Why Addiction has a Chronic, Relapsing Course. The Neurobiology of Addiction: Implications for Occupational Therapy Practice

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ABSTRACT. Approximately 200 million people in the United States have an addiction disorder that significantly disrupts employment, family relationships, financial stability, and personal health. As a result, addiction has become one of the most critical health care challenges presently facing the American health care system. Research in the last five years has provided substantial evidence that addiction is a neurobiological condition rooted in genetic factors. During the addiction process neurologic changes occur that are responsible for tolerance, craving, and relapse. It appears that once addiction becomes chronic, the brain enters an addicted state that may be irreversible without pharmaceutical intervention. Such alterations in neurochemistry–rather than poor volitional control–account for why addiction is characterized by a chronic, relapsing-remitting course. This paper discusses (a) the neurobiological factors underlying the addiction process, (b) available pharmaceutical treatment, and (c) how recent research regarding the neurobiology of addiction affects occupational therapy's role in addiction rehabilitation. A case study follows that illustrates how occupational therapists can contribute to addiction intervention.

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Addiction is a chronic, relapsing disorder characterized by compulsive use of one or more addictive substances despite clear, persistent negative consequences. An overwhelming amount of research produced in the last half decade suggests that prolonged exposure to alcohol and drugs of abuse causes long-lasting effects that appear to maintain the brain in an addicted state despite years of abstinence from the addictive substance. For this reason, many researchers contend that addiction should be viewed and clinically treated as a chronic medical illness.

Addiction frequently involves (a) the use of substances in larger amounts and for longer periods; (b) unsuccessful attempts to reduce, stop, or control one's use of the addictive substance; (c) greater time and effort spent attempting to obtain the substance, (d) neglect of major role obligations; and (e) continued use of the substance despite apparent health-related, economic, employment, legal, and/or family problems (APA, 2000; Cami & Farre, 2003). The major categories of drugs that most commonly produce addiction are psychostimulants (e.g., cocaine, amphetamines), opiates, ethanol, nicotine, marijuana, and phencyclidine-like drugs (e.g., PCP or angel dust). The addiction literature, however, also extends the definition of addiction to compulsive behaviors that meet the above listed criteria. Eating disorders, gambling, kleptomania, compulsive shopping, workaholism, and relationships and sex, are also considered addictions when they produce the dysfunctional behaviors listed above (Mathias, 2001a; Nestler & Malenka, 2004; "The Addicted Brain," 2004).

In 2002, approximately 120 million Americans age 12 and older reported current and consistent use of alcohol. Approximately 54 million engaged in binge drinking (i.e., heavy consumption of alcohol at least once during the week), and 15.9 million reported alcohol consumption of four or more drinks per day. In the 2002 National Survey on Drug Use and Health an estimated 19.5 million Americans age 12 and older reported current use of illicit drugs (Substance Abuse and Mental Health Services Administration [SAMHSA], 2005).

Addiction to alcohol and illicit drugs exacts a significant toll on society. Addiction-related health problems, participation in criminal activity, disruption of family relationships, loss of employment, and homelessness often result from addiction-related behaviors. The cost to society associated with lost productivity, crime, and medical problems resulting from addiction has been estimated at more than $300 billion

per year in the US, making it one of the most serious public health concerns presently facing American health care (SAMHSA, 2005).

Yet, the scientific community is only beginning to understand the neurologic underpinnings of the addiction process. It is only in the last five years that researchers have provided considerable evidence that addiction is a neurobiological phenomenon rooted in genetic factors. Such research has revealed two important findings that will affect both society's perception of addiction and how health care professionals should treat addiction: (a) one's risk for addiction may be genetically influenced, and (b) once the brain becomes addicted to a substance it may always remain in an addicted state despite years of abstinence (DeVries & Shippenberg, 2002; Nestler, 2002; Nestler & Malenka, 2004). The latter finding also suggests that the neurochemical mechanisms of an addicted brain underlie the cravings and repeated relapses commonly seen in the rehabilitation process. In other words, despite a person's sincere motivation to recover, a brain in an addicted state can drive a person to abuse substances again–even after years of abstinence–thus undermining the person's rehabilitation efforts. This newly gained understanding of the addiction process illuminates why recovery from addiction is commonly characterized by repeated remissions and relapses.

Nevertheless, many health care professionals and the larger society have not altered their perception of the addiction process accordingly. Addiction continues to be mistakenly perceived as a problem of moral character and poor volitional control. Public sympathy and concern often alternate with anger and resentment. Many express doubts about devoting medical resources to people who appear to have created their own problems. Many managed care organizations have reduced reimbursement for addiction treatment programs to 28 days; 10 years ago the average length of an addiction treatment program was six months (Weisner, 2001). Opiate maintenance (such as methadone maintenance for heroin addiction) continues to be politically and socially controversial–despite the fact that research has shown such programs to be the most effective treatment for heroin addiction, enabling people to remain abstinent from the illicit drug and helping them maintain stable family lives and employment ("Treating Opiate Addiction," 2004). Despite such research evidence the public continues to perceive opiate maintenance as formalized indulgence of a criminal vice ("Treating Opiate Addiction," 2005).

In order to provide the most effective treatment for addictions (a) health care professionals and the larger society must better understand addiction as a neurobiological disorder requiring medical resources, and

(b) medical researchers must be provided with adequate funding to develop pharmaceutical treatment that can stop the neurochemically-driven process of craving and relapse. This paper will (a) describe the neurochemical and genetic factors that underlie the addiction process, (b) explore currently available treatment for addiction, and (c) relate the significance of new research findings about the addiction process to occupational therapy's role in addiction treatment.

Course, Comorbid Disorders, Associated Medical Problems, and Risk Factors

Many people with addictions report that they first began using alcohol or drugs for recreation or to mask personal problems (Parker, 2002). Initially, the high produced by alcohol or drug intoxication is experienced pleasurably. People with addictions report that initial substance use produces feelings of warmth, clarity, relief, and the sensation of being connected to the universe (Bailey, 2004). For a very brief period, the high produced by substance use elicits a sense of well-being and euphoria. But shortly, after repeated exposure to the substance, the amount that initially elicited feelings of euphoria is no longer as effective. People using substances of abuse find that they need more of the substance to produce the sensation of well-being. The euphoria of the initial high is never experienced again, no matter how much a person increases his or her use. Instead, people who have become addicted to substances of abuse find that they require greater amounts of the substance just to feel normal. Without it, they become depressed, irritable, and often physically ill. Use of the substance then becomes compulsive as people lose control over their intended use. Greater amounts than anticipated are frequently consumed and for longer periods of time. At this point addiction has taken hold and people begin to experience severe cravings for the substance that are driven by the neurochemically addicted state of their brain. Such neural-based cravings compel them to seek and use the substance of abuse despite clear feedback that the addiction is harming their health, finances, and personal relationships.

