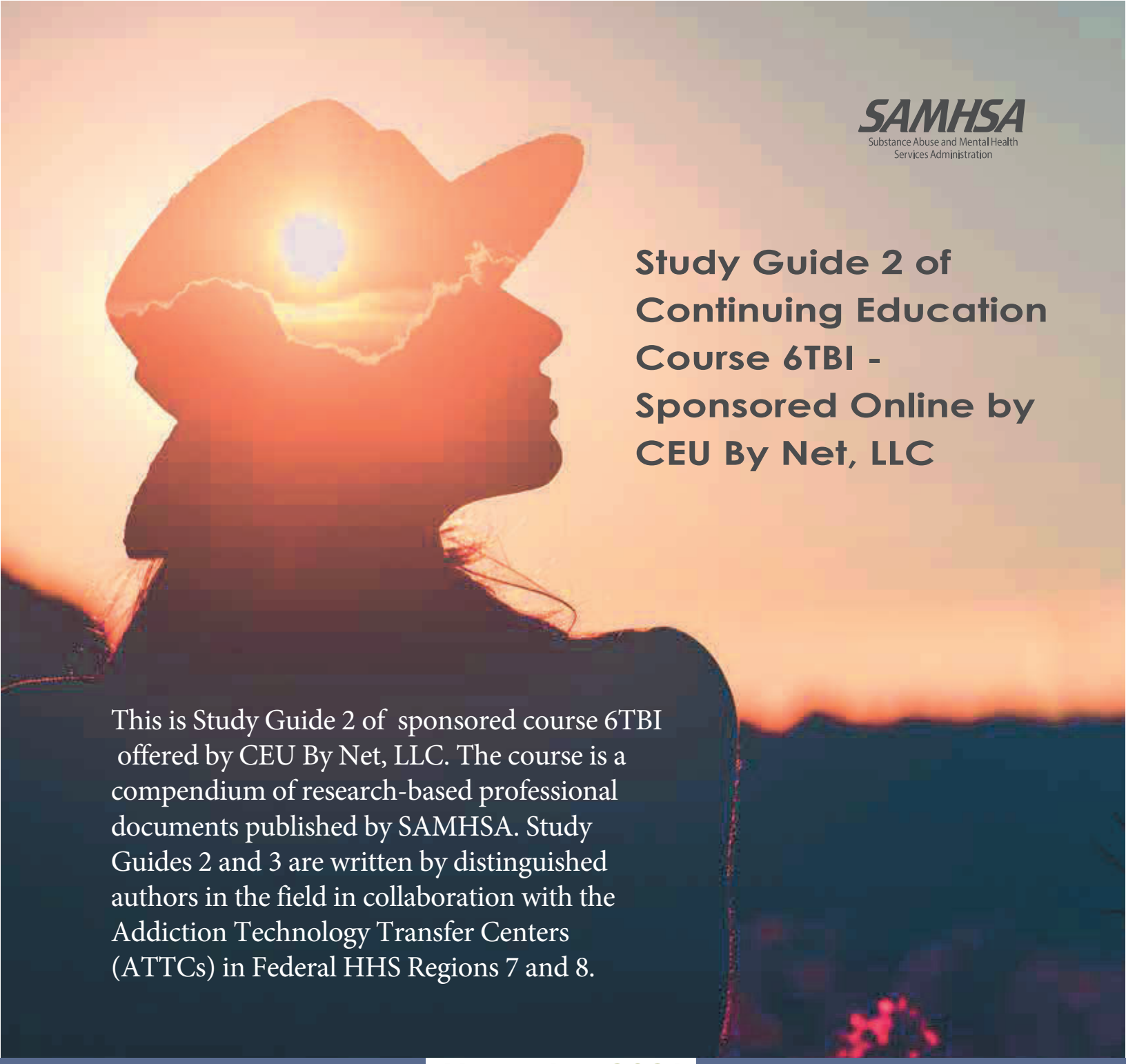

SAMHSA
Substance Abuse and Mental Health Services Administration

Study Guide 2 of Continuing Education Course 6TBI - Sponsored Online by CEU By Net, LLC

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Traumatic Brain Injury and Substance Use Disorders:
Making the Connections

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Funded by Substance Abuse and Mental Health Services Administration

Mid-America (HHS Region 7)
ATTC Addiction Technology Transfer Center Network
Funded by Substance Abuse and Mental Health Services Administration

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Study Guides 2 and 3 focus on some of the essential details of working with persons with TBI who have concurrent Substance Abuse issues. If you want to keep reading Study Guide 2 rather than taking Quiz 1 now, you may do so.

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PURPOSE AND AUDIENCE

The Mid-America Addiction Technology Transfer Center[1], the Mountain Plains Addiction Technology Transfer Center[2], and the National Association of State Head Injury Administrators (NASHIA)[3] provide this free toolkit to you entitled *Traumatic Brain Injury and Substance Use Disorders: Making the Connections*. We hope you will take the opportunity to read this document and share it throughout your networks.

This toolkit merges the content on traumatic brain injury (TBI) and substance use disorders (SUD) to expand the capacity to address both issues in treatment. It is a resource for behavioral health treatment providers, healthcare providers, educators, and health and human service administrators to gain a deeper understanding of the impact of SUD on persons who have survived a TBI. **The merging of the two fields expands the capacity of providers to address both concerns, with a specific recommendation for treatment protocols and screening tools.**

This toolkit also provides evidence-based content for serving people with a TBI and SUD. The author provides information on evidence-based screening tools, along with specific recommendations for accommodating cognitive impairment. In addition, the author provides suggestions for modifying the service delivery system to make the necessary accommodations to provide treatment that is more effective in serving this population. **A series of case vignettes offers readers specific suggestions for effective treatment interventions.**

The four Sections encompassed in the toolkit provide valuable information for advancing behavioral health providers' capacity when serving persons who have brain injuries. It also describes the toxic effects of substance use in persons diagnosed with a brain injury.

- Section 1 - for enhancing readers' understanding of the behavioral implications of a brain injury - is accompanied by visual images of the brain.
- Evidence-based tools for use in screening for brain injury are in Section 2, with strong encouragement for advance screening for brain injury. This Section also offers hands-on guidance on the use of the screening tools.
- Section 3 addresses neurocognitive problems, with specific suggestions regarding techniques for supporting clients with a traumatic brain injury. These techniques are described through the application of case vignettes that guide the reader in skill development.
- Section 4 provides the vignette of Gerry as an example of the importance of practitioners' use of evidence based practice, based on a provider guide for intervention, including guidance on how to use environmental support to address cognitive difficulties.

