCORTEX Subcortex	SUBCORTEX Limbic	LIMBIC Midbrain	MIDBRAIN Brainstem	BRAINSTEM Autonomic
Cognition	Abstract	Concrete	Emotional	Reactive	Reflex
Mental State	CALM	AROUSAL	ALARM	FEAR	TERROR

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### State-Dependent 'Storage' and Recall

- State-dependent storage**  
e.g., if parts of the brain are not "active," they will not "change" and, thereby, store new information
- State-dependent recall**  
e.g., you can't access cognitive information (cortically stored) when you are asleep

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Children who have been traumatized have emotional and state memories indelibly burned into their brainstem and midbrain!

Once you know how to ride a bicycle... can you unlearn it?

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### Consequences of Maltreatment

- Increases in violent behavior
- Increases in neuropsychiatric disorders
- Increased risk of substance abuse
- Increased risk for teenage pregnancy
- Increased risk for anti-social/criminal actions
- Increased risk of becoming perpetrators of abuse
- Increased risk of becoming victims of other abuse

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### Public Health

Health in all domains - all organ systems - is related to childhood experience

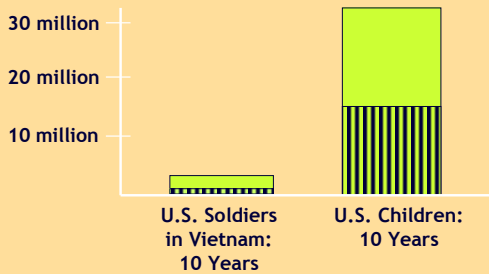
Increased distress, chaos and threat in childhood increases risk for cardiac, respiratory, skin, gastrointestinal, endocrine, immune and neurophysiological problems throughout life

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### Scope of Abuse



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