There is a saying in addiction rehabilitation: There are no old addicts; there are only dead, incarcerated, or recovered addicts. Addiction has a chronic course characterized by repeated periods of alternating abstinence and relapse. It is now understood that this chronic, relapsing-remitting course is rooted in the neurochemical processes that drive cravings and relapse, rather than a weak moral character and poor self-will. One year after they have stopped drinking, approximately one

third of people with alcoholism remain abstinent, one third resume drinking but consume lower amounts, and one third relapse and drink at former levels or greater (Goldman & Barr, 2002). Similar findings have been reported with people addicted to cocaine (Mathias, 2001b). Whether a person remains abstinent or relapses depends upon numerous factors including available social support, genetic risk factors, and the neurochemical state of the brain (Nestler & Malenka, 2004).

Comorbid Disorders

Substance abuse commonly occurs comorbidly with other mental health disorders. Schizophrenia, bipolar disorder, depression, antisocial and borderline personality disorders, conduct disorder, and attention deficit hyperactivity disorder are all associated with an increased risk for substance abuse. A dual diagnosis of substance abuse and another mental health disorder complicate the course and treatment of both. Outcomes for dual diagnoses involving substance abuse and a comorbid mental health disorder are often unfavorable (APA, 2000; Cami & Farre, 2003). Personality traits and mental health disorders are commonly considered as significant factors influencing one's risk for substance abuse and addiction. People with risk taking or novelty seeking traits have been shown to possess a higher risk for substance abuse than those without such personality traits (Cami & Farre, 2003).

Polysubstance Abuse

Polysubstance abuse is the use of two or more addictive substances simultaneously or sequentially (APA, 2000). For example, people addicted to cocaine often use alcohol, antianxiety medications, and opioids to counteract the symptoms of anxiety that are commonly produced by cocaine abuse. People addicted to opioids or marijuana frequently use alcohol, antianxiety medications, amphetamines, or cocaine to enhance the effect of the opioid or simulate the opioid high when the drug of choice is unavailable. It is also common for people with addiction to switch from one substance to another when the preferred substance can no longer be easily obtained (APA, 2000; Bailey, 2004).

In a related phenomenon, people with addictions often leave rehabilitation programs and remain abstinent from their former addictive behaviors, only to switch to another addictive substance or compulsive behavior. For example, a person with an eating disorder may remain free of binge eating behaviors after rehabilitation, but may begin to shop

compulsively. Switching from one substance or compulsive behavior to another occurs because treatment did not address the neurochemical mechanisms maintaining the brain in an addicted state. The addicted brain activates cravings that compel the person to use a similar substance or engage in a comparable compulsive behavior that will positively affect the brain's reward circuits (Nestler, 2002; Nestler & Malenka, 2004).

Associated Medical Problems

In addition to the harmful effects that addictive substances exert on the brain, many other health problems result from substance abuse. Alcoholism and drug addiction are associated with an increased risk of cirrhosis of the liver, cardiomyopathy, various cancers, infectious disorders, fetal abnormalities, and neurologic complications such as dementia. One's general health tends to deteriorate as a result of substance abuse. Malnutrition from a diet lacking adequate nutrients and poor personal hygiene can occur rapidly. Ingesting substances intranasally (i.e., snorting) can cause erosion of the nasal septum. Stimulant use can lead to sudden death from cardiac arrhythmias, myocardial infarction, cerebrovascular accident, or respiratory arrest. The use of contaminated needles during intravenous drug use significantly increases the risk for HIV infection, hepatitis, tetanus, vasculitis (inflammation of a blood or lymph vessel), septicemia (bacteria in the blood), bacterial endocarditis (inflammation of the heart lining caused by bacterial infection), embolism, and malaria (APA, 2000; Bailey, 2004; Leshner, 2000).

Risk and Protective Factors

Certain social conditions can increase or decrease a person's risk for addiction and substance abuse. Childhood and adolescent developmental factors that heighten a person's risk for addiction include weak family structures, ongoing childhood emotional trauma, poor school performance, peer group pressures, growing up in high crime neighborhoods, observing one or more family members engage in substance abuse, having too much free time, and lack of age appropriate activities. Conversely, protective social factors that decrease a person's risk for addiction include strong family bonds, parental involvement in academic and extracurricular activities, success in school performance, engaging in a balance of age appropriate activities, and having a peer group that abstains from substance use (Leshner, 2000).

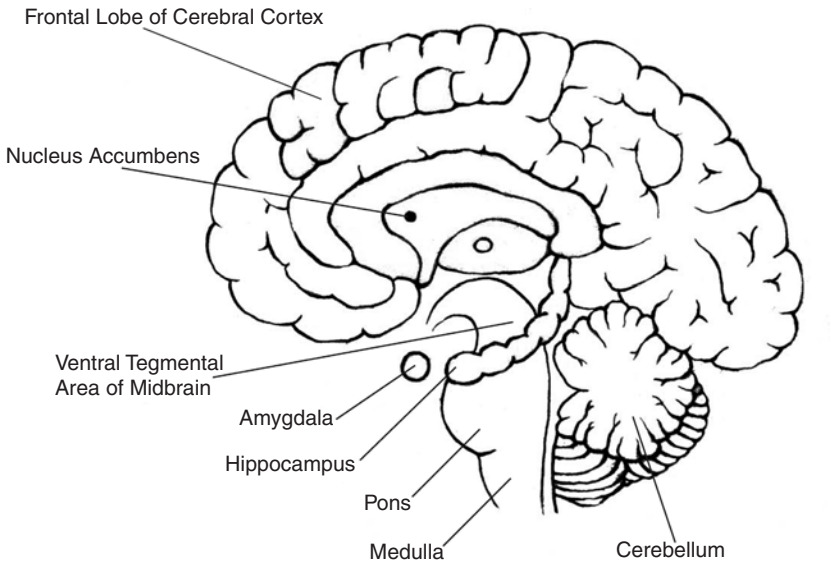
NEUROBIOLOGY OF THE ADDICTION PROCESS

The euphoria induced by substances of abuse occurs as a result of their effect on the brain's reward pathways. The brain's reward system is known as the mesocorticolimbic system–a complex circuit of neurons that evolved to encourage human beings to repeat pleasurable behavior that supports survival. Eating, drinking to quench thirst, and sex are all behaviors that produce surges of pleasurable neurochemicals in the mesocorticolimbic system. Research in the past five years has demonstrated that chronic substance abuse causes changes in the structure and function of the mesocorticolimbic system that can last for weeks, months, or years after a person's last ingestion of the addictive substance (Nestler & Malenka, 2004). Such alterations in the mesocorticolimbic system have been found to produce three main events: (a) the substance of abuse, when used chronically, no longer elicits the same pleasurable effects–known as tolerance (Laviolette & van der Kooy, 2004); (b) the brain produces powerful cravings for the substance that compel one's escalation of use (Mathias, 2001b); and (c) as a result of abstinence the brain adapts by becoming highly sensitized to the addictive substance–so that consumption of the addictive substance, after periods of abstinence, is experienced with heightened pleasure that often elicits relapse. This latter phenomenon is referred to as sensitization (DeVries & Shippenberg, 2002). In response to chronic substance abuse, these alterations in the mesocorticolimbic system trap people in a destructive spiral of escalating use, increased disruption of a person's life, and repeated relapse after periods of abstinence.