In summary, the toolkit includes content to enhance skills and resources among providers of substance use disorder services and other behavioral health treatment providers. The Mid-America and Mountain Plains ATTCs and NASHIA came together to provide critically important content regarding the negative impact of the use of alcohol and other drugs on treatment outcomes for persons with a brain injury. Readers will note that this toolkit underscores the importance of behavioral health clinicians providing necessary accommodations in treatment when serving persons with brain injuries. Throughout this toolkit and in case examples, an emphasis is placed on the negative impact on the use of substances among persons with a brain injury.

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[1] The Mid-America ATTC serves the states of Iowa, Kansas, Missouri, and Nebraska (HHS Region 7) through a collaboration between the Truman Medical Center and the University of Missouri-Kansas City. They serve multidisciplinary practitioners, agencies, and communities in implementing evidence-based practices for helping people with substance use disorders (SUD), with a focus on treatment and recovery supports.

[2] The Mountain Plains ATTC serves the states of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming (HHS Region 8) through a collaboration between the University of North Dakota and the University of Nevada-Reno. Their focus is to enhance treatment and recovery supports for individuals with SUDs and their family members in these six states. The emphasis is on serving providers in rural communities, with a focus on accessible learning opportunities.

[3] The National Association of State Head Injury Administrators assists state governments throughout the United States in promoting partnerships and building systems to meet the needs of individuals with brain injuries and their families.

RATIONALE for TOOLKIT

Traumatic Brain Injury (TBI) is a common but often undiagnosed co-occurring condition with substance use disorders. Depending on the setting you work in, one-quarter to one-half of the people you serve will report a history of brain injury with some loss of consciousness.[1-3] Those who do report a history of brain injury will also have longer and more severe histories of substance use and more co-occurring behavioral health issues. For this reason, as many as 75% of the people seeking services for concurrent mental health and substance use disorders are living with the effects of brain injury.[2] In most settings, the bottom line is that at least one out of five people presenting for treatment of a substance use disorder is also living with the effects of brain injury.

Because brain injury is often an invisible disability, it is easy to miss and to misunderstand.
People with TBI seeking services for substance use may experience subtle but significant changes in memory, attention, problem-solving, sensation, social behavior, and self-regulation, making it difficult to remember appointments, understand expectations, follow through with tasks, and participate in group settings. Trouble with recognizing social cues and observing social norms may

make it difficult for the person with TBI to fit into and benefit from some types of services. As a result, they often leave treatment prematurely because they cannot keep up or become discouraged. It is easy to imagine how frustrating this can be for both the client and their care providers. Having the right tools to recognize and manage the impact of brain injury can make a big difference in outcomes for a significant number of the people served in programs addressing substance use disorders.

When the problems that come with brain injury are relatively mild, it may be only a matter of understanding the symptoms that are observed and providing some simple accommodations. Often, brain injuries are complex and will require coordination among care providers. Ideally, a team of professionals that includes mental health and brain injury experts can be assembled to work together, providing services in an integrated fashion. Even when assembling the ideal team is out of reach, there are many steps providers can take to give the best possible care.

SCOPE of the PROBLEM

Approximately one in five American adults have sustained a traumatic brain injury (TBI) severe enough to result in some loss of consciousness.[4] The vast majority of these injuries are mild, with more than 90% released from emergency departments. Most people seem to recover well from mild TBI. However, substantial evidence suggests that having one or more brain injuries with loss of consciousness is associated with a significantly greater risk for behavioral health problems, including problematic substance use.[5, 6] A growing body of evidence indicates childhood TBI increases the risk for behavioral health problems, including problematic substance use beginning in adolescence.[7] Findings from research also suggest that having a history of one or more brain injuries with loss of consciousness is associated with greater symptom complexity, including more psychiatric symptoms and a significantly elevated risk of suicide.[8] TBI and substance use seem to be worse in combination than either condition is on its own. People using substances are at risk for poorer rehabilitation outcomes after TBI.[9]

Substance use is a risk factor for sustaining a brain injury.

- Between 23 and 51% of adolescents and adults sustaining a TBI were intoxicated when the injury occurred.[10, 11]
- Approximately one-quarter of people hospitalized for TBI have a history of substance use disorders.[8, 11]

TBI is a Risk Factor.

- 25 to 85% of incarcerated individuals report a history of TBI.[12] History of brain injury in this population significantly increases the risk of assault and violence, and decreases the efficacy of treatment for a mental health problem.
- Individuals who have experienced domestic abuse or assault are more likely to have sustained an Acquired Brain Injury (ABI).[13]
- People who are street-involved are more at risk for having a history of TBI before becoming homeless. Being homeless increases the risk of injury.[14]

TBI is associated with adverse health outcomes.

- People with a history of TBI of any severity are at two to four times the risk of attempting or having a death by suicide, particularly if the individual has a co-occurring psychiatric disorder.[15]

- History of TBI is associated with an increased risk of psychiatric disorders, including depression, anxiety, and PTSD.[16]
- TBI is associated with an increased risk of seizure disorder.[17]
- More than 50% of people living with TBI experience pain (most often headache).[18]
- History of TBI is associated with substance use that began earlier in life, persisted longer, and is more severe.[8]
- History of TBI may be associated with neurodegenerative disease and early cognitive decline.[19]
- Gender: males are 1.5 times more likely than females to sustain a TBI[20] (*Report to Congress on Traumatic Brain Injury in the United States: Epidemiology and Rehabilitation*., 2015).
- Age: children 0 to 4 years old, youth 15 to 19 years old, and older adults at risk for falls are at greater risk for TBI.[20]
- Employment and working conditions: certain military duties (e.g., paratrooper) may create the potential for TBI.[21, 22]
- Disability: having a previous TBI doubles or triples the risk of experiencing another TBI.[4]

Research suggests that there is a high incidence of cognitive impairment related to a variety of causes, including TBI, in people seeking services for substance use disorders.

Recent studies have found between 30 and 80% of clients attending inpatient programs scored below the cutoff for impairment on cognitive screening measures.[23, 24] Anoxic injuries associated with non-fatal overdose and substance-related brain injury are two common causes of injury to the brain in this client group.

