

Brain Injury

Introduction

Welcome to the Brain Injury Section of the Cambridge Center for Behavioral Studies. Please review the material contained in these pages to learn more about Traumatic Brain Injury (TBI) and Acquired Brain Injury (ABI), and to learn more about Applied Behavior Analysis (ABA) resources available for intervention and treatment. The content of the Brain Injury Section is refereed by an Advisory Board composed of leaders in ABA and TBI.

About the Action Editor for the Brain Injury websection:
Jeff Kupfer is President of Jeff Kupfer, P.A., in Colorado, President of the Four Corners Association for Behavior Analysis and Trustee of the Cambridge Center for Behavioral Studies. He can be reached by email at JKupf@aol.com.

Intended Audience

The Brain Injury Section of the Cambridge Center for Behavioral Studies is intended for:

- Survivors of Brain Injury
- Parents, Siblings, Spouses, Partners, Relatives, Neighbors, Friends, and Advocates
- Medical and Nursing Practitioners, Speech and Language Therapists, Occupational Therapists, Physical Therapists, Psychologists, Lawyers, Hospital Administrators, Insurance Representatives, Teachers, Paraprofessionals, and other Stakeholders who are directly involved in service delivery and research.
- Students and interns considering developing a career in Brain Injury

The Advisory Panel for the Brain Injury Section

The contents of the Brain Injury Section of the Cambridge Center for Behavioral Studies is reviewed and edited by a panel of behavior analysts, physicians and other professionals who have been selected because of their skills and expertise, and vast experience in the area of brain injury, diagnosis, and treatment.

- As of December, 2006, the advisory panel consists of:
 - **Ron Allen, Ph.D.**
Director of Brain Injury Services, [MAB Community Services](#), Brookline, MA
 - **Harvey Jacobs, Ph.D**
Licensed Clinical Psychologist and Behavior Analyst, Richmond, VA
 - **Jeff Kupfer, Ph.D.**
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Licensed Psychologist (Colorado, Nebraska, Massachusetts)
Action Editor, CCBS Brain Injury Section
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About Brain Injury

What is Traumatic Brain Injury (TBI)?

A traumatic brain injury occurs when an outside force impacts the head with an intensity to cause the brain to move within the skull or if the force causes the skull to break and directly injures the brain.

Direct blows include physical violence, sports, falls, firearms, motor vehicle and bicycle accidents.

Rapid acceleration and deceleration can produce a brain injury by causing stress and result in pulling apart nerve fibers. This can be caused from motor vehicle accidents, sports and recreation, and physical violence (e.g., Shaken Baby Syndrome).

Brain injuries can be conspicuous, as in the case of an **Open Head Injury**, in which an impact to the head occurs from an outside force and results in an injury to the skin or brain (e.g., skull fracture). A skin injury to the head may or may not be indicative of a traumatic brain injury.

Brain injuries can be inconspicuous, **Closed Head Injury**, and lack any outward physical accompaniment or sign that calls attention to a problem. These have the potential to be more problematic because they are not likely to receive proper medical treatment and lack proper documentation of an incident. For example, intracranial pressure can occur in which the brain swells, has no place to expand and becomes compressed. Following an motor vehicle accident in which there are no outward signs of an open head injury, it is advisable to receive medical supervision to rule out any closed head injuries.

What is Acquired Brain Injury (ABI)?

An acquired brain injury occurs after birth and results in a change in neuronal activity, not necessarily produced by trauma.

Anoxic brain injuries occur when the brain does not receive any oxygen. A hypoxic brain injury occurs when the brain receives some, but not enough oxygen such as when there is a restriction in blood flow or pressure. The sources of acquired brain injuries include:

- TBI
- vascular disruption
- airway obstruction
- heart attacks
- strokes
- hypo-or hyperglycemia
- arteriovenous malformation (AVM)
- aneurysm
- infectious diseases
- intracranial tumors
- encephalopathy
- seizures
- strangulation
- near drowning
- electric or lightning strikes
- VD or AIDS
- insect-carried diseases
- toxic exposure
- CO poisoning
- illegal drug use and alcohol abuse.

What is the Glasgow Scale?

The Glasgow Scale is used to determine levels of consciousness.