Neuroanatomical Structures of the Mesocorticolimbic System

The mesocorticolimbic system is a set of interrelated neuroanatomical structures of the cerebral cortex, midbrain, and limbic system. The system interprets whether behavior is rewarding and sends this information to other brain regions that have roles in decision making and action. The primary neural pathway of the mesocorticolimbic system originates in the ventral tegmental area of the midbrain and sends projections to the nucleus accumbens–a structure located deep beneath the frontal cortex (see Figure 1). The primary neurotransmitter used by this system is dopamine. Almost all drugs of abuse have the potential to become addictive because of their ability to increase dopamine levels in the mesocorticolimbic system. Drugs of abuse activate reward circuits with a force and persistence that is not observed in response to behaviors that

FIGURE 1. The mesocorticolimbic system is the brain's reward center and includes pathways connecting the nucleas accumbens, ventral tegmental area, amygdala, and frontal lobe.



naturally enhance the mesocorticolimbic system–such as eating and sex (Nestler, 2002; Nestler & Malenka, 2004).

The ventral tegmental area of the midbrain (located in the brainstem) acts as a gauge to measure reward. It sends signals to other brain regions regarding how pleasurable a specific behavior is. The amygdala–a limbic system structure located in the anterior temporal lobe–also plays a role in interpreting whether a behavior is pleasurable or aversive. The amygdala has connections with the hippocampus–another limbic system structure located in the temporal lobe (see Figure 1). The hippocampus records and stores the memories of emotionally laden events–particularly ones that may be pleasurable, such as the euphoria of a drug-induced state, or the extreme irritability and physical illness associated with withdrawal. These subcortical structures send messages to the frontal lobes of the cerebral cortex, which processes this information on a conscious level and uses it to make decisions regarding action.

Along with neurochemical addiction of the brain, the process of addiction involves a distorted type of learning and memory. Research-

ers have shown that addiction is associated with alterations in the frontal cortex that produce (a) an overvaluing of the reward, (b) an undervaluing of the risks associated with obtaining the reward, and (c) a diminished ability to connect addictive behaviors with their negative consequences (Volkow, 2003a). Another cognitive distortion related to the addiction process is referred to as priming–a phenomenon in which people learn to associate the euphoria of a drug-induced state with the objects and people commonly involved in the process of drug seeking and obtaining (Cami & Farre, 2003). For example, the sight of white lines of cocaine can produce anticipatory pleasure that activates the same areas of the brain as actual consumption. Thus, any sensory stimuli associated with drug seeking and obtaining can cause priming and relapse–the familiar sights and sounds of the neighborhood where one often obtained the drug, visual images of the substance, the paraphernalia used to ingest the substance, or the distinct smell of the drug or alcohol. Researchers have demonstrated that when cocaine addicts are shown videos of someone using cocaine or white lines on a mirror, the structures of the mesocorticolimbic system light up on functional magnetic resonance imaging (fMRI) and positron emission tomography scans (PET) (Nestler, 2002; Nestler & Malenka, 2004). The same regions respond similarly when compulsive gamblers are shown images of slot machines (Volkow, 2003a). This latter finding suggests that the mesocorticolimbic system responds similarly in nondrug addictions such as gambling, eating disorders, and compulsive shopping (Nestler & Malenka, 2004). In addition to physical changes, addiction appears to be a cognitive process involving compulsion, disrupted control, and poor reasoning.

Dopamine

All drugs of abuse cause the nucleus accumbens to receive a flood of dopamine. Dopamine is an essential neurotransmitter to both normal cognitive function and the experience of pleasure. There is evidence that people with low levels of dopamine D2 receptors are at greater risk for addiction and substance abuse (Martin, 2003). People with low levels of dopamine D2 receptors may be less able to experience feelings of pleasure from activities that are commonly intrinsically rewarding (e.g., engaging in an enjoyable hobby or sport, eating flavorful foods). Researchers have also shown that people with low dopamine D2 receptors are more likely to be obese or possess a binge eating disorder (Mathias, 2001a; Volkow, 2003b). Low levels of dopamine D2 receptors may

compel people to overeat to feel satiated and a sense of gratification from food. Deficient levels of dopamine D2 receptors have also been linked to a range of compulsive behaviors including excessive hand washing and checking disorders (Martin, 2003). Pharmaceutical drugs that target the dopamine D2 system have been shown to effectively reduce obsessive compulsive disorders. Drugs that target dopamine receptors, such as buproprion (brand name Wellbutrin and Zyban), have been effectively used in smoking cessation (Leshner, 2000).

Higher levels of dopamine D2 receptors may act as a protective factor against addiction. There is evidence in rats that dopamine D2 receptor levels can be increased by altering environmental conditions (Martin, 2003). While the leap from rats to humans is great, such findings may suggest the possibility that dopamine D2 receptor levels could be raised in humans by improving environmental conditions–thereby decreasing a person's risk for addiction. Modifying the environment to (a) reduce the risk factors for addiction and (b) enhance the protective factors against substance abuse may provide effective prevention and treatment.

cAMP Response Element-Binding Protein (CREB)

Tolerance and dependence occur in the early stages of addiction. Shortly after repeated exposure to a substance of abuse, people require more of the substance to obtain the same effect on mood. Tolerance occurs when exposure to a drug makes the brain less responsive to a subsequent exposure occurring shortly after (Mathias, 2001b). The reward response of the mesocorticolimbic system becomes diminished and people experience depressed mood and motivation. Ingesting more of the substance is the easiest and quickest way for people to feel normal again.

Dependence involves the physical illness that ensues when the drug of abuse is not consumed. Many researchers contend that dependence and addiction should be viewed as distinct phenomena. Physical dependence is not sufficient to cause addiction. Some drugs of abuse do not cause physical dependence, while some prescribed medications cause physical dependence but are not addicting. In other words, a person may require a medication to feel well but he or she does not crave it, increasingly need higher doses to feel the same effect, or engage in criminal activity to obtain the drug (Cami & Farre, 2003; Nestler, 2002; "Treating Opiate Addiction," 2004).

Both tolerance and dependence occur because chronic drug use suppresses the brain's reward pathways. Chronic drug use causes neural receptors in the mesocorticolimbic system to adapt by resisting the drug–thereby compelling the need for higher doses. Physical dependence and withdrawal occur when the drug leaves the body and neural receptors must adapt to the drug's absence. The neurophysiologic mechanism underlying tolerance and dependence is a molecule known as CREB (cAMP response element-binding protein). CREB is a protein that regulates the expression of genes. When drugs of abuse are consumed, dopamine levels rise in the nucleus accumbens causing the eventual activation of CREB. Chronic drug use causes sustained activation of CREB, which eventually dampens the responsiveness of the brain's reward system (Nestler & Malenka, 2004).

Sensitization

Sensitization is a heightened response to a substance of abuse after a period of abstinence (Cami & Farre, 2003). In other words, after abstinence from the substance–that could last weeks, months, or several years–the brain responds to re-exposure to the substance with increased sensitivity. Sensitization is the neurobiological process that causes relapse even after years of abstinence.