- **Non-fatal Overdose.** The opioid epidemic has resulted in an increasing number of non-fatal overdoses that can potentially result in lasting changes in cognition and behavior. Overdose can result in hypoxic brain injury (loss of oxygen to the brain). It has been estimated that in North America, approximately 23% of all IV drug users will experience a non-fatal overdose per year.[25] Those who do sustain a brain injury are at risk for future overdoses. Many overdoses are unwitnessed and do not result in medical attention, so it is difficult to measure their true impact. Still, evidence points to hundreds of thousands of episodes of loss of consciousness due to overdose each year. The cognitive effects of an overdose will vary, depending on how long the oxygen supply was interrupted.
- **Substance-Related Brain Injury.** The toxic impact of drugs will also vary, depending on the substance and pattern of use. Some substance-related changes in brain function will return to normal with abstinence. Some are lasting.

ALEX'S STORY

Alex's story illustrates how emotional regulation and behavior changes during the months after a brain injury can disrupt social relationships and mood. Because there are few outward signs of injury, others may not understand the difficulty they are having with managing their usual activities. Many people using cannabis or other drugs after brain injury report that they are doing so to manage the symptoms they are experiencing. Regular use may result in dependence and other harms that outlast the period of recovery. It is common for alcohol to have a more dramatic effect after brain injury, worsening mood and slowing down recovery.

Life wasn't perfect before my accident. I might get depressed, but it never lasted that long. I was smoking marijuana, and I did do some stupid stuff with friends while we were drinking. But it was for fun—to make things interesting and to be with my friends.

But after that fall down the stairs, something shifted. Everyone said I looked great; even my doctor said that things should be totally okay, but I didn't feel normal. It seemed like everything just got on my nerves. I couldn't stand crowds or noise. Everything took longer. My girlfriend broke up with me because I was being such a jerk.
After a few months, I started to worry I wasn't going to get back to normal. I had my bell rung playing sports lots of times but never got knocked out for five minutes, like I did this time.

Getting stoned started to be something I did to feel normal. Maybe I wasn't normal, but I didn't care as much. Maybe after five months or so, I started to smoke before work. After a few beers, I'd be this angry person. I almost got arrested.

SECTION 1

BRAIN BASICS

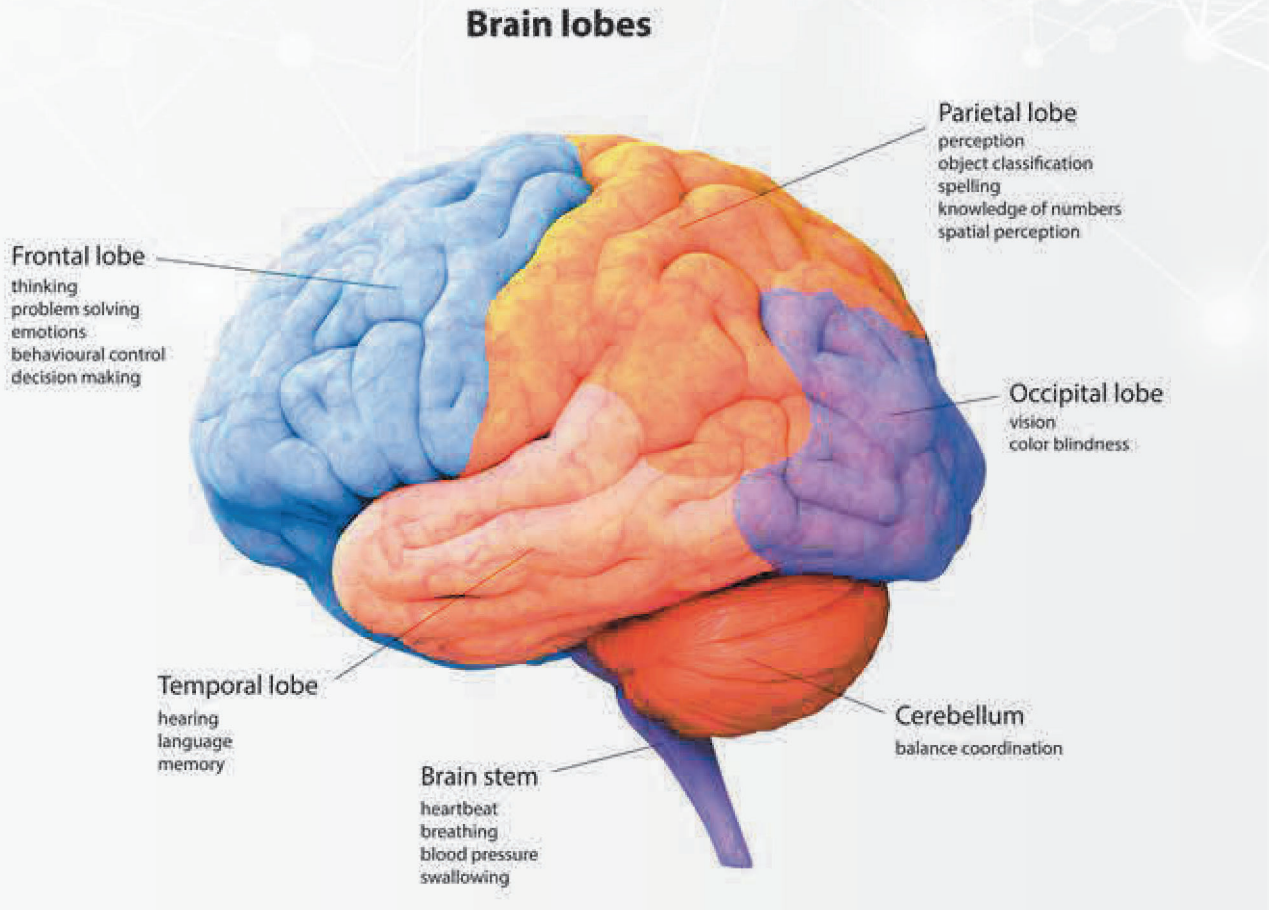
BRAIN BASICS

The brain is two to three pounds of delicate tissue which is the texture of jelly and is protected by the skull and three layers of protective membranes. Despite its relatively small size (less than 3% of a typical adult's body mass), the brain uses 20% of the energy and controls almost everything we do.

The brain evolved from the inside out, with the deepest parts of the brain (the brain stem) responsible for basic functions. As species became more complex, brain structures evolved to allow for more complex behaviors.

The brain stem is responsible for basic functions that maintain life. They include autonomic functions such as breathing and heartbeat. The limbic brain contains structures responsible for the generation and perception of emotions and directing the brain's memory. The brain's outer layer, the neocortex (or simply cortex), is responsible for most complex behaviors. (See Below)

Cerebral cortex. The brain's cortex is the grey matter or outer layer of brain tissue and is responsible for our most complex cognitive functions. However, without efficient connections within the brain, effective brain functioning would not be possible.



