Substance Abuse Is a Disease of the Human Brain: Focus on Alcohol

Raymond Anton

Preamble

It is useful in an article of this kind to inform the reader of the author's background, biases, and rationale for the format and content. As a clinically trained psychiatrist and addiction specialist/researcher, my training and experience have led me to best understand the "clinical side" of alcoholism and substance abuse. A large part of my career has been devoted to treating individuals with alcohol use disorders, especially in the context of clinical trials devoted to finding new medications to reduce craving, drinking, and preventing relapse. I also teach professionals about the diagnosis and treatment of alcohol and other substance abuse disorders. While my focus has been mainly on alcohol use disorders, much of what is known about the neuroscience of addiction is applicable to many, if not all, substances of abuse. I have seen the ravages of these diseases, including death, but I more commonly see the milder forms of these diseases that make people's lives just plain miserable and/or less enjoyable or productive than they would have been without their addiction. One cannot talk to the many hundreds of these individuals, as I have done, without coming away from that cumulative experience believing that alcohol, like other addicting substances, changes the way the brain functions. For non-clinicians, and especially for non-psychiatrists, these changes may not be obvious or believable — partly because without a solid education in how the brain works and how it relates to mood and behavior, one cannot appreciate that; just like the heart, liver, pancreas, kidney etc., the brain can malfunction in subtle ways. This malfunction, or in technical terms "pathology," can make the individual not behave normally in relationship to their choice to use or not use an addictive substance.

Therefore, my education and experience have formed my bias, if you want to call it such, that addiction is a brain disease. However, I also understand that one cannot become addicted to a substance unless one has both access to, and experience with, that substance. Consequently, there are personal and cultural aspects to all addictions. I also realize from a logical and practical perspective that "will-power" to use or avoid a particular substance changes over time during continued use. Control over the desire to use or not use a particular substance is not a static process, but varies with each substance and is set in cultural

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and economic expectations. Our collective obligations (e.g., laws, health coverage, work accommodation, etc.) towards those who use, abuse, and become addicted to substances become, out of necessity, a cultural debate not dissimilar to the overall health care debate now engulfing our country. Ultimately, a rational compromise as to what is appropriate, affordable, and can be practically delivered needs to be achieved. As Dr. Alan Leshner (a former Director of the National Institute of Drug Abuse) aptly wrote, "Addiction is both a public health and a public safety issue, not one or the other."[1] The body of this article will focus on the definition of addiction with an emphasis on why most scientists and addiction specialists believe it is a disease of the brain. Since I am the most familiar with alcohol dependence and have personally added to the science of alcohol use disorders and craving, that will be the focus of this paper.

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The Problem

One would be hard pressed to find anyone in the United States who does not believe that alcohol and drug misuse and dependence is a national problem. It has been the focus of much news, policy debate, health care expenditures, legal issues, mortality, personal suffering, and social unrest for many years. However, as the previous laundry list implies, it is not just one problem but many problems. Also, there are education problems related to general appreciation of how the brain works, a lack of understanding that alcohol and drugs actually do work on the brain, and a lack of general awareness of the health dangers associated with heavy alcohol and drug use not directly related to the substances (e.g., HIV infections, hepatitis, sexually transmitted diseases). There are problems of limited resources in the health care system, criminal justice system, social services, and in the military (during and after service). There is not enough money or facilities to incarcerate, treat, prevent, and accommodate those with disease related to alcohol and substance use. So, the "problem" is multi-faceted and can be seen differently by different people. However, the root cause of all of these "problems" is simply that individuals behave differently when they use substances and even more differently when they become addicted to them. It is easy to stand back and imply that we would not have these "problems" if people would "just say no" and not use potentially addictive substances. While that is an easy answer and an important public health message, the fact is that some substances, like alcohol, are legal substances that you can buy "over the counter," that are marketed and enjoy high social status. Other substances are widely available in our culture and have accepted uses, such as pain-killers, sleeping and anxiety aides, and stimulants. Others, such as cocaine, are so widely available, especially in certain American subcultures, that they present social opportunities with great economic and social support. As a result, just saying "no" is not always a realistic or expected response.