Shortly after repeated exposure to a substance, CREB activity is high and tolerance to the substance increases. During this period people require increasingly greater amounts of the substance to trigger the brain's reward circuits. But if the person abstains from substance use, CREB activity declines. It is at this point that tolerance begins to wane and sensitization dominates, setting off the intense cravings that drive compulsive drug seeking. Exposure to substance-related cues can elicit memories of past drug induced euphoric states that can cause relapse, often referred to as priming (Nestler & Malenka, 2004). The memory of drug-related cues persists far longer than drug cessation and can occur despite years of abstinence from a substance of abuse (Bailey, 2004).

The process of sensitization is linked to a protein called delta FosB. Most of the information regarding the mechanisms of delta FosB has emerged from animal studies. When mice and rats are exposed to chronic drug administration, delta FosB concentrations in the nucleus accumbens rise. Because delta FosB is a highly stable protein, it remains active in the nucleus accumbens for months (or longer) after drug administration. It is this persistence of delta FosB activity that causes the long lasting neurochemical changes after substance use has ceased.

Such findings suggest that delta FosB concentrations contribute to the hypersensitivity of substances that underlie cravings and relapse (Nestler, 2002).

Glutamate, a neurotransmitter that is important in learning and the formation of memories, appears to have a role in the sensitization process. Substances of abuse alter the sensitivity of glutamate in the ventral tegmental area and the nucleus accumbens for extended lengths of time. Researchers suggest that this state of prolonged heightened glutamate sensitivity strengthens the neural pathways of memories that link substance use with reward. This phenomenon, sometimes referred to as long term potentiation, appears to underlie the formation of memories that distort the substance use experience. Thus, people remember their experience more positively than it actually was, undervalue the risks associated with substance abuse, and appear unable to connect their substance abuse with disruption in family, employment, and personal life (Nestler & Malenka, 2004; Volkow, 2003a; Zickler, 2003).

Genetic Factors

Researchers are also beginning to better understand the role that genetic factors play in the addiction process. While psychosocial and environmental factors are influential, studies suggest that at least 50% of the risk for drug addiction may be a result of genetic patterns. Adult males whose parents abused alcohol have an increased risk for alcoholism, even when they were adopted at birth and raised by parents who did not abuse alcohol. Such men also possess a reduced sensitivity to the effects of alcohol–a factor that strongly predicts the development of alcohol abuse. Conversely, people with a gene for the enzyme aldehyde dehydrogenase are less likely to abuse alcohol, as the enzyme correlates with the presence of increased levels of acetaldehyde–a compound responsible for the experience of aversive effects in response to alcohol ingestion. A specific polymorphism of the neuropeptide Y gene has been correlated with increased alcohol consumption, while single-nucleotide polymorphisms of a gene encoding opioid receptors correlate with an increased likelihood of heroin abuse. A single-nucleotide polymorphism in the gene encoding the fatty acid amide hydrolase has been associated with an increased likelihood of drug and alcohol use. A gene for a specific D2 dopamine receptor (Taq1A) has been linked to severe polysubstance, alcohol, opioid, and nicotine abuse. Continued advances in genomic scanning will facilitate the identification of genes that contribute to the risk for addiction. It is hoped that treatment could then

better target the specific genetic factors underlying addiction (Cami & Farre, 2003; Nestler & Malenka, 2004).

TREATMENT

The most effective treatment strategies for addiction combine both pharmaceutical approaches and psychosocial therapies. Because research has revealed that addiction involves neurochemical alterations that persist over time despite abstinence, pharmaceutical approaches are considered to be the primary intervention to treat cravings and relapse. Because addiction, however, also involves distorted learning and memory, psychosocial therapies are used to address the emotional and behavioral components of the addiction process ("Drug Treatment," 2005; Goldman & Barr, 2002).

Pharmaceutical Intervention

Pharmaceutical advances in addiction treatment have largely addressed physical dependence and withdrawal. In contrast, it has been more difficult to develop effective medications that address craving and relapse–the actual processes that maintain addiction. Interventions that do not address craving and relapse are unable to treat the brain's addicted state. This is the key factor accounting for the ineffectiveness of most addiction treatment–intervention may address dependence, withdrawal, and environmental stressors, but it leaves the brain in an addicted state. People having received intervention that leaves the brain in an addicted state have a significant likelihood of relapse (Nestler, 2002; Nestler & Malenka, 2004).

There are currently three primary approaches to pharmaceutical treatment: (a) medication that prevents a drug from reaching its neurologic target, thereby rendering a drug's effects inert; (b) medication that mimics a drug's action without causing the deleterious effects of the addictive substance, thereby reducing cravings; and (c) medication that stops the neurologic addiction process, thus eliminating cravings, sensitization, and relapse (Nestler, 2002).

Blocking Drug Targets

The most common pharmaceutical approach to treat addiction involves blocking the substance from reaching its neurologic target.

Naltrexone is a narcotic antagonist used to treat opiate and alcohol addiction. Naltrexone was designed to block opiate receptors in the brain, thereby preventing opiate action. It also triggers a withdrawal reaction in people who are physically dependent upon opiates. Studies have shown that naltrexone can reduce the risk of relapse in the first three months after withdrawal by 36% (Bouza, 2004). The medication's side effects include nausea and depression–a factor that reduces medication compliance. Because naltrexone does not stop cravings many people who begin its use eventually discontinue the medication. Naltrexone has been shown to be most effective in highly motivated patients who are at risk for loss of profession and family if addiction persists (Fudala, 2003). Polysubstance abuse is also problematic. While naltrexone blocks the effects of opiates, it has no effect on other classes of illicit drugs. Thus, people taking naltrexone are able to become intoxicated by consuming other drug classes.

Mimicking Drug Action

Medications that block drugs from their neurologic targets do not address craving, and thus, relapse is likely to occur. In contrast, medications that attempt to mimic a specific drug's action in the brain can alleviate the cravings that can cause relapse. Methadone, a long-acting opioid receptor agonist, is the best example of this approach. Because of methadone's long half-life, people taking the medication have a low level of sustained opioid receptor activation. This prevents cravings and enables people to return to a more stable employment and family life (Kleber, 2003).

Methadone maintenance is controversial, as some believe that it legally reinforces opiate addiction. Methadone maintenance, however, has a significant amount of research support demonstrating effectiveness. Studies show that people on methadone maintenance are less depressed, more likely to maintain stable employment and family lives, less likely to commit crimes, and less likely to contract HIV or hepatitis (Kleber, 2003). Methadone maintenance and other long-acting opioid agonists, such as levo-acetylmethadol (LAAM), are effective because they allow the brain to believe that it is receiving the addictive substance, without causing the deleterious effects of that substance.

The use of nicotine patches and gums in smoking cessation treatment are also examples of drug mimicry. The theory behind such treatment is based on the idea that sustained release of low levels of nicotine can dampen nicotine craving, thus allowing people to eventually stop smok-

ing. Such treatment, however, has not been found to be highly effective, as cigarette smoking causes long term potentiation of glutamate activity in the nucleus accumbens, which in turn, causes dopamine levels to remain elevated for extended periods–a situation that sustains addiction. Nicotine patches and gums do not address long term potentiation of glutamate and dopamine (Zickler, 2003).

