

## Neuroscience, addiction and the brain: Implications for counselors who work with substance use disorders

An important shift is underway in the counseling profession to use neuroscience as an adjunctive tool. This trend has the potential to lead to improved client outcomes. One area in which neuroscience could be particularly helpful is in combating the addiction epidemic in the United States. To better meet this challenge, counselors are beginning to use the pertinent brain science behind addiction to inform considerations for clinical practice and develop new theories incorporating neuroscience. These new theories have further implications for the training of future mental health clinicians.

Insights from neuroscience are beginning to influence standards for counseling practice, particularly in the field of addiction. In this regard, neuroscience helps counselors and clients alike to understand the brains of individuals who are battling a substance use disorder or a substance use disorder with a co-occurring mental health issue.

Recently, national media sources have focused nationwide attention on the opioid and heroine epidemic. This increased awareness has in turn created a sense of urgency about better understanding the neuroscience underpinnings of addiction. In December 2016, Vivek Murthy, then surgeon general of the United States, issued the first ever *Surgeon General's Report on Alcohol, Drugs and Health*. Murthy publicly stated for the first time that addiction has for too long been considered a character flaw or moral failing. He further called for a cultural change in how Americans think about

addiction. He explained that addiction is a chronic disease of the brain that needs to be treated like any other chronic illness — with skill, compassion and empathy. This represents a significant shift in thinking and one that speaks directly to the importance of neuroscience as it relates to addiction.

This shift is important because the prevalence of addiction is growing in the United States. More than 20 million Americans have an active substance use disorder, and another 12.5 million Americans reported misusing prescription painkillers in the past year. Opioid overdose deaths have quadrupled since 1999, with 33,000 people in the United States dying from opioid overdoses in 2015 alone.

Marijuana legalization has also been a hot topic, with 26 states and the District of Columbia currently having laws that legalize marijuana in some form. A recent report from the National Bureau of Economic Research (NBER) found that in states where medical marijuana is legal, use, abuse and dependence increased among those 21 and older. Additionally, Linda Gorman of NBER found in her 2017 report that legalization of marijuana has been strongly associated with an increase in adult binge drinking.

### The brain science of addiction

Given such increases in substance use and dependence in our country, counselors increasingly may find clients seeking treatment for these conditions. As clinicians, it is important that we understand the basic brain science of addiction to increase our clinical

effectiveness. Neuroscience has yielded important insights into how psychoactive substances impact the brain and what best practices to follow for mental health care.

Drugs and alcohol mimic endogenous rewards from pleasurable experiences such as food and sex by activating a network of brain areas called the reward circuitry. In the brain's reward system, information travels through the ventral tegmental area to the nucleus accumbens and, finally, to the prefrontal cortex. This pathway is important as a survival response. It drives us to do the things that keep us alive and lead to reproduction.

Drugs and alcohol stimulate this pathway in an exponential manner that natural rewards cannot. Over time, the desire for the drug becomes more important than the pleasure the addicted person actually derives from it. By the time the intoxication enjoyment is gone, long-lasting changes may have occurred within these key brain regions. In nonclinical terms, the reward system has been hijacked.

Historically, addiction has been defined in terms of physical symptoms of withdrawal, such as nausea and cramps with heroin or shakes with alcohol. These symptoms were thought to reflect physiological changes within the brain, nervous system and vital organs of the person who was addicted. These are now better understood more specifically as changes in brain circuits or systems of neurons that result from learning and experience.

Individuals crave, seek and use drugs over and over again in part because they have a memory of it being more

wonderful than anything else they have previously experienced. Their brains have additionally been rewired so that when exposed to anything that reminds them of the drug, they will feel awful both physically and psychologically, as a strong craving and desire to acquire more of the substance returns. This is because substance abuse affects several neural and hormonal systems, and when supply to the drug is interrupted, these systems are thrown into confusion.

Effects can include noradrenergic hyperactivity, gamma-aminobutyric acid (GABA)-benzodiazepine receptor alteration, elevated hypothalamic-pituitary-adrenal (HPA) axis activity and changes in the N-methyl-D-aspartate glutamate receptors. This physiological confusion contributes to the physical symptoms of withdrawal, such as physical pain or blood pressure that soars or becomes unstable.

Additionally, the mesolimbic dopamine system is affected. When an individual's mesolimbic system is out of balance and his or her dopamine levels decline, that individual may feel apathetic, hopeless and joyless and have decreased motivation. Over time, these subcellular changes in the brain alter the strength of connections in the circuit, essentially hardwiring the desire for drugs into a habitual craving. This craving is easily reignited both by the drugs and environmental cues, including people, places and things associated with current or past drug use.

### Risk factors

As counselors, it is important to keep in mind that only a small percentage of those who experiment with drugs will develop a substance use disorder.