Our most complex behaviors are the result of interrelated circuits which connect areas of the brain. The frontal and prefrontal cortical areas are responsible for conscious thought and reasoning. They are designed to have a "top down" effect on emotions, allowing us to understand and think about what we feel and to plan action.

The limbic system (the emotional part of the brain) has a "bottom-up" effect on our behavior; it generates drives (such as hunger and lust) and is responsible for how we experience rewards. It is the connections between the emotional part of our brain, the limbic system, and the frontal lobes that give our thoughts and behaviors purpose and direction. As discussed below, the connections between the frontal and limbic systems that govern response to reward are particularly vulnerable to traumatic injury. Depending on when and how the brain is injured, brain injuries can result in temporary discomfort or become a life-changing event.

Definitions

An **acquired brain injury (ABI)** is any injury to the brain that occurs after birth that disrupts some aspect of brain functioning and is not the result of a progressive disease such as dementia and is not congenital.

Traumatic brain injury (TBI) is defined as a change in brain function or structure that results from a mechanical force (a blow or jolt). TBI may be caused by the head being struck by an object, the head striking an object, acceleration/deceleration, such as whiplash or being shaken, a foreign body penetrating the skull, such as a gunshot wound or skull fragment, or forces from an explosion or blast. Not all bumps to the head cause TBI. The signs that an injury has occurred include changes in brain function such as:

A. Any period of loss of consciousness or decreased consciousness.
B. Any loss of memory for events immediately before (retrograde) or after the injury (post-traumatic amnesia).
C. Neurological deficits such as weakness, loss of balance and coordination, disruption of vision, changes in speech, language, or senses.
D. Confusion, disorientation, slowed thinking, or difficulty concentrating.

Substance Use Disorder (SUD) refers to conditions that meet the criteria in the *Diagnostic and Statistical Manual of Mental Disorders (DSM–5).*[26] These include:

A. Taking the substance in larger amounts or for longer than you're meant to.
B. Wanting to cut down or stop using the substance but not managing to.
C. Spending a lot of time getting, using, or recovering from the use of the substance.
D. Cravings and urges to use the substance.
E. Not managing to do what you should at work, home, or school because of substance use.
F. Continuing to use, even when it causes problems in relationships.
G. Giving up important social, occupational, or recreational activities because of substance use.

H. Using substances again and again, even when it puts you in danger.
I. Continuing to use, even when you know you have a physical or psychological problem that could have been caused or made worse by the substance.
J. Needing more of the substance to get the effect you want (tolerance).
K. Development of withdrawal symptoms, which can be relieved by taking more of the substance.

Mild substance use disorder is defined as having two or three symptoms, moderate, four or five symptoms, and severe, six or more symptoms. Research notes that use of any amount of alcohol or other drugs following a brain injury is not recommended due to the complications it creates, including:

- People use alcohol or other drugs after they have a TBI do not recover as much.
- People will note an exacerbation of existing problems with balance, walking, or talking.
- People may experience additional problems with concentration and/or memory.
- People experience a more powerful effect from the substance.
- People may note an increase in impulsivity including saying and doing things without thinking first.
- It can cause seizure.
- It can increase your risk of an additional head injury.

Source: *https://wexnermedical.osu.edu/-/media/files/wexnermedical/patient-care/healthcare-services/neurological-institute/departments-and-centers/research-centers/ohio-valley/for-professionals/substance-abuse-and-tbi/the-effects-of-substance-use-and-tbi.pdf?la=en&hash=05C182391D3598054E98DA190DD1409C86CB2080*

Addiction: The American Society of Addiction Medicine (ASAM)[27] definition goes beyond the behavior associated with substance use disorders to consider interacting causal factors.

"Addiction is a treatable, chronic medical disease involving complex interactions among brain circuits, genetics, the environment, and an individual's life experiences. People with an addiction use substances, or engage in behaviors that become compulsive, that often continue despite consequence. Prevention efforts and treatment approaches for addiction are generally as successful as those for other chronic diseases." ASAM, 2019

Measuring the Severity of TBI

The main measurement of TBI severity is the degree of disruption of brain functioning that is observed or experienced at the time of injury. While there are some exceptions to this general rule, it is usually true that the length of time a person is unconscious or experiencing confusion and disorientation after an injury is directly related to injury severity. The period of loss of consciousness refers to how long a person is not responsive. The period of post-traumatic amnesia or confusion refers to the period of time that a person is disoriented after injury.

INJURY SEVERITY			
CRITERIA	**MILD**	**MODERATE**	**SEVERE**
STRUCTURAL IMAGING (MRI OR CT)	**Normal**	**Normal or Abnormal**	**Normal or Abnormal**
LOSS OF CONSCIOUSNESS	**<30 minutes**	**30 minutes to 24 hours**	**>24 hours**
POST-TRAUMATIC AMNESIA/ CONFUSION	**0-1 day**	**1-7 days**	**>7 days**

Modified from: *Brasure, M., Lamberty, G.J., Sayer, N.A., Nelson, N.W., Macdonald, R., Ouellette, J., ... Wilt, T.J. (2012). Multidisciplinary post-acute rehabilitation for moderate to severe traumatic brain injury in adults. Agency for Healthcare Research and Quality (AHRQ) Comparative Effectiveness Reviews, 72, ES1–ES20. Available at: http://effectivehealthcare.ahrq.gov/ehc/products/283/1141/CER72_TBIPostacute_FinalReport_20120725.pdf*

The Fingerprint of TBIs

The pattern of TBIs is not random. Because of the anatomy of the skull and how most traumatic injuries occur, TBIs tend to have the greatest impact on the structures of the prefrontal cortex and the temporal lobes. The inside of the skull has bony structures designed to hold the brain in place. When the force is great enough, rubbing up against these structures can cause damage to the surface of the brain and can also result in axonal shearing.

For these reasons, TBIs will tend to have a pattern of disconnection that has its greatest effect on the connections from the prefrontal cortex (executive functioning) and the limbic system (emotional centers) that make up the reward circuit. These are the brain structures that are responsible for focusing attention and regulating emotion and behavior; they mediate how a person responds to reward.

When connections between these areas are working well, judgments about risks and rewards are experienced as a gut feeling about the right thing to do. Focusing on a conversation in a noisy room, reading others' nonverbal behavior, keeping a lid on strong emotion, or remembering the good feelings that come with a success are automatic when connections in the brain are working. When these connections are disrupted as the result of TBI, these essential functions require conscious effort and become inefficient.