Wellbutrin (also called Zyban) is a medication that has been used effectively in smoking cessation treatment. Wellbutrin increases and sustains dopamine levels in the nucleus accumbens, much in the same way that cigarette smoking does. Thus, people using Wellbutrin are better able to stop smoking because the brain's reward circuits are triggered by the elevated dopamine levels. The high, sustained levels of dopamine prevent nicotine cravings and enable people to eventually stop smoking (Zickler, 2003).

Halting the Addiction Process

To truly end the addiction process and relapse, medication must both alleviate cravings and stop sensitization (i.e., the heightened response to a substance after a period of abstinence). While medications have been developed that can block drug targets and mimic drug action, it has been more difficult to design medication that addresses both craving and sensitization–the key features that maintain addiction. Medications that act on glutamate and dopamine receptors, and that prevent CREB and delta FosB activity are needed to stop the addiction process and allow the brain to return to a non-addicted state. To date, while such medications may be in development, they remain untested in humans (Nestler, 2002, & Nestler & Malenka, 2004).

Occupational Therapy Intervention

Until pharmaceutical intervention is able to address the neurologic mechanisms that trigger relapse, addiction recovery will remain a lifelong process marked by repeated periods of abstinence and substance abuse. Yet, because psychosocial and environmental factors operate in the addiction process, medication alone cannot fully treat addiction. Addiction is a multifaceted disorder that must be addressed at emotional, social, and neurologic levels. The challenge of addiction treatment, however, has been complicated by managed care practices that reduce both length of treatment and reimbursement for service (Stoffel & Moyers, 2004). As the length of addiction treatment continues to be

shortened by managed care agencies, occupational therapists can make unique contributions to the addiction treatment team by focusing on features of the addiction process that currently remain unaddressed by pharmaceutical intervention and other health care professionals. This is especially important in the present health care environment in which duplicated services will not be reimbursed. It is also essential for therapists to (a) understand the neurologic mechanisms underlying addiction and revise traditional treatment accordingly, (b) document the effectiveness of service, and (c) advocate for the profession's continued participation in addiction rehabilitation.

Intervention areas in which occupational therapists can uniquely contribute to addiction recovery include helping clients to (a) challenge the distorted thinking that accompanies the addiction process so that they can accurately perceive the toll that substance abuse has taken on their lives; (b) learn to avoid the drug-related sensory stimuli that can act as triggers for priming and relapse; (c) build new roles, activities, habits, and routines that are not associated with past substance use; (d) learn stress management techniques to better negotiate conflicts and tolerate emotions that can facilitate relapse; and (e) acquire appropriate social skills that can replace maladaptive behaviors learned from drug seeking and obtaining.

While several of the above intervention strategies can be implemented by other health care professionals–particularly challenging the distorted thought processes that accompany addiction–it is important to acknowledge the differences in treatment approach between occupational therapy and other services. While many other health care professionals use talk therapy as a primary means of intervention, occupational therapists use real life activities in the natural environment to address occupations and roles that have become dysfunctional as a result of addiction. Using real life activities in the natural environment may be more effective than talk therapy implemented in the artificial environment of the treatment setting. Some researchers suggest that skills needed to resist addictive behaviors may be best acquired in natural settings. Such settings provide real life triggers that can challenge clients to gain mastery in ways that artificial environments cannot (Calsyn, Morse, Klinkenberg, & Lemming, 2004; Davis, Jason, Ferrari, Olson, & Alvarez, 2005). Additionally, occupational therapists are uniquely skilled to use activity analysis, grading, and adaptation to help clients make small progressive changes until the larger goals of abstinence and maintenance are achieved.

Education

Along with other members of the treatment team, occupational therapists should reinforce client and family education about the addiction process. Clients and family members must understand that addiction is a chronic medical illness that is often characterized by periods of relapse and remission. Clients and family members must also understand that, because of neurologic changes resulting from substance abuse, recovery is often a lengthy process that may require several rehabilitation attempts. It is important to convey that when relapse occurs it is largely due to the neurologic mechanisms of priming and sensitization, rather than moral weakness and poor volitional control.

Challenging Cognitive Distortion

An important feature of the addiction process that is presently unaddressed by pharmaceutical intervention involves the changes in learning and memory that distort one's perception of the rewards and risks of substance use. Occupational therapists can help clients challenge their distorted thinking by comparing the rewards of substance abuse to the actual harm that has occurred to their health, family, employment, finances, and personal goals. Incentive to maintain abstinence is facilitated most when clients can understand, cognitively and emotionally, the deleterious effects that their substance abuse has caused to family members, friends, and personal life goals. It is often helpful to conduct a session in which loved ones confront clients with the real life harm that has resulted from the client's substance abuse (Csiernik, 2002). Exposing clients to people who successfully recovered from chronic addictions, and who can serve as role models can also strengthen clients' determination to maintain abstinence. Such role models can often confront and challenge a client's distorted perception about the rewards and risks of substance abuse more effectively than therapists and family members. Therapists can help clients to practice problem solving, weigh options, and choose positive alternatives to substance use. The degree to which clients are able to accurately perceive the negative outcome of substance abuse is predictive of the likelihood of relapse (Eells, 1991).

Preventing the Process of Priming

One of the most important features presently unaddressed pharmaceutically is priming–the condition in which sensory stimulation associ-

ated with substance use triggers intense cravings for the substance. Because priming is in large part a neurologically-based phenomenon, the most effective current approach to address priming is prevention. People with addiction who are motivated to abstain must learn to avoid the specific situations that can trigger priming and relapse. Such high risk situations must first be identified by each client and strategies to avoid those situations should then be developed and practiced. Ideally such skills should be practiced in group settings with other clients also learning the same skills. One of the most important factors predicting success in rehabilitation involves how adeptly clients can avoid high risk situations involving drug seeking and use. Clients who believe that they can return to their former peer group in which substance use was prevalent, are likely to relapse. Similarly, clients who are motivated to abstain but have spouses (or other close family members) who regularly use substances, have a high risk of relapse (Leshner 2000; Wand, 1998). In such cases, family therapy is recommended.

Role Development

Occupational therapists can help clients learn new activities that can support the development of roles unrelated to substance use. This is especially important if substance use began recreationally or if it was carried out within a peer group setting. Roles and activities that were associated with substance abuse must be exchanged for ones having no relationship to the client's former routines and habits involving drug seeking and use. The client must understand that the participation in former roles, habits, and routines associated with substance abuse can trigger priming and relapse. If the client does not understand priming, and is not motivated to avoid situations associated with his or her former drug use, relapse is highly likely.

Time Management and Leisure Skills

To avoid the activities, habits, and routines associated with past substance use, clients must be able to manage their time and develop a repertoire of leisure skills. As the addiction process becomes chronic, people tend to spend greater amounts of time in activities related to substance use–securing money for drugs, obtaining drugs, consuming substances and becoming intoxicated, sleeping, and repeating this cycle. When substance use is removed from their daily lives, people may be left with 16 to 18 hours of unoccupied time. Boredom and possessing

too much leisure time have been shown to be predictive of relapse (Helbig & McKay, 2003; Kwitny, 1998; Leshner, 2000).