Researchers have not been able to identify exactly why this is the case, but they have elucidated possible risk factors, including genetics, peer pressure, stress and the age that the person starts using. In 2008, researcher Rajita Sinha substantiated that chronic stress is a risk factor for developing a substance use disorder. Additionally, there are strong links between both posttraumatic stress disorder (PTSD) and traumatic brain injury and substance use disorders.

It is hypothesized that chronic and traumatic stress affect the functioning of the HPA system, areas of the limbic system and the prefrontal lobe. When we experience stress, the sympathetic nervous system and HPA axis initiate a cascade of changes in the body that includes activation of the endocrine system to release stress hormones such as adrenaline and cortisol. Chronic stress and release of these neurochemicals are harmful to the body and can play a role in addiction. For example, it is thought to be one of the most common causes of adrenal fatigue, which causes body aches, fatigue, nervousness, sleep disturbances and digestive problems. Therefore, an individual may use substances to combat these unpleasant conditions resulting from chronic and pervasive stress. This neurological reaction points to the role of environment in addiction and reinforcing how a consistently stressful environment can increase one's risk for developing, maintaining or relapsing into a substance use disorder.

A second aspect of the brain that plays a key role in stress and, consequently, in addiction, is the dorsolateral prefrontal cortex (DL-PFC). The DL-PFC is responsible for higher order functioning,

including attention, emotion regulation and complex problem-solving. When an individual is stressed, the DL-PFC helps to put the breaks on unhelpful and unnecessary physiological changes produced by the sympathetic nervous system. Clients can learn to engage the DL-PFC as a tool to help regulate impulses when stressed or triggered, which may ultimately reduce the chances of using substances to cope with stress.

The age of first use is also an important risk factor, given that during adolescence, our brains are still forming, especially in areas that are prominent in the addiction pathway. Substance use during this time can be particularly detrimental.

A study published on the Medscape Psychiatry website this past December reported that heavy drinking during the teenage years has been linked to decreased brain volume in the areas of the cingulate gyrus and insula. These areas are involved in emotion and emotion processing, autonomic and behavior regulation, interoceptive awareness and interpersonal functioning. This research also suggests that alcohol use during adolescence appears to interfere with normal brain development, even when a participant does not meet the criteria for a substance use disorder. Such interference could have long-term effects, including increases in impulsivity, decreases in behavioral monitoring and decreases in executive functioning.

The disruption in prefrontal activity, particularly the DL-PFC, is strongly related to the development of comorbid depression. Therefore, when taking a thorough and detailed substance use history, it is important to ask clients the following questions:

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- ❖ Do they have a family history of addiction?
- ❖ When did they first start using?
- ❖ Have they experienced any significant brain trauma?
  - ❖ Are they experiencing any significant stress or pressure in their lives?
  - ❖ Have they experienced past trauma?
  - ❖ Do they have positive social support available to them?

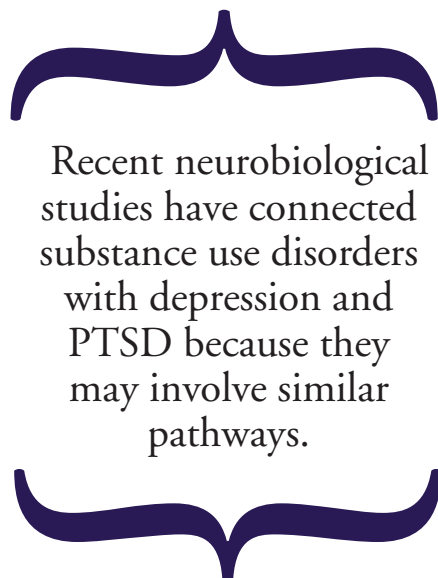
### Other considerations

In addition to taking a thorough history, there are several other important considerations when working with clients experiencing substance use disorders. Clients may initially need a medical detox admission to come off their drug of choice safely before beginning counseling. Let's take alcohol for example.

Long-term exposure to alcohol leads to a disruption in different excitatory (especially glutamate, an excitatory amino acid) and inhibitory neurotransmitters (especially GABA, an inhibitory amino acid). Therefore, when heavy drinkers suddenly stop or significantly reduce their alcohol consumption, the neurotransmitters previously suppressed by alcohol are no longer suppressed. They rebound, resulting in a phenomenon known as brain hyperexcitability.

This suggests that the effects commonly associated with alcohol withdrawals — which include anxiety, irritability, agitation, tremors and seizures — are the opposite of those associated with alcohol consumption. Alcohol withdrawal syndrome can be a life-threatening condition. As a counselor, you need to know and have formed relationships with the local drug addiction treatment facilities in your community. This is essential if you have a client in your office in the action stage of change who is ready to get help.