The reward circuit relies heavily on dopamine as a neurotransmitter. It is the reward where most substances of abuse exert their effects. As discussed below, the ongoing use of some substances of abuse alters the functioning of the reward system, making people more sensitive to immediate reward and less sensitive to punishing events. This same pattern is often observed after a TBI and results in behavioral impulsivity.

Brain Injuries and Overdose

An overdose can cause a brain injury, and having one overdose puts a person at risk for more.[25] People who are living with cognitive impairment are more prone to overdoses. They may have more difficulty monitoring their intake of a drug. It is also possible that changes in brain function may cause some drugs to have a more powerful effect.[28]

In overdose, the leading cause of damage to the brain is loss of oxygen. When loss of oxygen occurs for longer than 5 to 6 minutes, changes in brain chemistry occur that result in the destruction of neurons. Because the structures responsible for memory (the hippocampus) and movement (the cerebellum) use a lot of oxygen, these structures are among the first to show damage. The longer the loss of consciousness, the more tissue may be damaged or destroyed. Frequent overdoses with limited time for the brain to recover may result in increased damage. The symptoms of anoxic brain injury commonly impact executive functioning, memory, and attention, as well as movement.

Toxic Effects of Substance Use

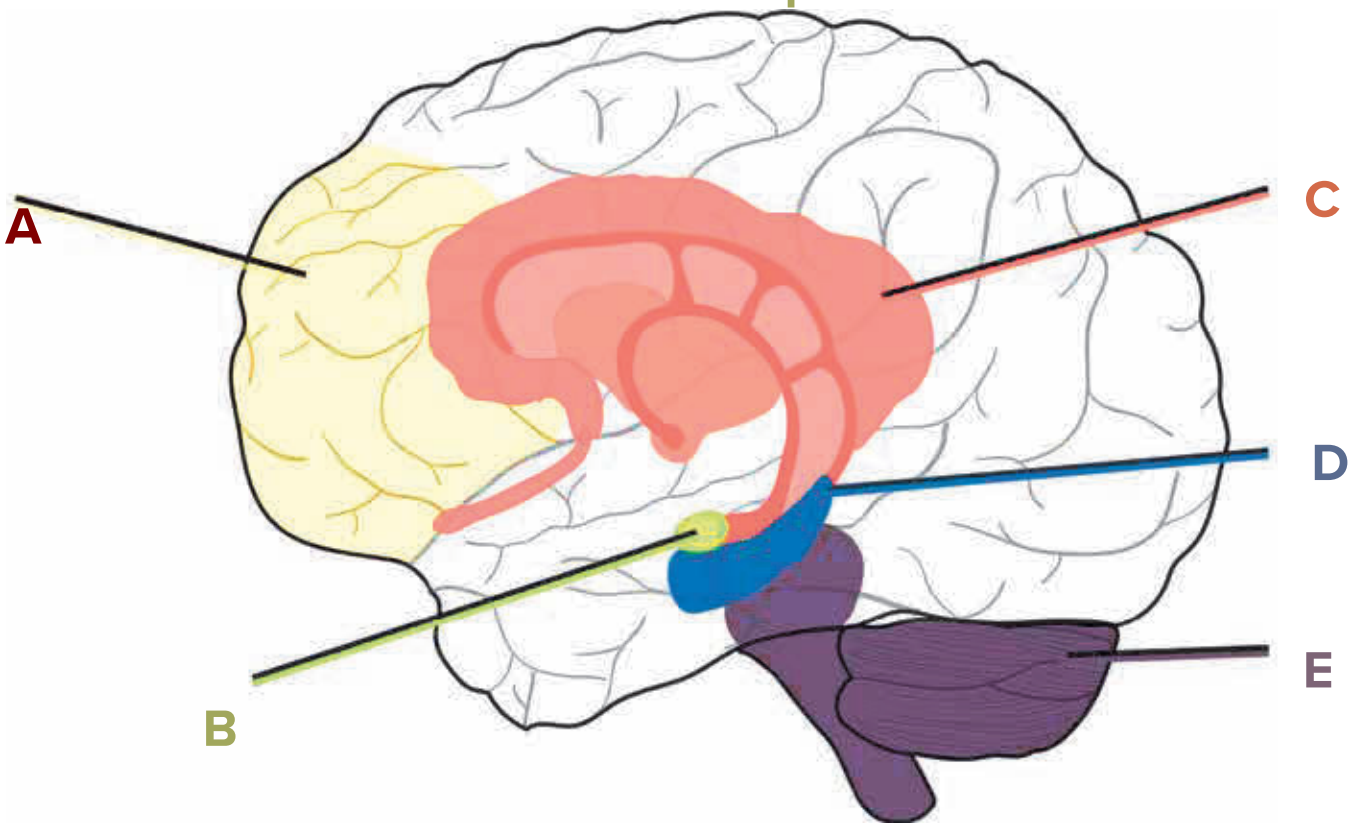
The impact of substance use depends on the substance used and the amount and duration of use. The age when substance use started is also an important factor. Starting substance use while the brain is developing can have long-term consequences.[29] Although the findings from the research are complex and sometimes contradictory, the most common difficulties associated with substances of all kind include problems with memory, attention, and executive functioning, including problem-solving, goal setting, and planning.

The table below provides a broad summary of the effects of common substances of abuse. Although more research is needed, it appears that the toxic effects of alcohol and other drugs are more dramatic in people who have had a history of brain injury.

SUBSTANCE	NEUROLOGICAL EFFECTS	COGNITIVE EFFECTS
ALCOHOL[30, 31]	• Associated with brain atrophy, particularly the Hippocampus (memory system). • Thiamine deficiency may cause a severe short-lived condition (Wernicke's encephalopathy) or result in lasting learning and memory problems (Korsakoff's syndrome).	Memory Executive Functioning: • Visual-Spatial abilities.
CANNABIS[32]	• Some evidence for atrophy in the Hippocampus (memory system) and changes in connectivity between the frontal lobes and limbic system. • May have a greater impact on the developing brain.	Memory Executive Functioning.
METHAMPHETAMINE[33, 34]	• Widespread damage to dopamine receptors, with cell loss in the emotion and reward system (limbic system), and Hippocampus (memory system).[56]	Memory Executive Functioning: • Inability to suppress habitual behaviors. • Sensitivity to short-term reward. • Insensitivity to punishment. • Insensitivity to normal pleasures.
COCAINE[35]	• Weakened connections between the frontal lobe and limbic system (frontostriatal) connections, brain atrophy, and changes in limbic (emotional) and Hippocampus (memory system).	Memory Executive Functioning: • Sensitivity to short-term rewards. • Insensitivity to normal pleasures. • Increased sensitivity to pain.
OPIOIDS[36]	• Weakened connections between the frontal lobe and limbic system (frontostriatal) connections, brain atrophy, and changes in limbic (emotional) and Hippocampus (memory system).	Memory Executive Functioning: • Sensitivity to short-term rewards. • Insensitivity to normal pleasures. • Increased sensitivity to pain.

