BrainSTEPS
Strategies Teaching Educators, Parents, & Students
A BRAIN INJURY SCHOOL RE-ENTRY CONSULTING PROGRAM

Training:
Pediatric Traumatic Brain Injury: Ages 0-5

April 30, 2014

BrainSTEPS
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Child & Adolescent
Brain Injury
School Re-Entry Consulting
Program
www.brainsteps.net

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1. **What are BrainSTEPS Teams?**
2. **What are Return to Learn Concussion Management Teams?**

The BrainSTEPS Program

Created by:
PA Department of Health in 2007

Unique partnership for funding:
PA Department of Health
PA Department of Education, Bureau of Special Education via the PaTTAN network

Implemented by:
Brain Injury Association of Pennsylvania

pennsylvania DEPARTMENT OF HEALTH | BRAIN INJURY ASSOCIATION OF PENNSYLVANIA | pennsylvania DEPARTMENT OF EDUCATION

BrainSTEPS
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- **31 BrainSTEPS Teams cover the state of Pennsylvania**
- **290 Brain Injury school consultants**
  - Educational professionals
  - Medical & Rehab professionals
  - Family members

BrainSTEPS team member Consultation Activities

Communication with family
Communication with school
Consultation with student
Records review
Consultation: strategies
Consultation with medical professionals
Consultation educational plan
Training of educators and support staff
Classroom and peer education
Information sharing among team
Demonstration of interventions
Observations/evaluations of student
Participation in IEP and 504 meetings

BrainSTEPS Teams monitor students annually until graduation

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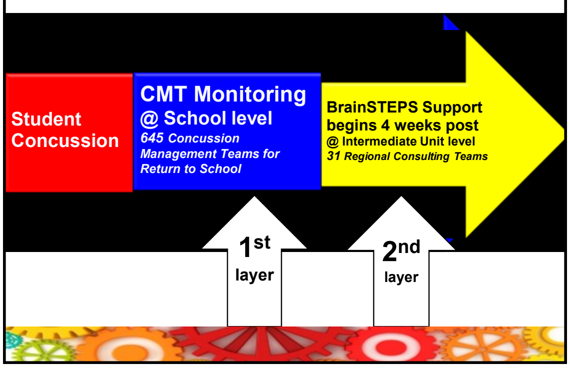
PA's Statewide Return to Learn Concussion Management Team (CMT) Model

PA's Layered Statewide Infrastructure for Concussion Return to Learn



Return to School BrainSTEPS Concussion Management Team (CMT) Project

- **CMTs consist of 2 monitors**
  - **Academic Monitor** (School Psych, Guidance Counselor) **Symptom Monitor** (School Nurse)
- **645 Return to School Concussion Teams across the state of PA since Jan. 2013**

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PEDIATRIC TRAUMATIC BRAIN INJURY: AGES 0-5

Stephen R. Hooper, Ph.D.
Associate Dean and Chair
Department of Allied Health Sciences
University of North Carolina School of Medicine

For Starters.....

- Can you remember your 1st birthday?
  - Probably not
- When do children begin to gain verbal control over their behavior?
  - ~ 3.5 years of age.
- When do children climb stairs using alternating feet?
  - ~ 3 years of age.
- When do children use 2-3 word phrases and ask questions?
  - ~ 30 months of age

For Starters....

- When do children have at least 50 words in their receptive vocabulary?
  - ~18 months
- When can children drink from a straw and stab with a fork?
  - ~ 24 months
- The average newborn's brain uses close to 75 percent of available energy from caloric intake.
  - True

Introduction

- TBI is…..An acquired brain injury is an injury to the brain, which is not hereditary, congenital, degenerative, or induced by birth trauma.
- An acquired brain injury is an injury to the brain that has occurred after birth. An acquired brain injury commonly results in a change in neuronal activity, which affects the physical integrity, the metabolic activity, or the functional ability of the cell.
- An acquired brain injury may result in mild, moderate, or severe impairments in one or more areas, including cognition, speech-language communication; memory; attention and concentration; reasoning; abstract thinking; physical functions; psychosocial behavior; and information processing (Brain Injury Association of America, 2004)

Introduction

- TBI is…..An acquired injury to the brain caused by an external physical force, resulting in total/partial disability or psychological impairment, or both, that adversely affects a child's educational performance.
- The term applies to open or closed head injuries, resulting in impairments in one or more areas such as cognition; language; memory; attention; reasoning; abstract thinking; judgment; problem solving; sensory, perceptual, and motor abilities; psychosocial behavior; physical functions; information processing; and speech.
- The term does not apply to brain injuries that are congenital or degenerative, or brain injuries induced by birth trauma.

Introduction

- Traumatic brain injury means an acquired injury to the brain caused by an external physical force or by an internal occurrence resulting in total or partial functional disability and/or psychosocial impairment that adversely affects a child's educational performance.
- Causes may include but are not limited to, open or closed head injuries, cerebrovascular accidents (e.g., stroke, aneurysm), infections, kidney or heart failure, electric shock, anoxia, tumors, metabolic disorders, toxic substances, or medical or surgical treatments.
- The brain injury can occur in a single event or can result from a series of events (e.g., multiple concussions).
- Traumatic brain injury also can occur with or without a loss of consciousness at the time of injury.
- Traumatic brain injury may result in impairments in one or more areas such as cognition; language; memory; attention; reasoning; abstract thinking; judgment; problem-solving; sensory, perceptual, and motor abilities; psychosocial behavior; physical functions; information processing; and speech.
- Traumatic brain injury does not apply to brain injuries that are congenital or degenerative, but can include brain injuries induced by birth trauma (North Carolina, 2013).

Introduction

- Traumatic Brain Injury(TBI) can have a devastating impact on the lives of individuals of all ages.
- The years between birth and 5 years of age are a time of rapid development.
  - Marked by periods of brain growth
    - Brain size
    - Brain weight
    - Number and quality of neuronal connections
  - Attainment of critical developmental milestones
  - Emergence of many important skills and abilities

Introduction

- A TBI during this developmental period may contribute to a wide range of negative outcomes.
  - Severe, pervasive disabilities
  - Mild, transient difficulties in specific functions (e.g., language, attention problems)
- There is some sense that those injured before 24 months of age may be at greater risk for long-term difficulties than those injured after 24 months.
- A TBI anytime during this developmental period may contribute to long-term functional outcomes, some of which may lie "silent."