While many substances cause immediate problems when ingested, like driving while intoxicated, the bigger and most challenging problem occurs when substances become chronically ingested with increasing amounts over time, leading to an "addiction." The remainder of this paper will describe the epidemiology of alcohol use, why some people transition from use into abuse and dependence, and what might be done about it. Finally, some comments will be made about the role of motivation or free will in this process.

History and Epidemiology of Alcohol/Drug Use, Abuse, and Dependence

While alcohol (and many other drugs for that matter) have been around for centuries or even millennia, the first significant, credible commentary on alcohol dependence in the United States was offered by the great American physician and signer of the Declaration of Independence, Dr. Benjamin Rush (1745-1813), who penned "habitual drunkenness should be regarded not as a bad habit but as a disease…habitual drunkenness is a palsy of the will."[2] Dr. Rush could not have possibly known about the brain mechanisms behind this enlightened insight, but nonetheless, early in our history the medical profession was aware that alcohol dependence (addiction) was something different than casual use. Problems caused by alcohol led to

the temperance movement in this country in the early part of the 20th century and to prohibition which, as we know, was a short-lived phenomenon. The problem with a concept like prohibition is that most alcohol consumers do not become dependent or addicted to it. While almost 63% of Americans age 18 and older have had at least one drink in the past year,[3] only 8.5% have experienced alcohol use disorders within that time.[4] However, 30.3% of Americans can be categorized as having alcohol abuse or dependence over the course of their lifetimes.[5] This compares to U.S. population rates of illicit use of marijuana (10%), pain relievers (5%), cocaine (2.5%), tranquilizers (2%), hallucinogens (1.6%), stimulants (1.4%), and heroin (0.2%).[6] It is clear that despite the amount of time and money spent on the "cocaine or methamphetamine epidemic," alcohol use disorders are far and away the most prevalent and costly substance abuse "problems" in the United States. Alcohol-related problems cause the U.S. economy $183 billion dollars a year (other substances $67 billion) in lost wages, medical expenses, loss of property, and accidents.[7] Alcohol consumption is among the top 10 leading causes of disability[8] and is the 3rd leading cause of potentially preventable cause of death right behind tobacco use and poor diet/inactivity.[9] The recognition of the debilitating nature of these illnesses has led almost every major medical society and federal government agencies to recognize alcohol and other substance dependence as diseases. In fact, it is hard to believe that anyone in the 21st century would currently believe that as addictions, alcohol or substance dependence is a "failing of character and will." However, it should be acknowledged that addiction does not develop quickly in most cases; there are times in the development of an addiction where the individual can, and perhaps should, exert some control over its development and once present might be expected to seek treatment. In that light, let us examine some more epidemiology underlying alcohol dependence.

Among youth (aged 12-20), 21% of males and 16% of females report binge drinking within the last month.[10] The peak prevalence of meeting alcohol abuse and dependence criteria over a 12-month period (18%) is between the age of 18 and 24 and then comes down abruptly, leveling off at about 4-6% between ages 30-50.[11] I and many others believe that although the young adult population meets criteria for alcohol abuse and dependence, youthful drinking constitutes more of a binge drinking pattern, i.e., too much, too fast (4-5 drinks in two hours), while those that truly become dependent/addicted are those who transform into a pattern of heavy drinking whereby they drink too much, too often (4-5 drinks per day on more than half of the days). Individuals tend to enter treatment for alcohol related problems between ages 35-45, when they are drinking often 8 or more drinks per day on 70% or more days, almost 10-20 years after they first begin to drink heavily. Therefore, for many this is a slowly developing illness. We now know that during those years of increasingly heavy alcohol consumption that the brain is slowly, but methodically, changed by this drinking behavior. We also know that irrespective of whether an individual meets criteria for alcohol abuse or dependence, that heavy drinking in its own right leads to considerable health problems. Heavy binge drinking is associated with unintentional death, homicides, assaults, suicides, and domestic violence.[12] Chronic heavy drinking is a factor that leads to increased risk for hypertension, liver cirrhosis, heart disease, stroke, and cancer.[13] So even though individuals might not meet criteria for alcohol dependence, there are many diseases caused, or exacerbated, by heavy alcohol use. The same could be said about the various sexual diseases, hepatitis, infections, and other medical conditions associated with the chronic use of other substances.