Mild (Glasgow Coma Scale 13 - 15) - concussion, change in mental status, or loss of consciousness is brief (few seconds or minutes), LOC is absent but dazed or confused, test scans normal. Common symptoms include: headache, fatigue, sleep disturbance, decreased concentration/attention/speed of thinking, memory problems, light or noise sensitivity, nausea or vomiting, balance problems, irritability, depression, anxiety, emotional mood swings.

Moderate (Glasgow Coma Scale 9 - 12) - loss of consciousness from a few minutes to a few hours, confusion lasts from days to weeks, physical, cognitive and/or behavioral impairments last for months or are permanent. Persons can usually recover with immediate treatment and/or successfully learn to compensate for deficits.

Severe (Glasgow Coma Scale 8 or less) - prolonged unconscious state or coma lasts days, weeks, months, or longer.

What is the Rancho Scale?

The Rancho Los Amigos Scale was developed as a measure of post injury behavioral responses. The following stages are:

1. **No Response** - appears to be in a deep sleep and is unresponsive to stimuli.
2. **Generalized Response** - reacts inconsistently and nonpurposefully to stimuli in nonspecific manner, reflexes are limited and often the same, regardless of stimuli presented.
3. **Localized Response** - responses are specific but inconsistent, are directly related to the type of stimulus presented, such as turning head toward a sound or focusing on a presented object, may follow simple commands in an inconsistent and delayed manner.
4. **Confused / Agitated** - heightened state of activity and severely confused, disoriented and unaware of present events, behavior is frequently bizarre and inappropriate to immediate environment, unable to perform self-care, if not physically disabled-may perform automatic motor activities such as sitting, reaching, walking as part of agitated state, but not necessarily as a purposeful act.
5. **Confused / Inappropriate / Non-Agitated** - appears alert and responds to simple commands, more complex commands, however produces responses that are nonpurposeful and random, some agitated behavior in response to external stimuli rather than internal confusion, highly distractible, difficulty learning new information, manage self-care with assistance, memory is impaired and verbalization is often inappropriate, may wander.
6. **Confused / Appropriate** - shows goal-directed behavior, but relies on cueing for direction, can relearn old skills (ADLs), but memory problems interfere with learning, beginning awareness of self and others.
7. **Automatic / Appropriate** - goes through daily routine automatically, but robot-like with appropriate behavior and minimal confusion, has shallow recall of activities, superficial awareness of, but lack of insight to, condition, requires minimal supervision due to impaired judgment, problem-solving and planning skills.
8. **Purposeful / Appropriate** - alert and oriented, able to recall and integrate past and recent events, can learn new activities and continue in home and living skills, some deficits in stress tolerance, judgment, abstract reasoning, social, emotional, and intellectual capacities may be present.

The Impact of Brain Injury

HOW MANY PEOPLE HAVE TBI?

Of the 1.5 million who sustain a TBI each year in the United States:

- 50,000 die;
- 235,000 are hospitalized
- 80,000 people annually experience the onset of long-term disabilities following a TBI;
- and
- 1.1 million are treated and released from an emergency department

The number of people with TBI who are not seen in an emergency department or who receive no care is unknown.

WHAT CAUSES TBI?

The leading causes of TBI are:

- Falls (28%)

- Motor vehicle-traffic crashes (20%)
- Struck by / against (19%); and
- Assaults (11%)

Blasts are a leading cause of TBI for active duty military personnel in war zones.

WHO IS AT HIGHEST RISK FOR TBI?

- Males are about 1.5 times as likely as females to sustain a TBI
- The two age groups at highest risk for TBI are 0 to 4 year olds and 15 to 19 year olds
- Certain military duties (paratroopers) increase the risk of sustaining a TBI
- African Americans have the highest death rate from TBI

WHAT ARE THE COSTS OF TBI?

Direct medical costs and indirect costs such as lost productivity of TBI totaled and estimated \$56.3 billion in the United States in 1995.

WHAT ARE THE LONG-TERM CONSEQUENCES OF TBI?

The Centers for Disease Control and Prevention estimates that at least 5.3 million Americans currently have a long-term or lifelong need for help to perform activities of daily living as a result of a TBI.