Outline/Schedule

- 9:00-10:15 Brain development and issues in early injuries
- 10:15-10:30 Break
- 10:30-11:45 Epidemiology, causes, and functional outcomes
- 11:45-12:00 Questions
- 12:00-1:00 Lunch
- 1:00-2:15 A neuropsychological assessment perspective
- 2:15-2:30 Break
- 2:30-3:00 Implications for the early childhood professional

Brain Development and Issues in Early Brain Injury

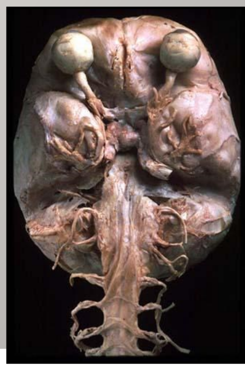
Brain Development

- As compared to school-age children, the anatomy of infants, toddlers, and preschoolers makes them more vulnerable to the negative effects of TBI.
  - For their bodies mass, the heads are proportionally larger.
  - Neck muscles are not strong enough to protect the head and brain stem from injury.
  - The brain is still forming, particularly with respect to neuronal connections and complexity.

Brain Development

- The brain and skull are in ongoing development during this time period.
  - The skull is thin, and pliable (e.g. sutures and 5 fontanelles) and not rigid.
    - Consequently, the developing skull responds differently to TBI
  - The brain has not formed all of its sulci and gyri- the younger the child, the "smoother" the brain surface.
  - Lack of myelin sheath for many of the neuronal fibers (i.e., axons)
  - Show a large, shallow subarachnoid space.

An Adult Brain



Infant Brain

The Primary Foundation: The Neuron

- The neuron is the basic cellular structure which transmits nerve impulses throughout a complex network of interconnecting brain cells.
- The brain contains approximately 180 billion cells, 50 billion of which transmit and receive sensory-motor signals in the central nervous system via about 15,000 direct physical connections.

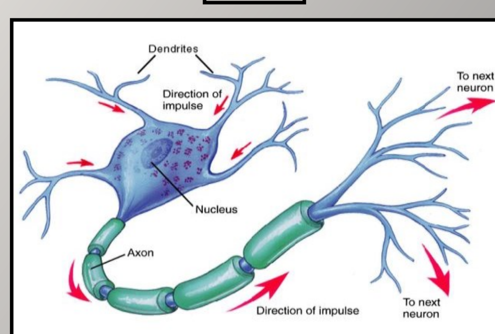
The Primary Foundation: The Neuron

- Neurons can be modified by experience, and they are said to learn, remember, and forget as a result of experiences.

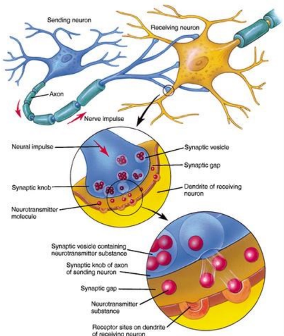
The Primary Foundation: The Neuron

- Neurons contain 4 defined parts:
  - Cell Body
  - Dendrites (receive impulses from other neurons)
  - Axons (conduct nerve impulses away from the cell body)
  - Axon terminals (synapses)

Neuron



Synapse



Brain Development

- Postnatal development is marked by increased complexity of neural structures.
- The process of myelination increases brain weight from approximately 400 grams at birth to 850 grams at 11 months, to 1100 grams at 36 months, to 1350 grams at age 15 years, with additional increases being documented through age 60 years.

Brain Development

- Myelination is the formation of the fatty sheath that covers the axons (i.e., brain white matter).
  - Increases signal transmission from 2 meters to 50 meters per second!
- The brain of a newborn contains very little myelin, and is the main reason why babies and young children process information so much more slowly than adults.
- Most areas of the brain begin adding myelin within the first two years of life, with the initial growth occurring in the primary motor and sensory areas—regions that receive input from the eyes, ears, nose, skin, and mouth—primitive functions for survival.
  - The process actually begins around the 6th gestational month.
- Despite this brain growth, neuronal pruning also occurs (i.e. the process of shedding "unnecessary" brain cells), and this begins during the preschool years.

Brain Development

- Four postnatal growth spurts have been found that roughly correspond to Piaget's stages of development:
  - 2 to 4 years (Sensorimotor and Preoperational)
  - 6 to 8 years (Preoperational Stage)
  - 10 to 12 years (Concrete Operational Stage)
  - 14 to 16+ years (Formal Operational Stage)

Central Nervous System: The Brain

- Brain Stem
- Cerebellum
- Cerebrum/Cortex
- Subcortical

Anterior View of Brainstem

Brain Stem

- The brainstem — located at the top of the spinal cord near the neck — is the most highly developed area of the brain at birth.
  - Controls all inborn reflexes (e.g., crying, startling, suckling)
  - Regulates basic life functions (i.e., breathing, blood pressure, heart rate, digestion, REM sleep).
  - Communicates with the amygdala – a key structure for emotional regulation – to regulate the baby's feelings, especially anxiety or, conversely, becoming calm.
  - These brain regions and connections mature early in life and are sensitive to parental feedback.

Brain Stem

- "Your patience, attention, and understanding are keys to helping your baby develop a healthy way to handle emotions" (Marian Diamond, *Magic Trees of the Mind*)

Cerebellum

- Receives information from the semicircular canals (inner ear) concerning orientation of body in space.
- Responsible for the unconscious adjustment of muscles in the body for coordinated, smooth, and complex motor activity.
- This area coordinates motor and sensory functions.
- Some researchers believe the cerebellum plays a role in higher-order brain functions (e.g., executive capabilities) and in the way children process social cues.
  - Could explain the presence of communication and social impairments following a TBI.

Cerebellum

- Injury can result in:
  - Dystaxia (movement disorders)
  - Dysarthria (slurred, slowed speech)
  - Nystagmus (blurred vision and dizziness)
  - Hypotonia (loss of muscle tone)
  - Poor balance and muscle coordination
  - Delays in rolling over to crawling and walking
  - Possible higher-order cognitive deficits

Major Brain Regions

- Cortical Regions
  - Temporal Lobes
  - Parietal Lobes
  - Occipital Lobes
  - Frontal Lobes
- Subcortical Regions
  - Basal Ganglia
  - Limbic System
  - Hypothalamus

Cerebrum

- Comprises the left and right hemisphere.
- These hemispheres seem to have anatomical (asymmetry) and functional (lateralization) differences.
- The left hemisphere has a greater ratio of gray matter to white matter, and seems to be more specialized for language-type functions.