Brains of alcohol-addicted individuals respond strongly to the rewarding/reinforcing effects of alcohol and that, similar to animals, there is likely to be a different chemistry in the brain in those brain areas with the prime suspect being dopamine activation.

So despite debate about the level of individual responsibility in the initial and chronic use of alcohol and substances, we have to recognize that "the problem" is a significant one, and platitudes will not change the reality of the situation. The best we can do is try to better understand the phenomena in order to prevent or treat it. One level of evaluation is to better understand why people use alcohol and drugs to begin with, and then how and why they might transition into an addiction.

Why People Use Drugs and Some Cannot Stop!

There have been an abundance of theories over the years as to why people use substances that in the short or long run are not good for them or the people around

them. The two most cogent modern biological theories based on hard science are the reward/reinforcement theory[14] and the stress-reduction theory.[15] The former posits that all substances of abuse share several things in common: they make people feel good (perhaps some more than others), and susceptible individuals want more (i.e., drugs are reinforcing, a behavioral term that essentially means that an environmental event, or drug in this case, is so favorably perceived that there is a motivation by the individual to seek it out again and again). The stress-reduction theory posits that the normal stress of every day life (job, marriage, money) as well as abnormal stress of severe events (rape, assault, war, accidents) can be relieved by the use of a substance, and that this relief in and of itself is rewarding, causing the individual to seek out the substance again and again to provide relief of the stress. Modern neuroscience has studied abused substances in animals (that easily learn to drink alcohol or to self-administer opiates and other stimulants) finding that all abused substances elevate a brain neurotransmitter called dopamine in the nucleus accumbens, a dime-sized area of the brain dubbed the "pleasure-center." It is also known that after repeated use of these substances, not only the substance itself but also the environmental "cues" associated with the substance (site and smell of alcohol or needles, etc.), will also increase dopamine in the nucleus accumbens. There have been many experiments done in various animal species that support these findings. In essence, the animal and by extension the human, with continued use of reinforcing substances will "sensitize" to the rewarding/reinforcing effects of these substances quite out of their conscious or willful awareness that this is happening. This pure biological phenomenon might be prevented initially through various external means, but once far enough along, it is hard to reverse. In fact, in animals there appears to be a long-term memory of the reinforcing nature of rewarding substances. This means, once this sensitization occurs, the brain might be changed for life.

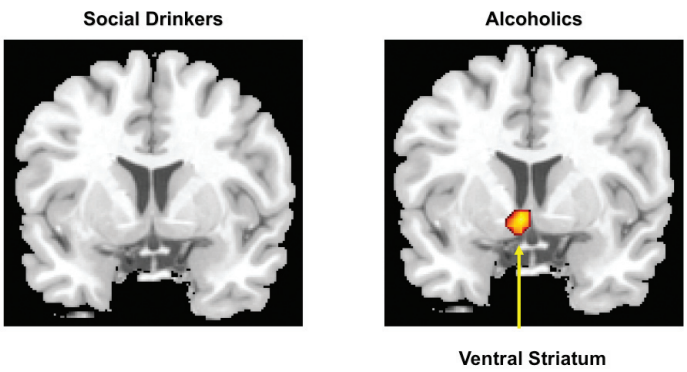
The clinical meaning of this phenomenon is that a person could never go back to controlled use of the substance, and perhaps related substances. A prime example of this is a smoker (nicotine powerfully increases dopamine in the nucleus accumbens) who quits, only to relapse many years later without any conscious thought of doing so. In the human, this phenomenon has been studied using modern brain imaging technology. For instance, we have used functional brain imaging, a technique that can measure second by second changes in nerve cell activation in small brain regions using magnetic resonance imaging techniques (fMRI). This is a well-accepted technique for evaluating how the brain is functioning in fully awake and conscious humans. We have utilized this in alcoholics and many others have done similar studies in cocaine, methamphetamine, nicotine, and opiate addicts.[16] In our studies, we give social drinkers and mildly alcohol dependent individuals a taste of alcohol and then show them pictures of alcoholic beverages or non-alcoholic beverages and compare the differences in brain nerve cell activation. We found that alcoholics show an increased brain activity in the nucleus accumbens (the pleasure center) when viewing alcohol pictures but not when viewing non-alcoholic beverage pictures.[17] Social drinkers do not show any differential activation when viewing alcoholic beverages or non-alcoholic beverages (see Figure 1). We also showed that the urge to drink reported after viewing the pictures was related to the magnitude of the activation in the nucleus accumbens and several other areas of the brain that remember the past experiences of alcohol use. The interpretation of this work is that brains of alcohol-addicted individuals respond strongly to the rewarding/reinforcing effects of alcohol and that, similar to animals, there is likely to be a different chemistry in the brain in those brain areas with the prime suspect being dopamine activation.

