

# A General Overview on How Brain Mechanisms, Environmental Factors, and Personality Traits Affect the Development of Drug Addiction and Substance Abuse

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**Abstract.** It is currently recognized that drug addiction is a brain disease brought on by substance usage, which modifies the biochemistry and structure of the brain and has multifaceted behavioral repercussions on those who abuse drugs. This article aims to discuss the biological, environmental, and personality factors that contribute to drug addiction by overviewing the brain mechanisms behind initial motivation and subsequent reinforcement of persistent drug use, as well as how environmental variables and personal traits affect individuals experimenting with drugs. Early drug addiction can be attributed to an innate reward circuit called the mesolimbic pathway. While subsequent craving is sustained by synaptic plasticity in the mesocorticolimbic dopamine system. Trauma histories, social norms and social networks, and early drug exposure due to family members' experiences with drug use can all serve as triggers for drug use. However, under specific conditions, some of these variables can also have the reverse effect, averting substance usage in the first place. Studies have found a correlation between drug abuse and personality disorders, and there are shared characteristics in the personalities of addicts, it is still impractical to say for sure whether a particular personality disorder is a root cause of drug addiction, and more research needs to be done.

## 1 Introduction

It is currently recognized that addiction is a brain disease brought on by chronic drug use, which modifies the biochemistry, morphology, and function of neurons. It is believed that the addiction process is mostly influenced by three factors: genetics, environment, and—most importantly—the complex and enigmatic relationships between the two. Yet, studies of brain function are providing a wealth of important information. The greatest opportunity for a long-term solution to addiction has seemed to lie in understanding what happens in the brain when a drug is taken in, injected, or inhaled, why it causes obsessive drug seeking, and how to interfere with that process. Increased instances of violence and their repercussions on families, communities, and social structures have been linked to persistent mental health issues in children, according to a wealth of studies. While narcotics have been the "center of gravity" of Colombia's civil strife for decades, according to the United Nations Development Program, the country's death toll from drug-related violence has risen to over 100,000 since 2006 [1]. In such drug-related violence, thousands of children and young people have died, thousands have been injured, and tens of thousands have parted with their parents [1]. This article will be looking at the biological mechanism, contextual variables, and

personality traits that might contribute to the initiation and development of drug addiction.

## 2 Addiction, the reward circuit, and the brain

It is oversimplified to believe that the enjoyable effects of drugs, as portrayed in movies and other media, are the main driving force behind chronic drug use. On the other hand, obsessive drug users frequently claim that they no longer find it enjoyable to use drugs [1]. There are various problems with the widely held notion that drug users become addicted because they seek to avoid encountering withdrawal symptoms. First of all, it doesn't explain the rationale behind drug usage until addiction takes hold since it typically takes multiple attempts before an individual's casual drug use turns into an obsessive problem [1]. Secondly, it fails to explain the significant proportion of drug abusers who relapse after extended periods of abstinence or after their first episode of withdrawal symptoms [1]. Thirdly, and this is rather unexpected, scientists have discovered that a drug's addictiveness has nothing to do with how severe its withdrawal symptoms are [1]. Cocaine, for example, causes intense addiction but only minor withdrawal symptoms, whereas a variety of substances, such as certain inhalers for asthma, nasal decongestants, and

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hypertension medications, cause withdrawal symptoms but do not trigger addiction [1].

The methodology mainly involves reviewing the literature. The researchers explain what motivates early drug use by elaborating on the innate reward circuit. One of the most significant reward circuits, the mesolimbic pathway consists of dopaminergic neurons that commence in the ventral tegmental area (VTA) and link to the nucleus accumbens (NAc) as well as other locations [2,3]. PET investigations on humans have demonstrated that DA levels in the dorsal and ventral striatum, which house NAc, are elevated by a number of substances, including stimulants, nicotine, alcohol, and marijuana. D2 receptors (D2Rs), a radioactive material that binds to DA, were used in these investigations. Researchers can quantify the reduction in D2R resulting from drug inhalation, which is related to an increase in DA, by comparing binding after placebo and after the drug [1]. Early drug use is primarily motivated by rewards, but addiction entails structural and functional alterations in the brain that continue long after the drugs have left the body and the user has stopped using them [4]. The bigger area where these changes occur is called the mesocorticolimbic dopamine system, and it consists of the ventral tegmental area as well as the brain regions that receive its dopaminergic projections, like the hippocampus, nucleus accumbens, prefrontal cortex, and amygdala [5].

All addictive substances enhance dopaminergic activity in the NAc by targeting the mesolimbic dopamine pathway. Food, drink, and sexual activity are examples of natural reinforcers that stimulate dopaminergic inputs to the NAc [4]. Nonetheless, drug abusers have a substantial decrease in dopamine D2 receptors and DA release during withdrawal. With a small percentage of the brain scan highlighted in yellow and red, indicating a dearth of dopamine D2 receptors in the NAc, this trend is particularly notable in the Meth Group [6]. In the VTA, glutamate- and dopamine-releasing neurons have stronger connections after even a single dose of addictive medications. Potentiation in the VTA causes longer-lasting alterations in the brain, such as longer dendrites and more complex synapses in the nucleus accumbens and prefrontal cortex, with continued drug usage [6].