Cerebrum

- The right hemisphere has a greater ratio of white matter to gray matter, and seems to be more specialized for visual-perceptual functions.
- Within each hemisphere, intrahemispheric connections allow for rapid communication for the perception and integration of information, and for the organization of complex output.

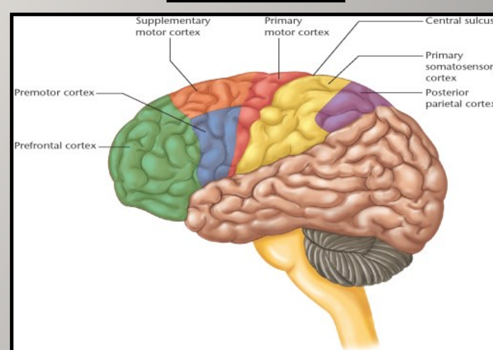
Cerebrum

- The hemispheres are connected by large bundles of myelinated fibers for rapid transmission of information.
  - Corpus Callosum
  - Anterior Commissure
  - Posterior Commissure

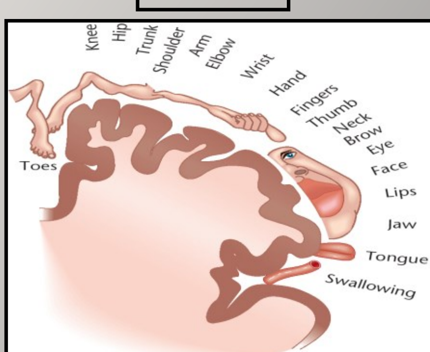
Frontal Lobes

- Three distinct regions:
  - Primary motor region (Motor Homunculus, Broca's area)
  - Premotor region
  - Prefrontal region (dorsolateral, orbital, medial)
- Rich interconnections to all brain regions, including subcortical areas.
- Developmental contingencies
  - Although frontal lobe development begins in infancy

Motor Cortex



Homunculus



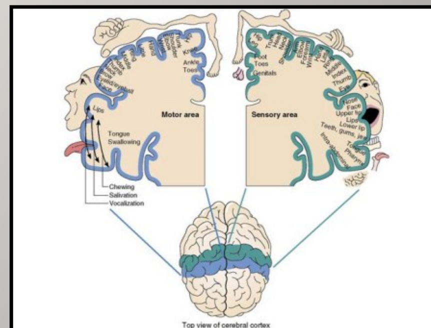
Frontal Lobes

- Functionally, these regions are related to planning, organization, efficiency, self-monitoring and regulation, abstract thinking, and metacognition abilities.
- Impulsivity, perseveration, inertia, and disinhibition also can be seen following injury or damage.
- These functions are vulnerable following an injury to these brain regions; however, they may not be detected with IQ testing or tasks that tap factual knowledge.
- A variety of associated social-behavioral-emotional problems also can surface following injury to the frontal lobes.

Parietal Lobes

- Plays a major role in information integration:
  - Sensory information (Sensory Homunculus)
    - Touch
    - Pressure
    - Pain
    - Temperature
  - Sensory information and memory
  - Internal state information with external world needs
- Parietal lobe processing tends to be multimodal.

Somatosensory Cortex



Temporal Lobes

- Temporal lobes are associated with:
  - Memory (Visual and auditory)
  - Visual item recognition (faces, auditory agnosia)
  - Auditory processing (Verbal and nonverbal)--Wernicke's area
  - Hearing – first sense to develop in babies
  - Emotion
- Language functions also have been intimately linked to the temporal lobes.

Occipital Lobes

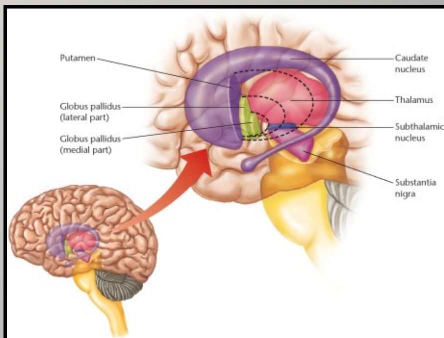
- Largely concerned with visual sensation and perception.
- These lobules are not as involved in multimodal information integration as the other lobes, but they do relate to the temporal and parietal lobes via the "what" and "where" pathways.
- Damage to these regions can create cortical blindness.

Subcortical Regions

Basal Ganglia

- Comprises three major structures:
  - Caudate nucleus
  - Putamen
  - Globus Pallidus
- Located within the region of the midbrain and diencephalon
- Intimately involved with motor functions and, when damaged, can produce postural changes, increases or decreases in muscle tone, and movement changes (e.g., twitches, tremors, jerks).

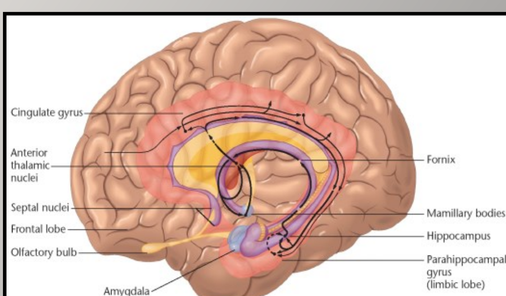
Basal Ganglia



Limbic System

- A set of structures deep in the forebrain comprising the hippocampus, septum, and cingulate gyrus.
- Maintains widespread connections with the neocortex, and with the autonomic and endocrinological systems.
- Serves as an intermediary between cognitive and emotional functions.
  - Analyzing and responding to fearsome, threatening situations
  - Monitoring sexual responses, including reproducing and nurturing offspring
  - Remembering recent and past events
  - Sensing and responding to feeling states (e.g., pleasure).

Limbic System



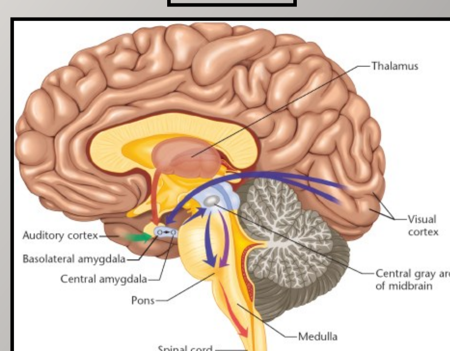
Limbic System: Hippocampus

- Important to memory and learning.
- Attention and inhibition.
- Rich connections with the septal nuclei and amygdala.
- Modulation of reactions to frustrations or punishment, particularly in regard to learning.
- Left hippocampus is highly involved in processing and/or attending to verbal information.
- Right hippocampus is more involved in the learning, memory, and recollection of nonverbal, visual-spatial, environmental, emotional, motivational, tactile, olfactory, and facial information.