The resource section of this manual includes resources to learn more about the impact of commonly used substances.

Brain and relationship to behavior below:



A

A. Pre-Frontal Cortex

1. Executive Functions
2. Focusing, Reasoning, Rationalizing

B

B. Amygdala

- Drives: Hunger, Sex, and Anger

C

C. Limbic System

- Controls Emotions, Memories, and Habits
- Motivation

D

D. Hippocampus

- Learning and Memory

E

E. Brain-Stem and Cerebellum

- Fight or Flight (Auto-Pilot)

SYMPTOMS ASSOCIATED WITH BRAIN INJURY

CATEGORY	SYMPTOMS	
MOTOR AND SENSORY EFFECTS	• Dizziness, lightheadedness, or vertigo. • Fatigue or lethargy. • Changes in walking and coordination. • Headaches and other pain symptoms.	• Sensory impairments (e.g., blurred vision, sensitivity to light and sound, ringing in ears). • Sleep disturbances. • Weakness.
COGNITIVE IMPAIRMENT	• Cognitive slowing (i.e., inability to process information efficiently). • Memory impairment (i.e., inability to remember what has happened in the past). • Impaired attention and concentration (i.e., knowing what to do in the present). • Difficulty multitasking. • Impairments of language and communication.	• Executive dysfunction (organization, planning, judgment, reasoning, initiation). • Impaired self-monitoring (insight and awareness). • Inability to problem-solve and develop new solutions. • Problems with generalizing strategies from one setting to another.
EMOTION AND BEHAVIORAL DYSREGULATION	• Increased likelihood of concurrent mental health issues (e.g., anxiety). • Increased likelihood of behavioral problems (e.g., anger, irritability, socially inappropriate behavior).	• Increased likelihood of impulsivity. • Increased sensitivity to environmental stimuli. • Lack of initiation. • Difficulty learning from experience.

Sources: *American Psychiatric Association, 2013; Lux, 2007;[37] National Institute of Neurological Disorders and Stroke, 2002, Ohio Valley Center for Brain Injury Prevention and Rehabilitation, 1994*

How the emotional and behavioral impact of executive impairments can affect participation in treatment

Cognitive problems (problems with attention, memory, and problem-solving) can contribute to problematic substance use and make the intervention more difficult. However, problems with emotional and behavioral dysregulation are often more difficult to recognize and, in many cases, create the greatest challenges for individuals with TBI. Many individuals with TBI find sensory and emotional inputs more difficult to manage, resulting in mood and behavior changes. These changes are often described as "a change in personality."

People living with brain injury often have a bigger gap between what they intend to do and what they can do. The ability to manage emotions (through both automatic brain processing and conscious thought) allows us to get organized to meet goals, get started on activities, monitor what is happening, and switch tasks or strategies when needed. A well-defined set of neuronal circuits between the prefrontal cortex (responsible for planning and reasoning) and the limbic system (responsible for emotions) are designed to ensure that we can adapt to changing situations and keep our behavior on course despite distractions. Problems with behavior and mood occur when the emotional system gets out of balance with the reasoning and planning system.

Efficient cognitive processing relies on healthy connections between brain structures. Most brain processes occur without our conscious effort. Our brains evolved to be as efficient as possible. Conscious thought is relatively slow and uses up a lot of brain energy. To be as efficient as possible, evolution has designed our brains to determine which behaviors are most successful and then set up habits that do not require much conscious thought–like an autopilot. One example of this phenomenon is learning a complex skill like driving a car. In the beginning, it takes all our conscious effort to control the gas and the brakes, judge where we are in the traffic lane, etc. However, as we become more experienced drivers, we may find ourselves thinking about something while driving and may arrive safely without much conscious awareness of all of the steps of driving a vehicle.