According to one study, about 40% of those hospitalized with a TBI had at least one unmet need for services one year after their injury. The most frequent unmet needs were:

- Improving memory and problem-solving;
- Managing stress and emotional upsets;
- Controlling one's temper; and
- Improving one's job skills

TBI can cause a wide range of functional changes affecting thinking, sensation, language, and/or emotions. It can also cause epilepsy and increase the risk for conditions such as Alzheimer's disease, Parkinson's disease, and other brain disorders that become more prevalent with age.

AN ANNUAL INCIDENCE COMPARISON OF TRAUMATIC BRAIN INJURY AND LEADING INJURIES OR DISEASES

Multiple Sclerosis	Spinal Cord Injuries	HIV/AIDS	Breast Cancer	Traumatic Brain Injuries
10,400	11,000	43,681	176,300	1,500,000

Sources

Project U 93 MC 00010-05-01 Partnership for Information and Communication (PIC) Cooperative Agreement with the Department of Health and Human Services (DHHS) Health Resources and Services Administration, Maternal and Child Health Bureau, Federal TBI Program, 2004.

Centers for Disease Control. "Traumatic Brain Injury in the United States: A Report to Congress." www: Centers for Disease Control, (January, 16, 2001)

What is Life After Brain Injury?

How a brain injury affects a person depends on many factors such as the type of injury, the extent of damage, the location of the injury, the onset of treatment, the type of treatment and the persons response to treatment, and the environment and living situation following the injury. The following list describes changes in functioning that occur post brain injury:

- **Physical Changes**
 - Muscle movement and coordination
 - Weakness
 - Fatigue
 - Balance
 - Sleep
 - Hearing, vision, taste, smell, touch
 - Speech
 - Seizures
 - Sexual function
- **Thinking**
 - Memory
 - Judgment
 - New learning
 - Communication
 - Attention and perception
 - Reading and writing skills
 - Thought processing speed
 - Sequencing and organization
 - Decision making and planning
 - Problem solving skills
 - Self-perception
 - Thought flexibility
 - Safety awareness
- **Behavioral**

- Social skills
- Emotional control and mood swings
- Reduced self-esteem
- Motivation
- Depression (agitated type)
- Anxiety, frustration, and stress
- Self-centeredness
- Anger management and coping skills
- Irritability and agitation
- Appropriateness of behavior (self-monitoring remarks and actions)
- Excessive crying and laughing
- **Challenges to Community and Vocational Re-entry**
 - Limitations in social interactions and living environments
 - Limitations to employment opportunities
 - Limited accessibility (physical, environmental, social)
 - Limitations in interpersonal relationships and sexuality
 - Limitations in recreational and leisure activities
 - Limitations in transportation
 - Limitations in financial / money management
 - Limitations in funding or benefits
 - Limitations in household management
 - Legal entanglement
 - Risk management and self-control
 - Risk for alcohol or poly-substance abuse
 - Risk for further brain injury
 - Risk for non-compliance with medication and treatment

Behavior Analysis and Brain Injury

Environmental Effects on Persons With Brain Injury

Antecedents (What happens before behavior)

Following a brain injury, there may be a broader range of stimuli conditions that affect behavior and function as aversive stimuli, that is, persons with a brain injury respond to escape and avoid these unpleasant stimuli or situations. Persons with brain injury may respond differently to sounds, lights, odors, tastes, and touch. This could result in reduction the way these stimuli affect behavior, particularly in:

- Accuracy in executing responses
 - timing and precision based on cues
- Reduction in generalization of behavior
 - applying skills to new situations
- Reduction in contextual control
 - Interpreting the situation

Suggestions:

- Regulate sounds, lights, temperature, and other stimuli
- Be aware of your actions, facial expressions and voice
- Model calmness and confidence
- Use structure and consistency so events are more predictable
- Provide concise instructions and offer choices

Behavior (Responses, Skills and Repertoires)

A brain injury can greatly reduce a person's ability to perform previously learned skills, as well as ability to learn new skills. It is advisable not to assume that a person is can perform a skill because he or she did so in the past. It is not uncommon for a person with a brain injury to show poor insight and judgment into his or her behavior.