Stress Management

Occupational therapists can help clients learn stress management techniques to better deal with the emotions and environmental stressors that formerly triggered substance use. It is common for people with addictions to use substances of abuse to mask uncomfortable emotions. When clients abstain from substance use, such emotions frequently reemerge. Therapists can teach clients a range of stress management techniques–meditation, visualization, progressive muscular relaxation, and diaphragmatic breathing–to better tolerate emotions of anger, sadness, and fear without the aid of addictive substances. Similarly, clients can learn to use such techniques to deal with environmental stressors that formerly triggered substance use (Buijsse, Woody, & Davis, 1999).

It is important for therapists to understand that abstinence is commonly accompanied by dysphoric mood and anxiety. These states occur as a result of the neurochemical changes that ensue during abstinence. In response to substance use, dopamine levels in the brain's reward circuits become abnormally elevated. Upon drug cessation, abnormally elevated levels of dopamine rapidly wane, causing depression and anxiety (Goldman & Barr, 2002). Some physicians advocate the use of antidepressants and antianxiety medications to alleviate the mood states that often cause people to resume substance use. Others caution against the use of any medication that could cause physical dependence in people with addiction disorders (Leshner, 2000).

Social Skill Training

Hospitalization, incarceration, street life, and homelessness may be commonly experienced as a consequence of chronic addiction. People may adopt dysfunctional behaviors to protect themselves from dangers existing in the above situations and from harm associated with drug seeking behaviors. As a result, social skills, problem solving, and conflict resolution may be lacking or maladaptive. Skills that enhanced the person's ability to safely negotiate drug-related environments are often considered inappropriate in the larger community and may impede the person's chances to assume work, family, and community member roles. Therapists can help clients practice and learn needed social skills in group settings. Practice should involve specific situations that are

likely to be encountered by clients as they attempt to assume desired roles in the larger community. Possessing the skills to interact with others in socially acceptable ways and to resolve conflicts non-aggressively can reduce stress that could potentially trigger relapse (Buijsse et al., 1999; Kwitny, 1998).

CASE STUDY

Joe was a 41 year old white male who was admitted to an inpatient treatment program after falling from a second-story building at a construction site where he worked. Joe's fall resulted from alcohol intoxication; however, he did not sustain physical injury. Instead, Joe's brother–who owned the construction company–offered Joe an ultimatum that included attendance at an addiction rehabilitation center or loss of employment and financial support. Joe agreed to attend a 28 day inpatient addiction program located in a nearby urban area.

History

Joe reported that he drank and smoked marijuana as a teenager but did not use stronger substances. He fathered two children as a teenager but did not marry. These children were raised by Joe's parents; however, Joe reports that he did not maintain consistent involvement in his children's upbringing. Both offspring are currently in their early 20s. After four years in the military, Joe attended a culinary institute and received an associate's degree. By age 30 he was employed as an assistant chef at a well known Atlantic City casino restaurant. During this five year period he developed a cocaine addiction and lost much of his salary to drugs and gambling. At 35 Joe accidentally overdosed on cocaine and alcohol, and almost died. His live-in girlfriend of seven years found him in a comatose state and called an ambulance that transported Joe to a local medical emergency center where he was resuscitated. After this incident, Joe was court ordered to attend an addiction rehabilitation program or serve a one year prison term. Joe chose attendance at a 90 day inpatient addiction program in a nearby urban area. He maintained sobriety for eight months, but then relapsed and began drinking.

For the next two years Joe remained free from cocaine use, but drank increasing amounts with greater frequency. Due to his erratic behavior, Joe's girlfriend asked him to move from their shared residence. They have continued their relationship to date; however, they maintain sepa-

rate homes in neighboring cities. At that time Joe's brother, Rob, began renting his basement apartment to Joe and hired him as a construction worker in his company. Rob also began to oversee Joe's finances so that Joe could no longer spend his salary on alcohol and drugs. In fact, Joe does not have access to his bank account; instead Rob and his wife manage all of Joe's expenses including rent, groceries, clothing, and self-care products. Rob allows Joe a small weekly allowance to purchase miscellaneous products (such as cigarettes, coffee, and bus fare) and places most of Joe's weekly salary in a savings account that Joe cannot access without Rob's signature. While Rob and his wife developed this arrangement to help Joe maintain sobriety, Joe has continued to drink with his peer group. Rob reports that the caregiver role he has assumed with Joe has become burdensome. He states that he relates to Joe as a father rather than an adult sibling. Joe reports that he resents his brother's overprotection and states that he does not need such assistance. While Joe acknowledges that he has an addiction problem, he externalizes blame to his brother's overprotection, his girlfriend's demands, and to stress related to work and family commitments.

Goals for Occupational Therapy Intervention

Goals established by Joe and the therapist included (a) enhancing Joe's knowledge about the processes of priming, relapse, and sensitization; (b) challenging Joe's perception of the rewards and harmful consequences of alcoholism; (c) facilitating the development of roles and leisure activities that are unrelated to substance use; (d) helping Joe manage life stressors that commonly cause him to drink; and (e) promoting the skills and motivation Joe needs to avoid both his former peer group and the activities previously associated with drinking.

Occupational Therapy Intervention

Although Joe was initially approved by his insurance company to receive 28 days of rehabilitation, he was permitted an additional two weeks of therapy during his fourth week of stay. Intervention began with education about the role of priming and sensitization in relapse. All members of the treatment team participated in the education process to reinforce the idea that the brain's reward system changes as a result of addiction in ways that maintain compulsive substance use. Family members also received education to better understand their loved one's addiction as a chronic medical illness.

Joe reported that he felt less shame when he learned that priming and sensitization are neurologic phenomenon, and that addiction recovery is frequently a lengthy process characterized by setbacks and gains. He began to perceive his relapses as part of a medical condition, rather than being indicative of character weakness and poor volitional control–terms with which he had been frequently labeled. Joe stated that his understanding of addiction as a medical illness helped him to better comprehend and appreciate his family's concern for his well being. He also stated that he began to view his addiction with greater seriousness once he comprehended that his brain chemistry had actually changed as a result of chronic alcoholism and drug use.

In occupational therapy, Joe identified all sensory stimuli that trigger his desire to drink. These were recorded in Joe's therapy journal so that he and the therapist could plan strategies to avoid priming. This activity was implemented in a group session in which members identified similar triggers and shared comparable stories. The ability to perceive that one's addiction experience is shared by others commonly helps clients understand that addiction is a medical illness with a common course.

Challenging Cognitive Distortion

Several therapeutic strategies were used to challenge clients' cognitive distortion. The first technique involved a group session in which clients created a panorama or timeline of their life using family photos, drawings, and magazine pictures. For each life period clients used pictorial representations to convey the personal goals, accomplishments, and losses they experienced during that life stage. They also identified the relationships, work/school pursuits, and major roles they possessed at that time. When this type of pictorial life panorama is set before their eyes it becomes a potent visual tool that helps clients clearly perceive how their lives have been changed by addiction. This activity powerfully confronts clients with the cost of substance use to themselves and to their family. Clients then share their panoramas with fellow group members who often report similar stories of loss and disappointment. After creating his panorama, Joe stated that he was most disturbed by the large number of events in his children's lives which he had missed because of substance use. He realized, too, that as a result of his addiction he had sabotaged opportunities to advance his culinary career and was unable to maintain a live-in relationship with his girlfriend.