Limbic System: Amygdala

- “Head Ganglion” of the emotional-motivational system.
- Unilateral and multimodal in its function.
- Primarily concerned with the expression of aggression, fear, and sexuality.
- Rich interconnections with neural pathways for vision in the inferior temporal lobe (e.g., social-emotional agnosia, social perception).
- Because of its receptive and reactive nature, it is also important to attention, learning, and memory.

Amygdala



Lurian Theory

- Three major units of the brain:
  - Unit 1 - Comprises the brain stem and largely concerned with basic arousal.
  - Unit 2 - Comprises the temporal, parietal, and occipital lobes and largely concerned with information input.
  - Unit 3 - Comprises the frontal lobes and largely concerned with information output.

Lurian Theory

- Functional systems of complex human functions.
- Zones of proximal development - Primary, Secondary, and Tertiary.
- Developmental features to the zones:
  - Primary (birth to 12 months), Secondary (birth to 5 years), and Tertiary (5 through adulthood).
- Rehabilitation guidance.

Epidemiology, Causes, and Functional Outcomes

Epidemiology

- TBI is a national epidemic.
- Approximately 1.4 million individuals of all ages incur a TBI annually in the US.
  - ~52,000 result in death
- Leading cause of death and long-term disabilities in children and adolescents.
- Most prevalent in individuals between the ages of 15 to 24 years.

Epidemiology

- Prevalence data on children from birth to 5 years of age have surfaced over past 25 years.
- Across several large epidemiological studies, early estimates have ranged from about 19% to 40% of all pediatric TBI cases.

Epidemiology

- ~200,00 visits to Emergency Departments
  - 62% Male
  - 79% Caucasian
  - Primary reason – Falls (54%)
- ~15,000 hospitalizations
  - 61% Male
  - 56% Caucasian
  - Primary reasons – Falls (41%), Motor Vehicle Incidents (11%), and Assaults (7%)
- ~1,100 brain injury-related deaths
  - Primary reasons – Motor Vehicle Incidents (46%), Assaults (32%)

Epidemiology

- A substantial number of children under the age of 24 months have sustained inflicted, non-accidental injuries secondary to abusive head trauma (aka Shaken Baby Syndrome).
  - Incidence is ~17/100,000 per year
    - Birth to 12 months = 29.7/100,000 per year
    - 13 to 24 months = 3.8/100,000 per year
  - Boys > Girls
  - More common in young mothers
  - More common in multiple births
  - More common in minority families, but likely secondary to socioeconomic status

Causes

- TBI results from inertia and/or contact that can cause translational (i.e., brain moves along a straight line) or rotational (i.e., brain rotates around the center of gravity) forces.
  - e.g., Coup-Contre Coup and rotational injuries
- Primary causes of TBI in infants, and toddlers, and preschool children:
  - Falls
  - Motor vehicle crashes
  - Crushing injuries
  - Abuse/Inflicted injuries

Causes

- Falls tend to result in:
  - Injuries of translational force;
  - Focal dysfunction;
  - Relatively better outcomes.
- Motor vehicle crashes tend to result in:
  - Injuries of rotational force;
  - Diffuse involvement;
  - Relative more severe outcomes.

Causes

- Inflicted injuries (Abusive Head Trauma)
  - Involve rapid angular acceleration-deceleration forces of a major magnitude.
  - Some evidence to suggest that impact also accompanies these forces.
  - Can result in some of the most severe cases of injury and, in many instances, death.

Functional Outcomes of Preschool TBI

- Early literature hailed plasticity of the young brain as protection against the negative outcomes associated with TBI.
- More recent evidence suggests otherwise; in fact, data suggest that early TBI can be quite detrimental to overall development.
- Although the estimated incidence of TBI is lower in preschool children than school-age children, the morbidity is at least as high.

Functional Outcomes

- To date, approximately a dozen or so studies have examined functional outcomes from TBI during the birth to 5 years developmental period.
- Taken together, TBI in young children can impact academic, motor, and cognitive functions.
  - Impairments can persist long past the injury
  - Injuries can “lie silent” and manifest at a later developmental period.
- Inflicted TBI may manifest greater functional deficits than non-inflicted TBI.

Functional Outcomes

- Developmental-Intellectual Outcomes:
  - Contributes to lowering overall intellectual functioning.
  - Both verbal and nonverbal abilities affected, particularly the latter
  - The greater the injury severity, the greater chance that there will be long-term problems (Mild/Moderate > Severe), with findings holding at least 2 years post injury.

Functional Outcomes

- Developmental-Intellectual Outcomes:
  - Membership in the severe group contributed to more substantial delays/impairments AND more persistent problems over time.
  - The younger the age of injury, the greater the chance for impairment.
  - Lower premorbid functioning contributed to long-standing problems..
  - Inflicted brain trauma under the age of 24 months lessened the overall level of functioning over time.

Functional Outcomes

- Motor Outcomes:
  - Typically evident after preschool TBI
  - Both fine-motor and gross motor functions can be affected
  - Mild/Moderate > Severe
    - Even mild/moderate injuries can result in low average motor functioning

Functional Outcomes

- Language Outcomes:
  - Closely tied to injury severity
    - Mild/Moderate > Severe
  - Earlier age of injury also produced more impairment at time of injury and at 8-12 months follow-up
    - Injuries prior to 31 months of age exhibited a greater degree of expressive language dysfunction than children injured after the age of 31 months – likely secondary to the developmental ascendancy of expressive language functions at that developmental period
  - Additionally, receptive language also affected (but an earlier developmental ascendancy here)
  - Premorbid language capabilities may be a significant factor in predicting recovery
    - Places critical importance on early developmental screening by primary care providers and schools

Functional Outcomes

- Memory Outcomes
  - Moderate/Severe cases show flatter recovery curves, with severe cases having the lowest level of memory functioning at 12 month follow-up.
  - Conversely, mild cases tend to recovery their memory capacity at 12 month follow-up
  - Immediate memory > Delayed Recall and Learning functions.
  - Are there differential performances across severity levels for other types of memory?