Second, it is important to do a thorough assessment to determine if you will be treating a mental health issue along with a substance use disorder and whether there are psychopharmacological interventions that will further aid in the treatment of a comorbid mental health disorder. Recent neurobiological studies have connected substance use disorders with depression and PTSD because they may involve similar pathways. For example, neurobiological similarities between major depression



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and substance use disorders likely contribute to both symptom overlap and high rates of comorbidity. Substantial data indicate that extrahypothalamic corticotropin-releasing factor and HPA axis irregularities and alterations in catecholamine, serotonin, GABA and glutamate systems are associated with major depression and acute withdrawal distress in substance use disorders.

Research has also shown that a multimodal approach to treatment using diverse treatment modalities is most effective in treating addiction. Therefore, consider developing a network of practitioners in your area who can serve as a treatment team. This team could include counselors, medical doctors, chiropractors, acupuncturists and pain management physicians.

Finally, it is important to understand that one of the prominent diagnostic features of the disease of addiction is denial, which can cause significant resistance to treatment. This may be the result of anosognosia, in which clients possess a lack of insight into their condition. This is common among those with substance use disorders.

Neurobiologically, anosognosia may be in part due to a disruption in brain regions or connections supporting conscious recollection in episodic memory. This may include the posterior parietal and medial frontal regions and the insula, leading to an impaired switching mechanism between the default mode network and the central-executive control network. As a result of this condition, one week clients may fully

understand their disease, but the next week they may be trying to convince their clinician that their drinking or drugging is under control and that abstinence is not necessary.

Counselors may also have clients fully committed to their recovery who relapse and deal with shame, guilt, hopelessness or even suicidal thoughts. The ups and downs of addiction counseling can be exhausting for clinicians and clients as clients move back and forth through the stages of change. Addiction professionals strongly recommend being well-versed in motivational interviewing, an empirically based technique that can help clinicians work with clients' ambivalence and denial.

### Counseling approaches

When working with clients who struggle with addiction or with addiction and a comorbid mental health issue, certain neurologically minded counseling theoretical approaches have been found to be effective. Each of the approaches uses components of mindfulness, which has been shown to reduce stress and enhance regulation of the sympathetic nervous system.

Acceptance and commitment therapy (ACT) is an empirically based psychological intervention that uses acceptance and mindfulness strategies mixed with commitment and behavior-change strategies to increase psychological flexibility. A 2015 review found that ACT was better than placebo in the treatment of addiction.

Dialectical behavior therapy is an approach that works toward helping people increase their emotional and cognitive regulation by learning about the triggers that lead to reactive states. The approach also helps to assess which coping skills to apply in the sequence of events, thoughts, feelings and behaviors to avoid undesired reactions.

Mindfulness-based cognitive behavior therapy uses traditional cognitive behavior therapy methods and adds in newer psychological strategies such as mindfulness and mindfulness meditation.

These new counseling theories or approaches are not typically covered in-depth in most counseling programs. Counselors should consider learning and gaining clinical competence in one of these emerging modalities.

When working with addiction, it is also important to be familiar with the American Society of Addiction Medicine's "level of care" criteria and how these relate to counselors' assessment and treatment recommendations. Because of the disease severity and possible subsequent damage to the brain, including serious conditions such as cerebral hemorrhage and cerebral infarction, some clients will need a higher level of care than counselors can provide in their private practices or community-based mental health facilities.

There are five broad levels of care:

- ❖ Level 0.5: Early intervention
- ❖ Level 1: Outpatient services
- ❖ Level 2: Intensive outpatient/partial hospitalization services
- ❖ Level 3: Residential/inpatient services
- ❖ Level 4: Medically managed intensive inpatient services

Outpatient settings are not appropriate for most clients who need a level of care higher than 2. Once clients have been successful in a higher level of care, outpatient settings may be appropriate.

## Conclusion

It is clear that counseling professionals will continue to encounter caseloads with larger percentages of clients facing substance use or comorbid disorders.

It is important that we continue to acquire specialized skills and knowledge around the neuroscience of addiction to prepare for this emerging challenge. This emphasizes the importance of counseling programs requiring course work in addiction that incorporates neuroscience. This may also mean counselors obtaining additional licenses and certifications in addiction that are informed by neuroscience, attending continuing education classes and staying updated on the latest research in addiction as it relates to the brain. These actions will serve to strengthen the place of the counseling profession as a front-runner in effectively working with substance use disorders.

For additional foundational reading on neuroscience and addiction, see:

- ❖ *The Science of Addiction: From Neurobiology to Treatment* by Carlton K. Erickson

- ❖ *Advances in the Neuroscience of Addiction*, second edition, edited by Cynthia M. Kuhn & George F. Koob
- ❖ *Behavioral Neuroscience of Drug Addiction* edited by David W. Self & Julie K. Staley Gottschalk ❖

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