Others have postulated that chronic and excessive use of substances that elevate dopamine in pleasure centers will leave this important neurotransmitter deficient when the substance use is stopped (e.g., dur-

Figure 1

Cross Section of Brains of Socal Drinkers and Alcoholics Undergoing Functional Magnetic Brain Imaging While Viewing Pictures of Alcohol After a Sip of Alcohol

Areas of brain cell activation are highlighted in color with yellow showing the highest cell activity. Social drinkers had no activation of brain cells while alcoholics showed increase activation in the ventral striatum (sometimes deemed the "pleasure center of the brain") as they viewed satient alcohol pictures. Adapted from H. Myrick et al., Archives of General Psychiatry *65, no. 4 (2008): 466-475.*



ing attempts at abstinence), and that deficiency might underlie the craving to use the substance once again — i.e., to feel "normal." Work done utilizing a second powerful brain imaging tool called Positron Emission Tomography (PET scanning), which measures the binding of a dopamine-like drug to its receptors, has shown differences in the dopamine system between non-drug abusing volunteers compared to those who chronically used cocaine, methamphetamine, heroin, or alcohol.[18] It has been hypothesized based on this work and other experiments done with humans and animals,[19] that these changes in the dopamine system lead to changes in other areas of the brain dealing with evaluation of saliency and motivation that in turn lead to craving and a loss of control over the use of substances, while substituting the reward of substances for the natural rewards of daily living (love, food, sex, money, etc.). The net result of this brain pathology is a "hijacking" by alcohol and drugs of the normal hedonic (pleasure generating) response to life, leading to a compulsive desire to use alcohol or drugs. Since much of this "addiction pathology" occurs in more primitive areas of the brain out of conscious awareness (which is normally centered in higher brain regions of the cortex), it is generally accepted that much of this compulsive urge/craving to use drugs is out of conscious awareness. It is the goal of treatment to either suppress this compulsive urge/craving to use a substance with a medication, that is not itself addictive, and/or to bring this compulsive urge into conscious awareness so modifications can be made.[20]

The second major theory is the stress-reduction theory of substance abuse. This is similar to the colloquial idea that "people use drugs to escape from their problems." It is becoming increasingly clear that some individuals are genetically and developmentally more sensitive and prone to "stress." Recent evidence suggests that childhood trauma (physical/sexual abuse, accidents, war, and perhaps poverty in general) makes people less resilient to stress and more prone to stressful reactions as adults.[21] These individuals and other adults who did not experience stressful events as children but who have significant and or repeated stress as adults are at higher risk for substance abuse.[22] A recent, stark example of this is the increased rates of binge drinking and alcohol problems in those soldiers with the greatest combat exposure in Iraq.[23] In these individuals, brain active substances might be experienced as being more pleasurable against a background of "emotional pain," or in the case of sedatives or alcohol might actually cause acute lifting of depression, reduction of anxiety and intrusive memories, and initial improvement of sleep. However, these initial reactions are just a sirens-song since, upon continued use, the substances are likely to increase stress and to cause the exact symptoms that they are initially meant to reduce. Consequently, under this scenario the brain is abnormal to begin with (either through genetics or experience), and substance use is an attempt at normalization but can lead to increasing cycles of use, dysphoria, social stress, more use, and ultimately physical and psychological dependence.