In a second strategy, loved ones were invited to attend a family session with the client in which they read a previously prepared letter de-

scribing how the client's substance use had hurt them and other family members (such as children). In this activity family members are allowed to speak without interruption as long as they do not become abusive–at which point therapists intervene. It is suggested that therapists read the family member's letter prior to the session to mollify words that may incite the client. Writing a letter prior to the session enables family members to (a) fully express their range of sentiments–including both hurt and love, and (b) adhere to the letter's content rather than engage in harmful verbalizations. Clients are encouraged to offer complete attention to each family member's words and are not allowed to engage in argument or blaming. Ground rules that apply to both family members and clients include the following: (a) all words must be spoken in compassionate and loving tonal inflections rather than angry and accusatory verbal expressions; (b) silence must be respected by all who are not speaking; no one is allowed to interrupt each other; and (c) all speakers must make *I statements* rather than *you statements* and can only verbalize their own feelings. Clients are encouraged to refrain from addressing the content of the letter until at least one day passes, at which time they can respond to their loved ones in written form with the therapist's assistance. Refraining from speaking immediately in response to their family members' letters better ensures that clients will not engage in angry, acrimonious speech that can exacerbate family relations. It also offers clients time to process cognitively what was said and reduces defensiveness and denial. Joe was able to listen while his brother and sister-in-law expressed both their love for Joe and the pain they felt from observing the harm he experienced as a result of addiction. Several days later Joe and the therapist responded to his brother and sister-in-law in a letter in which Joe expressed appreciation for their continued willingness to help him despite the chaos his addiction had caused in their lives.

In a third strategy, former clients who have successfully maintained abstinence for one year or longer were invited to speak with present clients about (a) the personal losses they sustained from substance use, (b) the distorted thinking that caused them to overvalue the rewards and undervalue the harm of substance use, and (c) the strategies they currently use to maintain sobriety. Such former clients can effectively challenge present clients to consider whether the rewards of substance use actually outweigh the harm. This technique is often highly effective as former clients–already understanding the ways in which people can manipulate others to avoid responsibility–do not allow current clients to externalize blame, deny apparent harm to themselves and others, or

maintain the illusion that they can control their addiction and substance use.

Preventing the Process of Priming

In an initial group session Joe identified triggers that elicited cravings. All of the identified triggers were associated with activities that supported former drinking patterns. These activities included socializing with his peer group, attending ballgames and horse races, spending time at a local bar with friends, and watching televised ballgames alone in his apartment. These triggers were recorded in his journal and weighted in order of their ability to elicit cravings. In the early weeks of his rehabilitation, Joe believed that he could continue his prior friendships but refrain from drinking when exposed to the activities and people with whom he previously drank. A former client who successfully maintained his abstinence for 1 year and 5 months, and who became Joe's sponsor (or addiction rehabilitation coach), helped Joe reconsider the likelihood of maintaining abstinence when exposed to friends who drink.

Joe and the therapist then developed a behavioral contract in which Joe formulated strategies and alternative activities to avoid each identified trigger. It was Joe's responsibility to record (a) the instances when he experienced cravings, (b) the events that triggered the craving, and (c) which strategies and activities he used to prevent priming. This log was presented to the treatment team each week and Joe was encouraged to continue his log recordings after discharge. In an occupational therapy group session using role playing, Joe and fellow group members also learned how to deescalate peer pressure and refuse invitations to drink. Joe was additionally advised to alter routes to and from work to avoid passing his local bar and the homes of friends who used alcohol.

Once clients are discharged from rehabilitation it is essential to enlist the aid of a sponsor and family members who can reinforce clients' efforts to abstain. In the first year after Joe's discharge his sponsor phoned him several times a week and brought him to the gym or to AA meetings to help Joe avoid triggers that threatened to cause priming and relapse. He also encouraged Joe to phone him if he experienced cravings and desired to drink. On these occasions the sponsor would often speak with Joe about the personal consequences of alcoholism and engage him in the activities specified in Joe's behavioral contract.

Role Development and Leisure Activities

To further ensure that priming and relapse would be less likely to occur, it was important to help Joe develop roles and activities that were unrelated to previous patterns of drinking. Joe wanted to develop an adult relationship with his brother and become more involved as a father in his children's lives. He was also enthusiastically anticipating his new role as a grandfather–which would occur in several months when Joe's adult son and daughter-in-law were due to have a baby. Joe stated that because he was frequently absent while his own children grew up, he sincerely desired to be a sober grandfather who would be a consistent and positive presence in his grandchild's life. Joe's desire to be sober for his grandchild was also facilitated by his son's comment that he would not allow Joe near the baby unless he stopped drinking.

Rob and Joe participated in several family sessions along with members of the treatment team. In these sessions Joe stated that he felt overprotected by Rob. Rob, conversely, stated that he felt responsible to assume a parental relationship with Joe because he perceived Joe as irresponsible and childlike. The occupational therapist noted that Rob and Joe did not participate in any shared activities in which they each held equal roles. The therapist asked both men to identify activities they engaged in together while growing up. Such shared activities were noted as playing team sports, attending professional sporting events, playing pool and cards, and lifting weights in the gym. Joe and Rob engaged in several recreational activities together until young adulthood, when each enlisted in separate branches of the military. Both now appeared eager to reestablish a relationship on an equal level. Joe and Rob decided that they would schedule two hours a week to play golf together, lift weights, or shoot baskets with Rob's children. These activities began in Joe's fourth week of rehabilitation and have continued to date.

In preparation for his role as a grandfather, Joe expressed his desire to learn to hold an infant. During one session the occupational therapist brought in baby paraphernalia (e.g., a bottle, a stroller, and baby wipes) and her daughter's life-like baby doll. The therapist taught Joe how to hold an infant, how to quiet a crying infant using gentle rocking, how to feed an infant with a bottle, and how to push an infant's stroller. In another session the occupational therapist took Joe to *Kids R Us* to purchase appropriate gifts for a newborn. The therapist also showed Joe the kinds of toys that are developmentally appropriate as infants become toddlers.

Time Management

Joe also needed to learn to manage his day so that he would not experience large amounts of time without activity–a situation that could easily lead to relapse. The periods of time that presented the highest risk for relapse were evening hours after work and weekends when Joe had no structured activity. The occupational therapist bought Joe a schedule planner and together they filled evening and weekend hours with desired activities. Many of these activities enlisted the participation of others–Joe's family members, sponsor, and girlfriend–to maintain his motivation and encourage his continued engagement in activities unrelated to alcohol use.

Teaching clients to follow a structured schedule is less difficult when they attend inpatient rehabilitation, during which all of their waking hours are scheduled. Conflicts arise, however, when clients are discharged and cannot independently create and maintain adherence to a scheduled set of activities. To help clients learn time management, it is beneficial to encourage them to become responsible for scheduling more of their time with healthy non-substance-related activities, while they are in a rehabilitation program. A client should be able to demonstrate that he or she can independently develop and follow a daily schedule by the final week of rehabilitation.