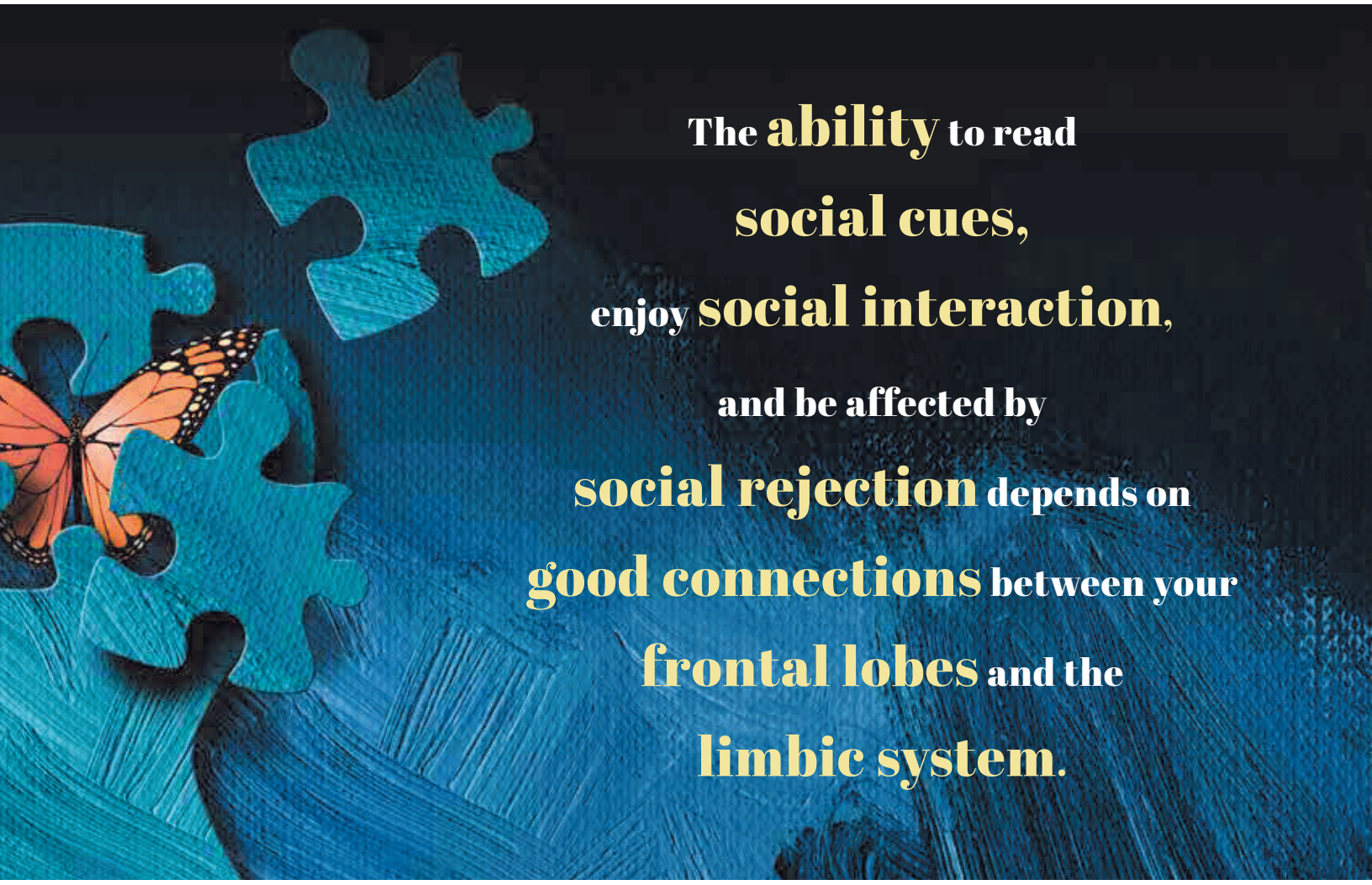
When it functions well, the brain can sort through sensory inputs and direct our attention to what is most important, like picking out a conversation in a noisy room or tuning into others' social cues. To get our needs met, the healthy brain's reward system chooses habits that result in a feeling of reward. The feeling of reward comes from the release of dopamine in the reward circuit. Most of the time, behavior or experiences that result in the release of dopamine are good for us, but it is not a perfect system. At the best of times, human beings may find it difficult to alter habits that are no longer useful. But when the immediate rewards are high, and the problems associated with the behavior occur over the long term, behavior changing habits become more difficult. Overriding the automatic behaviors requires a well-connected brain and strong executive functioning. Addiction is an example of when the reward system is led astray, and the conscious-control systems may have less influence over behavior. Impulsivity exists, undermining their emotions in the moment and neglecting longer-term goals. This is a problem that researchers have labeled delay discounting. Behaviors associated with delay discounting can be frustrating for both the client and the provider.

In a quiet, distraction-free environment and in the presence of a caring and empathetic provider, a person may show good insight and a genuine intention to work toward a goal. They may be able to make realistic suggestions and seem to be good planners. Their emotional state is calm, and their frontal lobes are at their best. Outside of the session, where there are distractions, temptations, and stressful circumstances, it takes a very well-functioning executive system to override the strong emotions that may arise and to resist temptations. There is evidence that substances such as opioids and alcohol alter a person's ability to process rewards effectively over time.[38] TBIs may also disrupt the systems that allow the brain to override emotion, creating a new problem or worsening a problem associated with brain changes due to long-term substance use. To respond in a consistent way when under stress, the brain must have the capacity to moderate the signals coming from the emotional centers in the brain.

Signs of difficulty associated with impaired functioning of the prefrontal cortex include:

1. Poor follow-through with goals and intended behavior.
2. Failure to learn through experience.
3. Difficulty setting realistic goals.
4. Trouble recognizing how their behavior affects outcomes.

Difficulty reading others' social cues may occur after TBI. The ability to read social cues, enjoy social interaction, and be affected by social rejection depends on good connections between your frontal lobes and the limbic system. Reading and responding to social cues is usually so ingrained in us as adults, we are often not aware we are doing it. We walk into a room and feel a "vibe," and we understand when an interaction will be welcome and when it might not be. Each of these subtle cognitive abilities relies on the brain to focus its attention, take in the information, and interpret it properly. Very often a TBI (as well as some substances such as opioids) interferes with the process of reading and responding to social cues. For example, difficulty reading facial expressions may lead one to misread a neutral face as anger, miss the subtle signs of disgust that an interaction is not going well, or fail to respond to greetings. In addition, difficulty reading social cues may complicate the process of developing rapport with a therapist or working in group settings.



Brain Injury Recovery and Outcome

Signs that there are difficulties with social cognition include:

1. Difficulty taking turns in conversations
2. Appears to lack empathy
3. Is overly friendly
4. Defensive (assumes others are angry)
5. Isolates from group
6. Is overly sensitive
7. Lacks a sense of humor (unable to understand sarcasm)
8. Is gullible

Difficulties with emotional regulation are the result of impairments of frontal subcortical circuits. When moderated, emotional regulation rises and falls according to the seriousness of a situation and is influenced by an individual's thoughts and behaviors in a predictable way. People who have dysregulated emotions may have very strong emotional responses that can be triggered by something that may seem trivial to others. As a result, they may keep returning to an event or a type of emotion, unable to work things through or let them go.

Shallow or volatile emotional states may occur. For example, an individual may have an outburst of angry behavior. After the episode is ended, they may return to a calm and friendly state and have difficulty recognizing why others may still have a strong emotional response. Emotional flooding may occur. Flooding occurs when an individual is easily overwhelmed and seems to shut down or freeze when an emotionally difficult situation arises. This is a natural response that may occur at a much lower threshold or last longer in the individual who is having difficulty regulating their emotions.

Signs of poor emotional regulation include:

1. Sudden shifts in mood (from calm to upset and back again).
2. Client describes a sudden onset of mood ("I go from 0 to 10").
3. Seems to "check out" or appears bored when emotional situations arise.
4. Strong tendency to return to emotionally upsetting events.

How well a person recovers from TBI is related, in part, to the severity of the head injury. However, there is a great deal of variation from person to person. The timeline for recovery also varies with the severity of the injury. It tends to be fastest initially and then gradually plateaus. It is important to know that improvements can continue to happen for many years after a TBI. Still, once a plateau in progress is experienced, progress requires re-learning and practice, and changes are likely to be very gradual.