Alcohol, possibly more than any other substance, causes brain toxicity at a much more gross/non-specific level. Possibly because alcohol disrupts brain cell membranes and growth, and possibly because it causes liver toxicity leading to a buildup of toxic chemicals in the brain as well as a reduction in essential vitamins and minerals, there is measurable brain tissue loss with chronic alcohol use. It has been shown that chronic alcoholics have a loss of grey matter (neuronal cell loss) in many areas of the brain that are associated with abnormalities observed in memory, special function, and judgment.[24] What this means clinically is that alcoholics drinking at a certain level may not think clearly, and deficits in the frontal lobe area of the brain might lead to the inability to recognize the effect that drinking is having on their lives (often referred to clinically as "denial"). Historically and to some extent currently, "denial" is viewed by some as a willful or semiconscious attempt to avoid abstinence, social stigma, and economic and social consequences. However, a more enlightened view might include the actual brain damage caused by alcohol (as detailed above) as being one factor underlying the inability to judge the seriousness of alcohol consequences on one's life and functioning. Additionally, these individuals may lack the motivation and/or will to stop drinking. This is why for some severe or susceptible alcohol dependent individuals, the only way the brain can recover enough function to fight the disease is to be free of alcohol for a protracted period of time, sometimes requiring a long hospitalization/rehab stay. In an eye-opening development, recent evidence also suggests that the adolescent brain, one that is continuously maturing and molding at the cellular level, might be even more sensitive to the "toxic effects" of alcohol.[25]

The bottom line for alcohol is that it can cause a number of brain abnormalities. As discussed above, it can "hijack" the normal motivational system,[26] cause poor judgment and reduce inhibition of response in the normal "watch dog" areas of the brain,[27] and lead to addiction through attempts at stress reduction.[28] The net result is a loss of control over substance use and a need, in more severe cases, for external intervention. Of course, individuals that use both alcohol and other substances, such as cocaine or heroin, are even more vulnerable to these effects.[29] Also, the use of alcohol

by individuals with other psychiatric conditions that affect the brain, such as schizophrenia and bipolar illness, can lead to the need for more clinical services and complicate the treatment of both illnesses.[30]

Why Are Some People at Risk — Is It in the Genes?

One would have to live on Mars not to realize that we are living in a new era of the human genome. Just as we will never have life again without computers, science and medicine will never exist again without knowledge of human genetic structure. Just as television, radio, satellites, and oral contraception are parts of our everyday life, we will soon be living with the knowledge of how our individual genetic makeup will make us prone to certain diseases and not others. We will be making important decisions based on this information: what to eat, where to live, whom to marry! While we are still in the early stages of this revolution, some things about genetics, heritability, and addictive disorders, especially alcohol dependence, are already known. While we know that somewhere between 40-60% of alcohol dependence is inherited, particularly in males, we do not know exactly which genes or set of genes increase the risk.[31] We also do not know as much as we should about how a drink of alcohol effects people with various genetic differences. One hint is that individuals who have different genes making liver enzymes that break down alcohol such as "alcohol dehydrogenase (ADH)" and "acetaldyde dehydrogenase (ALDH)" have different risks for developing alcoholism.[32] However, these differences occur in a small number of people and might be racially/ethnically different. For the most part, it is believed that differences in genes that code for brain chemicals and their receptors underlie how alcohol affects individuals differently. A growing number of large population studies suggests that the genetic differences in some brain neurotransmitter systems involved with the brain pleasure circuit might be associated with higher risk of excessive drinking and addiction. Also, genetic differences in stress response[33] might put people at higher risk of excessive drinking. The latter is an example of a gene by environment interaction, and the study of how environmental events (i.e., severe stress or even the use of substances) might alter genetic function, a field called epigenetics, is a hot area of research interest. Whether it is heredity (the genes we are born with) or an interaction between these genes and environmental events and/or between genes and substances themselves, there is no doubt that the genetic brain differences are likely to be at the root cause of addiction.