Suggestions:

- Monitor current skills and repertoires
- Develop compensatory behaviors to replace ineffective responses
- Carefully monitor the difficulty of activities
- Break activities into small steps and shorten the duration of activities
- Offer breaks often
- Gradually increase or change performance criteria

Consequences (What happens after behavior)

Following a brain injury, there may be a disruption of previous learned behavior - reinforcer relationships. This may be particularly true in the way a person responds to rules about these relationships. The result of this disruption is a net reduction in the amount or regulation of events important to the person. It is for these reasons, along with changes in brain activity, that a person with brain injury appears more unstable, more agitated, and more unpredictable. Treatments directed toward agitated depression, anxiety, and personality changes must take these environmental changes into account in order to provide a more thoroughgoing approach.

Suggestion:

- Provide reinforcement for initiating quick responses to requests and for performance, as well as for meeting goals
- Establish strong and meaningful connections between compensatory behaviors and consequences
- Provide a high amount of positive statements and minimize negative statements
- Use verbal instructions that tie antecedents, behaviors and consequences together so that rules become more effective

- Alter dimensions of reinforcer delivery using magnitude, duration, frequency, delay and schedule

Behavior Analysis

Behavior analysis is the scientific study of behavior. Behavior analysis has evolved over the past eighty years to provide a systematic approach to understanding and describing behavior and its relationship to environmental determinants. Behavior analysts committed to rigorous scientific methodology and experimental analysis have produced **Applied Behavior Analysis**-a discipline in which the principles of behavior are directed toward the human condition and of significance to those individuals in its application. A philosophy of behavior has emerged that provides a thorough-going conceptualization of human and other animal behavior, and provides a framework for analyzing complex behaviors.

For more information about Behavior Analysis, contact the Association for Behavior Analysis at: www.abainternational.org

Board Certified Behavior Analyst (BCBA)

Board Certified Associate Behavior Analyst (BCABA)

The Behavior Analysis Certification Board®, Inc. is a nonprofit corporation that develops, promotes, and implements a national and international certification program for behavior analyst practitioners through its establishment of uniform content, standards, and criteria for credentialing process, thereby establishing "best practice" and ethical standards for the profession.

There are two levels of certification:

1. A Board Certified Behavior Analyst must possess at least a Masters Degree, have 225 classroom hours of specific Graduate-level coursework, meet experience requirements, and pass the Behavior Analysis Certification Examination.
2. A Board Certified Associate Behavior Analyst must have at least a Bachelors Degree, have 135 classroom hours of specific coursework, meet experience requirements, and pass the Associate Behavior Analyst Certification Examination.

The Behavior Analysis Certification Board administers examinations three times per year in over 200 sites within the United States and over 150 sites outside the U.S., and has approved course sequences in over 100 universities.

To learn more about Board Certification, contact the BACB at: www.bacb.com.

Certified Brain Injury Specialist (CBIS)

The Brain Injury Association of America (BIAA) has established the American Academy for the Certification of Brain Injury Specialists (AACBIS) to develop core competency standards for persons working the people with acquired brain injuries. These standards were developed in conjunction with job evaluations and employer needs to augment staff training. AACBIS certifies brain injury specialists (CBIS) and persons who are qualified to train the specialists as certified brain injury specialist trainers (CBIST).

There are eight core competency areas: Overview of Brain Injury; Philosophy of Rehabilitation; Understanding the Brain and Brain Injury; Health, Medications and Medical Management; Understanding and Treating the Functional Impacts of Brain Injury; Children and Adolescents with Brain Injuries; Family Perspectives; and Legal and Ethical issues. Together these competencies provide caregivers a unique understanding of the population they serve.

Call BIAA or check their web site www.biausa.org or the [AACBIS](#) web site ([Certified Brain Injury Specialists by state](#)) or call BIAA (703) 761-075 to find a CBIS in your area.

Pharmacology Treatment

It is not uncommon that persons with brain injury will be treated with medications, at least initially. Using medications under the supervision of a qualified physician can be a tremendous asset in recovery; however, it can also result in adverse reactions. Medications that are effective with some populations may not be effective with persons with brain injury. The following suggestions are offered:

- Ensure that the medical or psychiatric professional providing care and treatment to persons with brain injury have vast experience with brain injury and, more specifically, "challenging or disruptive behaviors"
- Don't be shy in asking about experience, credentials, or references
- When in doubt, always seek second opinions

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