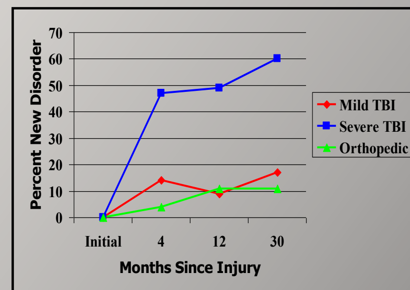
Functional Outcomes

- Social-behavioral difficulties might be expected following a TBI in the birth to 5 time period.
- Factors influencing this include:
  - Severity of injury
  - Young age at injury
  - Relative lack of time to develop adaptive coping skills
  - Associated cognitive impairments
  - Family factors, particularly in cases of abuse

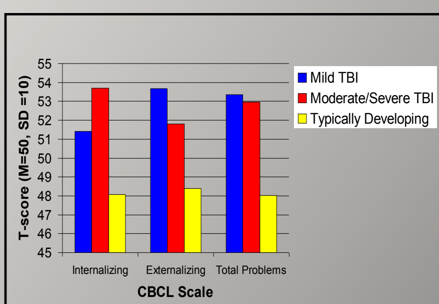
Functional Outcomes

- Social-Behavioral Outcomes
  - Following an inflicted injury before 24 months of age, social competence appears to be impaired when compared with a community sample
    - Communicative signaling behaviors (i.e., fewer social initiations, less responsive in social interactions)
    - Less positive affect
    - Less joint attention (i.e., mutual eye gaze)
  - When using parent ratings of social-behavioral functioning, preschoolers who sustained a TBI (both inflicted and non-inflicted) before 24 months did not differ across severity or a matched comparison group
- These early findings are mixed, but given their young age, it is clear that developmental surveillance and progress monitoring will be critical to manifest social-behavioral dysfunction in the preschool years

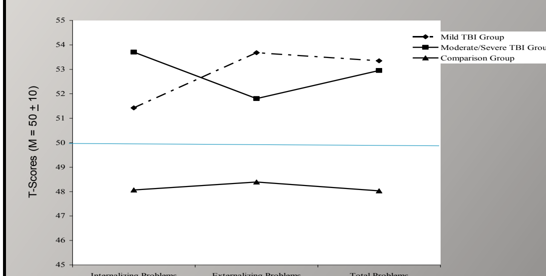
Rates of New Psychiatric Disorder



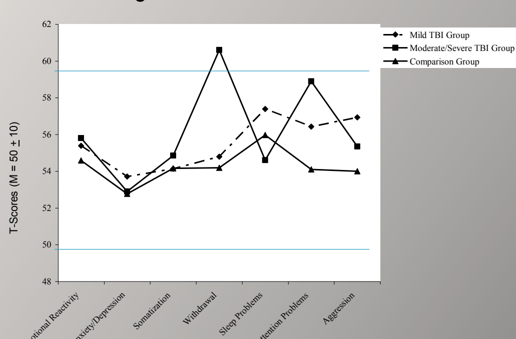
Parent Ratings of Behavior Problems of 3-Year Old Children Injured Prior to 2 Years of Age



Parent Ratings of Social-Behavior in Preschool TBI



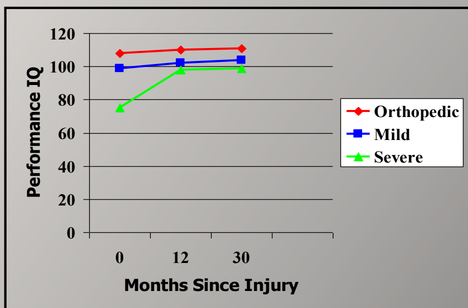
Parent Ratings of Social-Behavior in Preschool TBI



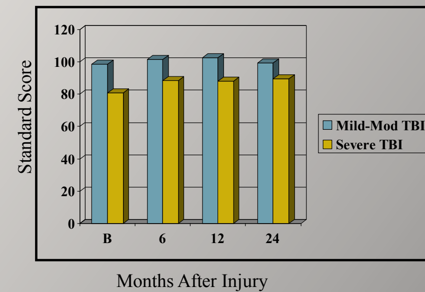
Factors Affecting Outcomes

- Severity of injury
  - Mild > Moderate > Severe
    - Level of functioning as well as rate of recovery
- Mechanism of injury
  - Inflicted TBI and Motor Vehicle Incidents produce more impairment than falls
- Earlier age of injury tends to produce more impairments and slower recovery over time
  - Critical for early identification and ongoing neurodevelopmental surveillance
- Relationship of factors is complex and poorly understood in preschool children
  - e.g., mechanism of injury x age of injury interaction

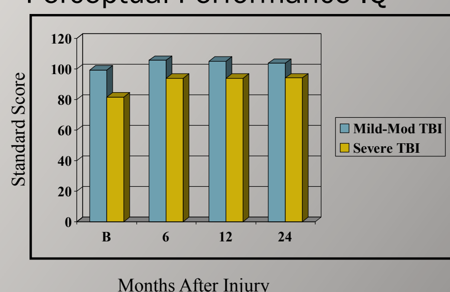
Typical Cognitive Recovery Curve



Preschool Recovery Curve: Composite IQ



Preschool Recovery Curve: Perceptual-Performance IQ



A Neuropsychological Assessment Perspective for the Preschool Child

Neuropsychological Assessment

- The increased focus on the assessment and treatment needs of preschool children with a variety of developmental needs is no accident.
  - Children with a wide array of acquired and neurodevelopmental problems are now populating inclusive preschool classes
  - Requiring special education preschool services
- In part, improvements in medical care have contributed to lessening the mortality among sick or injured infants and toddlers.
  - The decrease in mortality likely has contributed to an increase in morbidity
- It is this latter supposition that has contributed to increased research and clinical efforts addressing the assessment and treatment needs of preschool children with exceptionalities.
  - Low birth weight preschoolers
  - Prenatal drug exposure
  - ADHD
  - TBI
  - Assessment-treatment linkages
- The need to develop appropriate educational programs highlights the concurrent need for detailed profiles of abilities, and neuropsychological assessment strategies can provide one vehicle for addressing this need.

Assessment: A Definition

- Assessment is a goal directed problem solving process that uses various measures within a theoretical framework. It is a variable process that depends on the questions asked, the type of student, and a myriad of social, developmental, and contextual factors. It cannot be reduced to a finite set of steps or rules.