Stress Management

Joe stated that he had difficulties with anger management and explosive outbursts during periods of intoxication. As part of rehabilitation Joe received psychological counseling in which he explored possible reasons for his anger, how anger facilitated his alcohol use, and in what ways anger affected his relationships with his family and girlfriend. In occupational therapy, Joe and fellow group members participated in role playing in which they practiced (a) walking away from potential conflicts instead of engaging in argument and physical violence; (b) sublimating one's anger using safe, healthy mediums (such as exercise and sports); and (c) counting to ten before responding aggressively when irritated by another's words or behaviors. These techniques helped clients to acquire greater impulse control. Clients also learned strategies to assuage anger through meditation and visualization exercises.

Outcome

Joe was discharged after receiving six weeks of inpatient addiction rehabilitation. He returned to the basement apartment that he rented from his brother and resumed his employment as a construction worker in Rob's company. Joe was fortunate to receive consistent and strong support from his family members, sponsor, and girlfriend, and was able to maintain abstinence for seven months after discharge. At that time he relapsed after arguing with his son about access to his grandchild. Joe returned to his former drinking patterns for approximately one month until his sponsor secured family intervention that helped Joe and his son begin to resolve past conflicts and form a healthier adult relationship. Joe was again able to maintain sobriety for four more months until he relapsed after a severance with his girlfriend. Upon resuming their relationship, Joe maintained sobriety for six additional months without relapse. During that time, however, Joe's mother became terminally ill with cancer and died within a year of her diagnosis. Joe believes that his mother's death facilitated his third relapse after rehabilitation. He reports that he drank for several months until he voluntarily readmitted himself into his former inpatient rehabilitation center for 28 days. As of this writing he has maintained abstinence for three months following discharge.

REFERENCES

The addicted brain. (2004). *Harvard Mental Health Letter, 21*(1), 1-4.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., Text revision.). Washington, DC: Author.

Bailey, K. P. (2004). The brain's rewarding system and addiction. *Journal of Psychosocial Nursing, 42*(6), 14-18.

Bouza, C. (2004). Efficacy and safety of naltrexone and acamprosate in the treatment of alcohol dependence: A systematic review. *Addiction, 99*, 811-828.

Buijsse, N., Woody, C., & Davis, S. F. (1999). Occupational therapy in the treatment of addictive behaviours [sic]. *British Journal of Therapy and Rehabilitation, 6*, 300-307.

Calsyn, R. J., Morse, G. A., Klinkenberg, W. D., & Lemming, M. R. (2004). Client outcomes and the working alliance in assertive community treatment programs. *Care Management Journal, 5*, 199-202.

Cami, J., & Farre, M. (2003). Mechanisms of disease: Drug addiction. *New England Journal of Medicine, 349*, 975-986.

Csiernik, R. (2002). Counseling for the family: The neglected aspect of addiction treatment in Canada [Electronic version]. *Journal of Social Work Practice in the Addictions, 2*, 79-92.

Davis, M. I., Jason, L. A., Ferrari, J. R., Olson, B. D., & Alvarez, J. (2005). A collaborative action approach to researching substance abuse recovery. *American Journal of Drug and Alcohol Abuse, 31*, 537-553.

DeVries, T. J., & Shippenberg, T. S. (2002). Neural systems underlying opiate addiction. *Journal of Neuroscience, 22*, 3321-3325.

Drug treatment for alcoholism today. (2005). *Harvard Mental Health Letter, 22*(1), 3-5.

Eells, M. A. W. (1991). Strategies for promotion of avoiding harmful substances [Electronic version]. *Nursing Clinics of North America, 26*, 915-927.

Fudala, P. J. (2003). Office-based treatment of opiate addiction with a sublingual-tablet formulation of buprenorphine and naltrexone. *New England Journal of Medicine, 349*, 949-958.

Goldman, D., & Barr, C. S. (2002). Clinical implications of basic research. Restoring the addicted brain. *New England Journal of Medicine, 347*, 843-845.

Helbig, K., & McKay, E. (2003). An exploration of addictive behaviours [sic] from an occupational perspective. *Journal of Occupational Science, 10*, 140-145.

Kleber, H. D. (2003). Pharmacologic treatments for heroin and cocaine dependence. *American Journal on Addictions, 12*(Suppl. 2), S5-S18.

Kwitny, W. (1998). Group treatment for substance abuse. *OT Practice, 3*(7), 37-39.

Laviolette, S. R., & van der Kooy, D. (2004). GABAA receptors signal bidirectional reward transmission from the ventral tegmental area to the tegmental pedunculopontine nucleus as a function of opiate state. *European Journal of Neuroscience, 20*, 2179-2187.

Leshner, A. I. (2000). Approach to therapy. The disease of addiction. *Lippincott's Primary Care Practice, 4*, 249-253.

Martin, K. R. (2003). Social environment appears linked to biological changes in dopamine system, may influence vulnerability to cocaine addiction [Electronic version]. *NIDA Notes, 17*(5), 7, 10, 14.

Mathias, R. (2001a). Pathological obesity and drug addiction share common brain characteristics [Electronic version]. *NIDA Notes, 16*(4), 10, 13.

Mathias, R. (2001b). Even modest cocaine use can cause brain changes related to addiction [Electronic version]. *NIDA Notes, 16*(3), 8-9.

Nestler, E. J. (2002). From neurobiology to treatment: Progress against addiction [Electronic version]. *Nature Neuroscience, 5*(Suppl. 1), 1076-1079.

Nestler, E. J., & Malenka, R. C. (2004). The addicted brain [Electronic version]. *Scientific American, 90*(3), 78-85.

Parker, H. (2002). Adolescent and recreational alcohol and drugs, careers gone wrong: Developing a strategy for reducing risks and harms [Electronic version]. *International Journal of Drug Policy, 13*, 419-432.

Stoffel, V. C., & Moyers, P. A. (2004). An evidence-based and occupational perspective of interventions for persons with substance-use disorders. *American Journal of Occupational Therapy,* 58, 570-586.

Substance Abuse and Mental Health Services Administration. (2005). *Substance abuse and mental health statistics*. Retrieved August 3, 2005, from http://oas.samhsa.gov/

Treating opiate addiction, part I: Detoxification and maintenance. (2004). *Harvard Mental Health Letter, 21*(6), 4-6.

Treating opiate addiction, part II: Alternatives to maintenance. (2005). *Harvard Mental Health Letter, 21*(7), 4-6.

Volkow, N. D. (2003a). Director's column. The addicted brain: Why such poor decisions? *NIDA Notes, 18*(4), 3-4.

Volkow, N. D. (2003b). Brain dopamine is associated with eating behaviors in humans. *International Journal of Eating Disorders, 33*, 136-142.

Wand, R. (1998). Treating substance abuse disorders. *OT Practice, 37*(7), 35-36.

Weisner, C. (2001). Factors affecting the initiation of substance abuse treatment in managed care [Electronic version]. *Addiction, 96*, 705-716.

Zickler, P. (2003). Nicotine's multiple effects on the brain's reward system drive addiction [Electronic version]. *NIDA Notes, 17*(6), 1, 6.