In an initial attempt to better understand the relationships between specific genetic differences and response to alcohol and its treatment, our group and others have been evaluating a specific genetic difference in the brain receptor for opioids (synthetic opioids include morphine, heroin, oxycontin). The brain manufactures opioid-like compounds, i.e., proteins called enkephalins and beta-endorphins, that have been related to "runners high" and also likely to modulate both physical and perhaps emotional pain. These opioid-like compounds work by binding to receptors on specific brain cells, a number of which are located in the brain pleasure centers. It was discovered a few years ago that individual genetic differences lead to small changes in the protein structure of these receptors, rendering them more sensitive to these opioid-like compounds. It has been known for awhile that alcohol releases these opioid compounds from brain cells, and it is thought that alcohol-induced euphoria or reinforcement might be related to this release. This might be at the root of the colloquial statement of a heavy drinker that "s(he) is feeling no pain." A few recent studies in humans have shown that some individuals (about 20-30% of Caucasians) who have a single change in one amino acid of the brain opioid receptor have a greater response to alcohol than those who do not have this inherited difference. Importantly, it has been shown that blockade of this receptor by a Food and Drug Administration (FDA)-approved drug for alcoholism called naltrexone works better in the 20-30% of Caucasians with this genetic difference compared to those 70-80% of those that do not have this genetic difference.[34] Recently, we also discovered that naltrexone will block the activation in the brain pleasure center of alcoholics caused by tasting alco-

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hol and viewing pictures of alcohol.[35] We are currently studying if the specific opioid receptor genetic difference, mentioned above, will also affect the ability of naltrexone to alter brain activation to alcohol cues in alcoholics. If this crucial link can be made, the evidence for the brain-opioid system's involvement in alcohol effects will be strengthened. Furthermore, an individualized pharmacogenomic approach to treatment for alcohol dependence will be solidified. This is only one example of many alcohol and drug genetic interactions being currently investigated.

Is Treatment Effective?

A large amount of literature exists on the treatment effectiveness for many addictions, and there is not enough room in this article to do this topic justice. The American Psychiatric Association has published expert guidelines for the treatment of addictions based on a thorough evaluation of published studies.[36] One might ask that if addiction is a "willful" choice, then why don't substance-using individuals simply just stop using? That is a reasonable question. Some data suggest that within the general population there are a number of people who can modify alcohol use or quit on their own,[37] usually associated with certain life events (marriage, completing school, and parenthood) and/or greater social stability and less severe and co-morbid substance abuse. However, many other addicted individuals (especially those seeking treatment) can only stop for a short time (days or weeks). In fact, to paraphrase Mark Twain, "It is easy to stop smoking; I have done it hundreds of times." Statistically, much less than 10% of smokers can stop and remain smoke free for a year without treatment. Individuals with alcohol dependence are equally unsuccessful. Despite receiving the best treatments, 70-80% of them will relapse to some drinking and 40-60% to heavy drinking in the year after treatment. The rates for cocaine and heroin are equally high or higher. It stretches the imagination that individuals will spend weeks, months, and years of their lives seeking help and spending enormous resources on various treatment approaches if they can "just stop on their own." In the meantime they lose their jobs, their homes, and their families. Is this because they lack the "will" to stop? Not likely. It is because their brains were either vulnerable to the addiction or have been affected by the substance (as detailed above) to an extent that they do not have complete control over their destiny. In fact, it is a central tenant of Alcoholics Anonymous (AA) that alcoholics lack the power over their addiction and their lives.