Neuropsychology: A Definition

- Clinical Neuropsychology is an applied science concerned with the behavioral expression of brain function/dysfunction. It is the study of the relationship between brain function and subsequent behavior.

Goals of Neuropsychological Assessment

- Determine spared versus impaired abilities.
- Understanding impact of injury and/or a neurodevelopmental problem (e.g., LD).
- Assist in localization of function and dysfunction.

Goals of Neuropsychological Assessment

- Assist in determining whether to remediate or to compensate.
- Generate suggestions for remediation and compensation.
- Suggestions for monitoring and tracking of progress in school setting.

Neuropsychological Assessment

- There are numerous complexities related to the neuropsychological assessment of children.
- Some of these complexities include:
  - Test selection
  - Interpretation issues
  - Assessment-treatment linkages
  - Other factors that contribute to behavior and learning challenges
- These concerns are magnified further when a neuropsychological perspective is applied to children below the age of 6 years where reliability is always suspect.
- Approximately 25 years ago, Aylward (1988) described this latter area as a "no man's land" with respect to its current level of development, particularly for children birth to two years of age.
- This area has advanced since that time, and it certainly has expanded in its interest and importance.

Neuropsychological Assessment

- Consistent with the use of neuropsychological methods with school-age children and adults, a neuropsychological approach for the preschool child can yield a wealth of information pertaining to:
  - Diagnostic profile description
  - Prognosis
  - Identification of Various treatment factors
- A neuropsychological perspective should serve to advance our understanding of brain-behavior relationships in the preschool population and facilitate examination of young children with special needs.
  - This may be particularly important for the preschool child who has sustained a TBI.

Neuropsychological Assessment

- Over three decades ago, Behr and Gallagher (1981) proposed that professionals use a more flexible definition of what constitutes special needs in the preschool population.
- They suggested that the definition should describe not only the extent of developmental variation, but also the type of variation.
- Consistent with this formulation, neuropsychological diagnosis is concerned with the detailed and comprehensive description of a child's profile of strengths and weaknesses.
- This profile may provide clues reflecting the effects of a brain lesion or neurodevelopmental anomaly on subsequent learning and behavior.

Neuropsychological Assessment

- It also may lend much needed information to increasing our understanding of brain-behavior relationships during this developmental period.
- The emphasis on profile description has forced clinicians to address the ecological validity of a set of neuropsychological findings (e.g., what is being affected in the child's day-to-day life and what might be affected later).
- In this regard, clinicians have begun to apply their findings to the preschool classroom setting, the preschooler's adaptive behavior and learning needs, and parent-child and teacher-child interactions.
- This latter application is critical in that it can help bring the family into the treatment equation as required by federal law and contemporary family-center practice.

Neuropsychological Assessment

- Several intellectual batteries that are useful for preschool children
  - Ages 2 to 5 years:
    - WPPSI-IV
    - Stanford-Binet V
    - Differential Abilities Scale-2
    - Woodcock-Johnson III
    - Leiter International Performance Scale-II
    - Kaufman Assessment Battery for Children-II
    - Cognitive Assessment System
  - Ages birth to 5 years:
    - Mullen Scales of Early Learning
    - Bayley Scales of Infant Development

Neuropsychologiacl Assessment

- Several neuropsychological batteries that are appropriate for preschool children.
  - Reitan-Indiana Neuropsychological Battery
  - CANTAB
  - NEPSY-II

NEPSY-II: A Developmental Neuropsychological Assessment

- Normed for ages 3 through 16
  - Ages 3-4
  - Ages 5-16
- Six major domains across 32 subtests
  - Attention and Executive Functions
  - Language
  - Visual and Visual Perception
  - Motor Skills
  - Memory and Learning
  - Social Perception
- Many subtests are attractive to preschoolers (e.g., Affect Recognition, Theory of Mind, Animal Sorting, Clocks, Inhibition, Picture Puzzles, Geometric Puzzles)

NEPSY-II: A Developmental Neuropsychological Assessment

- Based on Lurian theory.
- Can be administered in its entirety, by domain, or by subtest(s).
- Multidimensional in its presentation.
- Provides for a quantitative as well as a qualitative appraisal of abilities.
- Has proven useful with a variety of clinical groups.

NEPSY-II: A Developmental Neuropsychological Assessment

- Primary Scores – typically scaled scores for a global aspects of a subtest.
- Process Scores – An examination of specific error types and rates.
- Contrast Scores – comparison of higher versus lower cognitive functions via scaled scores.
- Behavioral Observations – Percents for common behaviors in clinical populations.
- There are no domain scores.

Neuropsychological Assessment

- Despite these recent advances in neuropsychological batteries for preschool children, the informal or flexible batteries likely enjoy more widespread use.
- Rey-Casserly (1999) provided an approach for the neuropsychological assessment of preschool children that comprised a tripartite model:
  - Clinical history
  - Clinical observations in the clinical setting and natural environment
  - Test performance designed to extract both quantitative and qualitative data
- Lezak suggested that the construction of an informal battery should provide:
  - Examination of a broad range of input and output functions
  - Developmentally appropriate procedures with satisfactory normative data
  - Practicality in relation to the purpose(s) of the neuropsychological examination.
  - The capacity to address the qualitative (i.e., how a child performs or approaches a task) and quantitative (i.e., level and pattern of performance) aspects of a child's functioning.

Neuropsychological Assessment

- With these guidelines in mind, several clinical and empirical preschool neuropsychological assessment models have emerged over the past several years that have described specific constructs important to this developmental time period.

Neuropsychological Assessment

- Clinical Models
  - Deysach (1986)
    - Gross motor
    - Fine-Motor
    - Sensory-Perceptual
    - Verbal
    - Short-term memory
    - Abstraction/Concept formation
  - Hartlage & Telzrow (1986)
    - Cognitive abilities
    - Basic language
    - Preacademic
    - Motor
    - Sensory
    - Social
    - Adaptive

Neuropsychological Assessment

- Clinical Models
  - Wilson (1986)
    - Language (Auditory integration, auditory cognition, auditory short-term memory, retrieval)
    - Visual (Visual-spatial, visual cognition, visual short-term memory)
    - Motor (Fine-motor, gross motor)
  - Aylward (1988)
    - Basic neurologic functions
    - Receptive functions
    - Expressive functions
    - Processing
    - Mental activity

Neuropsychological Assessment

- Empirical Models
  - Jansky (1970)
    - Visual-motor
    - Oral language
    - Pattern matching
    - Pattern memory
  - Silver & Hagin (1972)
    - Auditory association
    - Visual-neurological
    - Psychiatric impairment
    - Chronological age
    - IQ

Lurian Neuropsychological Constructs

- Motor
- Sensory perceptual
- Attention
- Language
- Visual processing
- Memory and Learning
- Executive Functions

- Related Domains
  - Intellectual
  - Achievement
  - Adaptive behaviors
  - Social-emotional
  - Family
  - School environment

Motor Components

- Gross motor strength
- Basic fine-motor speed
- Complex fine-motor speed
- Motor coordination and planning
- Spatial-based movement
- Oral-motor
- Balance

e.g., Peabody Motor Developmental Scales

Sensory-Perceptual Abilities

- Most evaluations typically assess the tactile, visual, and auditory modalities.
- The modalities of olfaction and taste are tapped less routinely, although olfaction can be disrupted in many traumatic brain injuries.