Mechanisms of recovery from TBI:

- The recovery of brain chemistry to a more normal state includes:
- Swelling goes down and allows neurons to go back to normal
- Neurons reconnect
- Neuroplasticity (new connections forming between undamaged neurons)

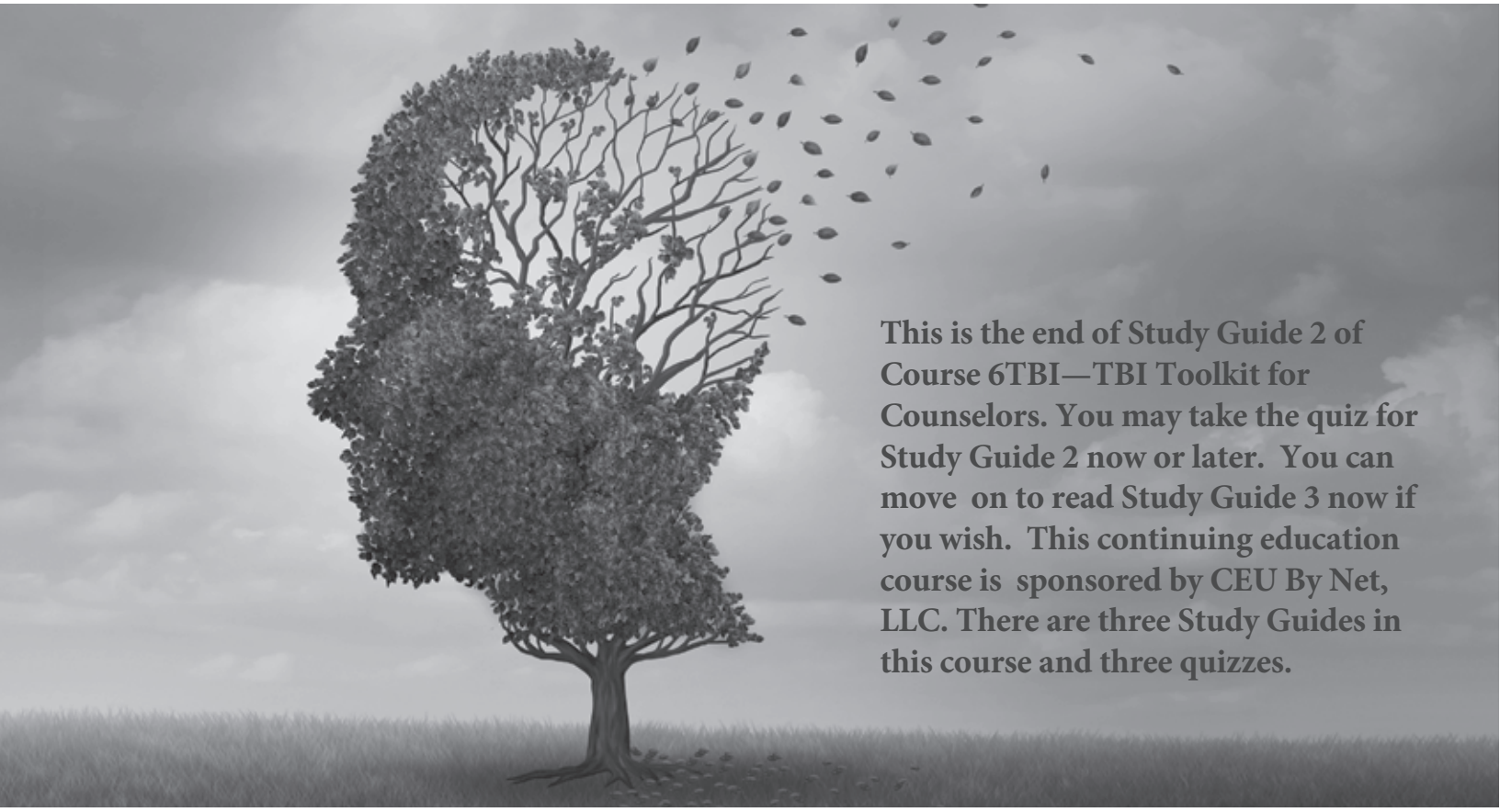
Mild TBI (Concussion): 70 to 85% of people who experience a mild TBI will recover fully within days to weeks or months. Most mild TBIs have no findings on neuroimaging. However, in some cases, there may be minor findings. Roughly 15% of people have some ongoing symptoms after a mild TBI, including vision changes, sensitivity to light and noise, headaches, fatigue, and difficulty with memory, and concentration.

Moderate TBI: Moderate TBI often requires a hospital stay and may result in lasting problems. People sustaining moderate injuries can usually return to many of their regular activities. The course of recovery for moderate TBI is generally longer than that for mild injuries. The most rapid changes occur in the months following injury, with noticeable changes occurring up to a year or two post-injury. Improvements may continue indefinitely but at a slower pace.

Severe TBI: People who have sustained a severe TBI have generally had a hospital stay and generally experience lasting effects that impact their daily lives. The period of greatest recovery after severe TBI lasts a year or two. Although changes in brain functioning may occur indefinitely, functional improvements in the later stages of recovery are often due to learning how to compensate for the problems caused by the injury.

Risk Factors for Greater Disability after TBI:

- **History of Previous Injury.** The higher the number of injuries sustained, and the more recent the injuries are, the greater the risk for lasting effects. Multiple mild concussions or injuries resulting from falls, domestic violence, or sports can result in lasting changes in functioning—even though the individual experiences few symptoms.
- **Assault and Abuse.** Injuries sustained as the result of physical violence often have poorer outcomes.
- **Childhood Injury.** Sustaining an injury in childhood during vulnerable periods of brain development can increase the risk for problems after brain injury. Symptoms of childhood brain injuries may unfold as expectations for development and behavior increase.
- **Older Age at Injury.** This may create a risk for slower or less complete recovery.
- **Pre-Injury Mental Health Problems.** This includes depression, anxiety, and substance use disorders: may face difficult and protracted periods of recovery.
- **Post-Traumatic Stress Disorder (PTSD).** This results in changes in emotional regulation as well as cognitive changes. When PTSD occurs with a brain injury, there is a much greater risk of lasting problems.
- **Social Supports and Access to Healthcare.** People who have limited access to healthcare and social supports do not recover as well from a TBI. Social supports include access to income, education, employment, safe working conditions, early childhood development supports, and access to necessities such as food, clothing, and shelter. Access to healthcare and social supports is influenced by race, with notably poorer outcomes for people of color.



This is the end of Study Guide 2 of Course 6TBI—TBI Toolkit for Counselors. You may take the quiz for Study Guide 2 now or later. You can move on to read Study Guide 3 now if you wish. This continuing education course is sponsored by CEU By Net, LLC. There are three Study Guides in this course and three quizzes.