To be sure, the amount of treatment and its nature might differ markedly between a young person who is drinking too much or who just started using cocaine, compared to an older adult who has been drinking daily and heavily for 15-20 years and/or also using cocaine daily. For alcohol it takes about 10-20 years of increasingly heavy and continuous use for individuals to seek treatment, usually after several attempts to cut-down or quit on their own. A few lucky people are successful in stopping on their own, but the vast majority needs some form of treatment. Early in a person's drinking history, education-based approaches (primary and secondary prevention) utilizing statistics and motivational attempts to get individuals to recognize the current and potential harm (physical and social) to themselves and others have a good chance of working, in essence building their resistance factors or "strengthening their free-will" and ability to make rational choices. Also early on, the risk of becoming a more severely addicted individual caused by genes and culture has a better chance of being overcome with education and support (see Figure 2). However, later on, when brain adaptation (addiction) becomes more firmly rooted, the person's genetic makeup and environment/culture encapsulate his or her free-will, leading to many repeated and failed attempts of cutting down and/or quitting. Once addiction sets in, motivation and free-will are not strong enough to overcome biology and environmental support for substance use. It is at this stage that greater intervention is needed to allow free-will to escape its bondage and to become fortified, thus allowing the addicted individual a fighting chance at success. At this stage of addiction or dependency, the options range from inpatient or rehabilitation stays to outpatient intensive counseling using cognitive behavioral, AA, or group therapy techniques, to the use of medications to reduce craving and prevent relapse.[38] Recently, with the increasing knowledge of brain-changes related to addiction, there has been a larger focus on the use of medications to reverse these changes. It has become recognized that "talk therapy" can only do so much to alter the addicted brain. Scientists think that it takes a long time for brain neurochemistry to return to normal, if ever. Both animal and clinical studies suggest that vulnerability to relapse is long lasting. Some make a strong case for addiction as a chronic lifelong illness[39] not dissimilar to hypertension, asthma, and diabetes. In this context, various treatments might be utilized over time with medications playing a more prominent role in the more severe and intractable cases. Medications have been approved by the FDA for the treatment of alcoholism based on solid clinical trials and new medications are showing promise (for brief review see Miller 2008).[40] While no medications have been approved for cocaine at this time, brain targets are

Figure 2a

Developmental Model of the Role of Free Will in Addiction

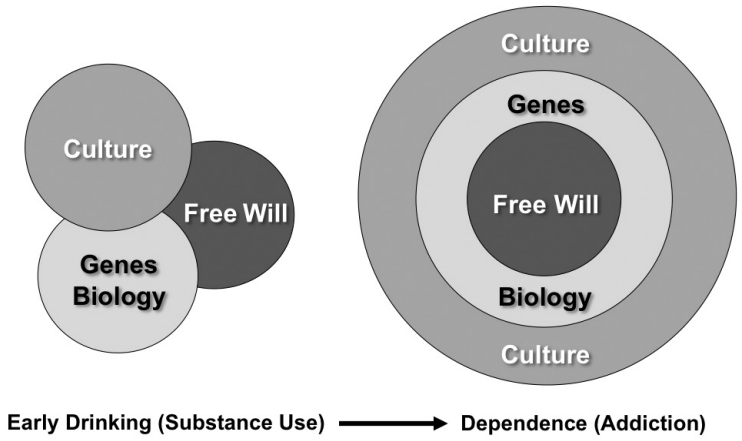
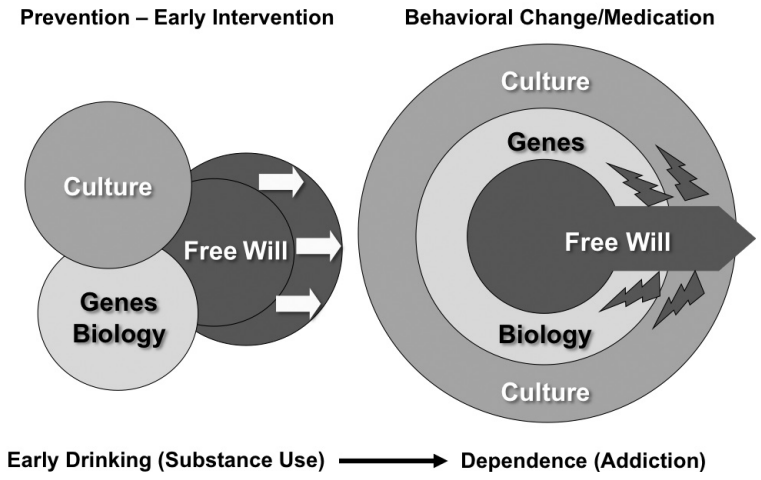