Attention Abilities

- Selective Attention (Focus/Execute)
  - Modality specific
  - Alertness and Disinhibition
- Sustained Attention (Vigilance, Span)
- Encoding
- Attentional Set Shifting
- Divided Attention
- Stabilize/Readiness

e.g., Kiddie Conners Continuous Performance Test

Expressive Language

- Communicative intent
- Oral-motor fluency
- Naming
- Word and phrase repetition
- Organization of output
- Vocal tone and prosody
- Pragmatics

e.g, Preschool Language Scale

Receptive Language

- Phonemes
- Word and phrase comprehension
- Conflictual and comparative statements
- Vocal tone and prosody
- Speed of processing
- Pragmatics

e.g., Peabody Picture Vocabulary Test-IV

Visual Processing

- Visual recognition (faces, colors, objects)
- Visual discrimination
- Visual closure
- Visual-spatial (2-dimensional)
- Visual-spatial (3-dimensional)
- Visual organization and planning
- Visual problem solving and efficiency

e.g., Developmental Test of Visual-Motor Integration-6

Memory and Learning

- Modality
- Time
- Retrieval
  - Strategies for retrieval

    e.g., Woodcock-Johnson III Picture Memory and Word Recall subtests

Memory Components - Modality

- Visual
- Verbal
  - Language
  - Non-verbal auditory
- Somatosensory/Tactile
- Taste
- Smell
- Multisensory

Memory Components - Time

- Immediate/Short-Term – Information that you need once or for a few seconds.
- Long-Term – Information that you need to retrieve at a later time.
  - Remote Recall – A special condition of long-term recall

Memory Components - Retrieval

- Recognition
- Automatic
- Episodic vs. Nonepisodic Memory
  - Contextualized recall
- Declarative vs. Procedural Memory
  - Facts vs. procedures
- Strategies for retrieval
  - Multiple repetitions
  - Semantic cues
  - Phonemic cues
  - Associative learning
  - Recognition

Executive Functions (Luria, 1966)

- Executive function is defined as the ability to maintain an appropriate problem-solving set for attainment of a future goal. This set can involve (a) an intention to inhibit a response or to defer it to a later, more appropriate time; (b) a strategic plan of action sequences and/or; (c) a mental representation of the task, including the relevant stimulus information encoded in memory and the desired future goal-state.

Executive Functions (Welsh & Pennington, 1988)

- Executive function is primarily the set maintenance required to achieve a future goal. This set would include the requisite skills of planning, organization, inhibition of maladaptive responses, self-monitoring, and flexibility of strategies contingent on feedback.
- Goldman-Rakic (1990) would add to this definition the concept of working memory.

A Conceptual Model of Executive Functioning (Denckla, 1993)

- Delay between stimulus and response
- Internal representation of schema
- Internal representation of action plan
- Response inhibition
- Efficiency and consistency of response
- Active strategies and deployment
- Flexible strategies and deployment

Executive Functions

- Regions within Dorsolateral Prefrontal Cortex (DlPFC) appear to influence:
  - The selection of behaviors
  - Recognition of context-dependent changes between stimuli and behavior
  - Potentiation of sets of stimulus-response contingencies related to behaviors in context
  - Flexible, goal-driven control of behavior

Executive Functions

- Varying levels of damage to the DlPFC are associated with:
  - Lack of motivation, creativity, or goal-following
  - Difficulty in initiating or flexibly modifying actions, resulting in stereotyped responses
  - Inability to assess others' mental states – Theory of Mind
  - Perseveration and more random-choice errors than age-matched controls
  - Increased distractibility and problems with sustained attention
  - Impaired working memory
  - Understanding of complex task rules

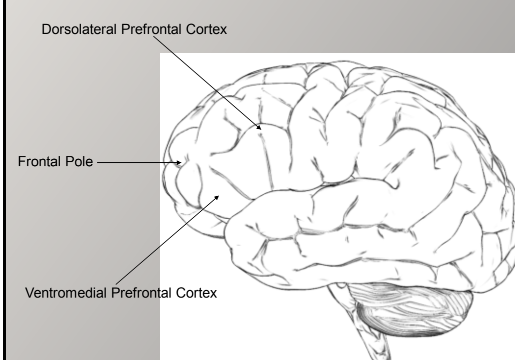
e.g., WJ-III Auditory Working Memory Subtest, Shape School, Behavior Rating Inventory of Executive Functions-Preschool Version

Executive Functions

- The Ventromedial Prefrontal Cortex (VmPFC) is critical for elucidating the relation between stimuli and reinforcers, and for explaining the inability of individuals with vmPFC damage to learn reward contingencies.

Executive Functions

- Damage to the orbitofrontal cortex, consisting of both ventral and medial regions, leads to:
  - Impulsivity
  - Sensitivity to immediate rewards
  - Lack of self-control
  - Disruption of both affective and nonaffective stimuli
- Individuals with VmPFC damage tend to select behaviors with the highest perceived reward, not the highest perceived utility.



BE FLEXIBLE!

Implications for the Early Childhood Professional

Implication for Early Childhood Professionals

- Early identification
  - Critical for initiating the special education process and early intervention
    - What if child is being served in another child care arena?
  - There is the potential immediate need for services, but downstream needs also should be considered (i.e., injuries lying silent)
- TBI is challenging for special educators in that it is a dynamic condition that can change rapidly secondary to recovery.
  - What about mTBI (i.e., concussions) in very young children??
  - Critical for schools to link to local primary care providers

Implication for Early Childhood Professionals

- Employ a Developmental Approach
  - "Preaching to the choir" – This should be automatic for any developmentalist.
  - Critical that you understand core tenets of child development (e.g., necessary foundational skills, timing of major milestones, developmental framing of problems—for child and others, etc.)
  - Should we consider recovery from a developmental perspective??
  - Utilization of evidence-based developmentally appropriate practices.

Implications for Early Childhood Professionals

- There must be increased collaboration between professionals to ensure a higher quality of care from a developmental perspective.
  - Professions from medical, psychological, allied heath (OT, PT, Speech/Language), and early childhood education need to have open <u>and</u> frequent lines of communication.
  - Preschool/School transition issues are critical.

Implication for Early Childhood Professionals

- Comprehensive Assessments
  - Given the range of potential impairments following a TBI in the preschool years, a comprehensive assessment is essential to pinpoint spared versus impaired abilities.
    - A neuropsychological perspective??
  - A variety of approaches can be utilized here (e.g., multidisciplinary, interdisciplinary, transdisciplinary)
  - Should facilitate the development of a treatment plan and/or Individualized Family Service Plan (IFSP)
  - Should facilitate the development of a progress monitoring plan as part of the larger developmental surveillance process
    - Effects of an early TBI will not stay constant over time

Implication for Early Childhood Professionals

- Developmental Surveillance
  - Critical to ongoing recovery, tracking progress, school-based preparation based on developmental needs, and forecasting future challenges with families.
  - Should be based on factors such as severity, age of injury, time since injury, and needs
    - Likely will be more frequent in nature
    - Likely will require collaboration with other non-school providers (e.g., primary care providers, community therapists, etc.)
  - Can take the form of formal, routine re-evaluations (e.g., OT, PT, Sp/L, etc.), and/or informal strategies such as classroom observations.
  - Should facilitate planning for the transition into elementary school

Implications for Early Childhood Professionals

- Families receive fragmented care in the community, typically secondary to lack of communication and awareness of issues pertinent to TBI.
- TBI is not normally distributed, thus there may be families who have marginal resources prior to the TBI.

Implication for Early Childhood Professionals

- Partnerships with Families
  - Again, "preaching to the choir" – A collaborative, working relationship with parents and family members is key to understanding a child's functioning in the home following a TBI.
  - Parent and teacher "teams" can be powerful in creating change for a preschooler in a learning, behavioral, or social situation by facilitating consistency across settings and tasks.
  - Can facilitate extended partnerships with community-based providers.
  - Will facilitate the identification of other factors that will influence development, learning, and recovery.
    - Maternal depression
    - Fiscal needs
    - Marital discord
    - Sibling needs

Implications for Early Childhood Professionals

- Transitions back to the family, school, social arena, and communities are not well understood, and even less so for preschoolers.
- There is no clear reintegration protocol for students with TBI.
  - STEP Program in Pennsylvania
- The dynamics of TBI often contribute to deficit manifestations sometime after the injury, and this could be misinterpreted.

Implication for Early Childhood Professionals

- Education, Education, Education
  - Critical for early childhood professionals as most college and graduate school curricula do not address the nuances of TBI
    - Early childhood professionals engage in early identification, early intervention, progress monitoring, developmental surveillance, family/community partnerships, etc., and knowledge of TBI is essential
  - Conversely, the early childhood professional may be the one who needs to regularly interact with the child and family on issues following a TBI.
  - An increased knowledge base on TBI will guide pre-academic instruction and behavior management which, in turn will facilitate recovery and overall development

Implications for Early Childhood Professionals

- Prevention activities remain critical to addressing this health issue.
  - Bicycle helmet laws
  - Speed limit laws
  - Drunk driving laws
  - Recreational safety issues
  - Sports return-to-play
  - Shaken Baby Syndrome education

Period of PURPLE Crying

- P – Peak of Crying (~2 to 16 weeks of age)
- U – Unexpected
- R – Resists Soothing
- P – Pain-Like Face
- L – Long Lasting (many hours)
- E - Evening

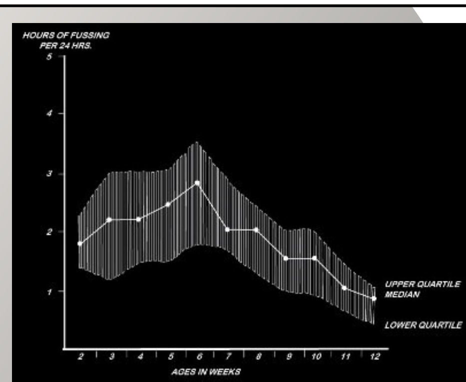


FIG. 2. Summary of the total crying time of the 80 infants studied.

Period of PURPLE Crying

- The program materials include:
  - 10 minute DVD
  - 11 page booklet
- The program is designed to be:
  - Educational and attractive to parents of newborns on the first day of life;
  - Provide clear, memorable, meaningful, attractive, positive messages;
  - Written at a third grade reading level;
  - Multicultural both through translation (10 languages) and the visuals;
  - Acceptable to public health nurses (i.e. no bottles, blankets, bumper pads, etc.);
  - Free of charge to parents.
- Includes closed captioning for the hearing impaired.

Period of PURPLE Crying

- Several randomized control trials have found that the intervention group scored higher in:
  - Their knowledge about crying and shaking;
  - The dangers of shaking;
  - Sharing advice concerning walking away when frustrated with crying.
- There was a casual relationship found if the mothers read and watched the materials given to them.
- The studies concluded that the PURPLE materials were effective in increasing maternal knowledge and behaviors surrounding SBS.

Implication for Early Childhood Professionals

- Much remains to be learned, particularly with respect to evidence-based practices with infants, toddlers, and preschoolers following a TBI.
- From the available literature, there is no question that TBI during early childhood can have a negative affect on overall development—not just in the acute phase, but in later developmental epochs.

Implication for Early Childhood Professionals

- Similar to the TBI literature for older children and adults, factors such as severity, age at injury, and mechanism of injury can affect outcomes
  - This information should be obtained as soon as possible, with a particular attention to injuries before the age of 24 months.
  - Inflicted injuries should pull for your particular attention given their apparent poorer outcomes and associated family factors (i.e., where is the perpetrator, is the child in foster care, etc.)
- Critical for the field to continue to examine this question, and the early childhood professional should be an active player in this work.

Questions?

Contact Information:
Stephen_Hooper@med.unc.edu