Figure 2b

Treatment Model to Utilize Free Will



increasing,[41] and a number of clinical trials have been completed including ones using a cocaine vaccine.[42] Active work is also ongoing on medications to treat methamphetamine addiction, a particularly devastating and intractable problem.[43] There are medications already FDA approved, and likely more on the way, to treat opiate dependence[44] and nicotine dependence.[45] It should be noted that all of these medications work on the brain, again emphasizing the knowledge base that supports addiction is a brain disease.

Why Should We Care? Costs and Benefits of Detection and Treatment

Here is a sobering fact! Alcohol use disorders cost American society $185 billion per year due to loss of life and property, reduced productivity, and health care expenses. Health care costs to employers for each person with an alcohol use disorder are twice as high as those without these problems,[46] and each substance-abusing employee costs his or her employer $640 as of 1999.[47] Controlled scientific studies have indicated that treatment for alcoholism in general,[48] in primary care practice,[49] in emergency rooms,[50] and in trauma centers[51] are all cost effective and lead to reduced health care utilization and expenditures. This and other observational data has led many businesses to offer employee assistance programs (EAP) with a large focus on the prevention, identification, and treatment of alcohol and other substance use disorders.[52] Under vigorous scrutiny, worksite interventions and EAP programs focusing on alcohol use disorders have been shown to be effective and cost saving over time.[53] So whether we call problem-drinking or substance abuse diseases or not, the identification and treatment of these conditions during routine clinical care and in the work place are likely to have major benefits to the individual, to businesses, and to the general well-being of society. This principle has recently been recognized in several ways. First, a new CPT code has been approved by which physicians can be reimbursed for alcohol screening and intervention as a part of routine clinical practice. Second, Congress has recently passed "Mental Health and Substance Abuse Parity Legislation" that guarantees parity of insurance coverage for alcohol use disorders and substance dependence in line with coverage for other medical conditions. To delve further into many of the topics in the previous discussion, you can visit <www.ensuringsolutions.org>.

It is a well-documented fact that the number of individuals in our prisons and jails who have diagnosable alcohol and substance abuse disorders is large and staggering.[54] Recently, the increasing use of both treatment interventions while in prison and the use of drug-treatment courts to help keep individuals out of jail seem to be paying off.[55] There are attempts to refine this concept by evaluating which individuals might benefit most from community-based treatment as an alternative to incarceration.[56]

Summary

Perhaps, it is a function of our advanced and enlightened society that there is a growing awareness of the ravages of alcohol use disorders and substance addiction on individuals, their families, and our culture in general. Perhaps, it is the recognition that our prisons and jails cannot endlessly expand to hold individuals whose primary crime is the use, or distribution of, illegal substances and/or violence secondary to alcohol and substance use. Perhaps, it is the expanding knowledge of the neuroscience of addiction that enlightens us about how alcohol and drugs affect the brain which in turn may lead to continued and uncontrolled use (especially in those who are genetically or environmentally at risk). Or perhaps, it is an economic awareness, that by not preventing, identifying, and treating alcohol and substance abuse disorders, we are worse off as a nation than by doing these things. And just maybe, and hopefully, the stigma of alcohol and substance dependence has lessened (perhaps because of all of the above), to the point where as a culture we can be compassionate about these diseases in the same way we have compassion for the cancer victim, the person with diabetes, and those with asthma, heart disease, and more recently depression, diseases of which many have behavioral components but are rooted in biology as well. It is only when we apply an enlightened approach to these problems that they will truly be solved, and the debate as to whether, and more importantly when, "alcohol and substance use becomes an addiction" can be laid to rest. The challenge ahead lies in gaining more knowledge and in better applying the knowledge that currently exists. It appears that in the private sector this is already happening. Slowly, but surely, it will also happen in the public sector as well. The increasing prevalence of Employee Assistance Programs (private sector) and Drug Courts (public sector) highlights this issue.

Note

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