Many experts see addiction as a learning phenomenon because of the structural plasticity of addiction and the involvement of dopamine and glutamate, which are similar to changes that occur during learning [7]. Cravings are a prime example of this, as they can endure for years on end even after years of sobriety. One fascinating aspect of craving is that it gradually intensifies throughout the initial weeks or months of drug abstinence; this is known as the "incubation of craving." The potentiation of "silent" synapses that have grown throughout the course of addiction in glutamatergic pathways from the prefrontal cortex and the amygdala to the nucleus accumbens is a good example of drug-induced plasticity [8]. Although the postsynaptic side of the synapses lacks the required receptors, they are nevertheless able to release glutamate; after withdrawal, the synapses develop and become

functional. When drug-related cues are presented to cocaine addicts, the unsilencing of these pathways results in craving. An addict's typically low brain metabolism turns hyperactive in areas involved in learning and emotion once they encounter stimuli related to drugs [7].

### 3 Environmental factors and addiction

#### 3.1 Drug addiction and families

Early life experiences are thought to have a significant influence on addiction-related behavior. An individual may adopt healthy outlets in an enjoyable household or maladaptive obsessions in the face of adversity, depending on family dynamics and parenting styles. One may wonder what would happen to the children when their lives are so intricately linked to the drug environments that their parents and siblings live in. Specifically, are these kids more likely to become drug addicts themselves?

Interviews with 36 kids and adolescents in the 'Growing up in a drug-dependent household' study and with 24 drug-addled siblings and 20 siblings in the JRF research 'Drugs in the family' provided the source of the data [9]. In the second study, half of the siblings who were using drugs were interviewed for the study reported having a brother or sister who was using drugs either now or in the past. In three of these families, several siblings had been seriously involved in drug use. A minority (10/36) of the participants in the previous study indicated the development of personal drug-related issues [9]. A significant disclaimer, nevertheless, relates to the disparities in average ages between the samples: siblings in the second study had an average age of 19 years (range 13–23 years), while children and young adults in the first study had an average age of 14.8 years (range 8–22 years). Given that drug issues are most likely to arise from mid-adolescence onwards, age is undoubtedly a factor. Age will play a role in some of the disparities in the two samples' relative absorption of illegal drugs [9].

The primary trigger for drug use kicking off is exposure to drugs; however, there is a difference between deliberate drug exposure by a parent or sibling and routine drug exposure as drugs are a part of their daily lives. The results of this study confirm the literature's identification of role modeling and advocacy as potentially significant factors in the onset of drug use by siblings [9]. The onset of drug use can result from both intentional and habitual drug exposure. When one or both parents were consumed by their own alcohol or drug issues, there was an additional dynamic at play, which might amplify the detrimental effects on older kids [10,11]. Although typically to a lesser extent, the siblings of problem drug users also frequently reported being introduced to drugs. Almost every sibling who had a drug issue admitted that their brother or sister had been somewhat exposed to their drug use. This meant, at least, observing how drug use affected siblings' conducts, but it more frequently involved having seen drugs, the

accessories used to use them and frequently even having been there when drugs were being used. Due to efforts at concealment, exclusion from the family home, and tight enforcement of rules against drug use while in the house, a mere five of the problem drug-using siblings in Barnard's study stated that none of their siblings had witnessed drugs or drug usage [9]. But just as with drug usage by parents, this proved challenging to maintain. Deliberate exposure refers to situations where drugs or their effects are purposefully presented to siblings, and where the usage of the drugs is intentionally encouraged. Given that drugs are made readily available by reliable familiars, circumstances in which siblings are willfully supplied drugs by their own family members—often in the context of the home—have to be viewed as having a high risk of promoting drug take place. But the startling discovery was that, in several instances, it was meant to have the reverse effect on the probability that a sibling would experiment with narcotics like heroin [9]. Learning from the experience of living with a problematic drug-using family member had a greater impact on drug prevention than the didactic role that some parents and siblings took on when counseling against drugs. These kids and young adults were determined never to use drugs since they witnessed what a devastating impact drug usage had on their family members [9].

### 3.2 Trauma and stressors

A wide range of clinical settings and populations have demonstrated that substance use disorders (SUDs) and various psychological disorders frequently co-occur. Among those who are dual-diagnosed, posttraumatic stress disorders (PTSD) are commonly observed [12]. The study conducted by Tate et al. looked at the correlation between Axis I psychiatric diagnosis and the context of the first post-treatment drug use episodes and 1-year treatment results among substance abusers. As a result, among SUD-PSY patients, negative emotional states were more often present before post-treatment use episodes. While most SUD individuals indicated interpersonal antecedents, most SUD-PSY individuals reported intrapersonal/environmental antecedents [12]. The SUD-PSY group was more likely to relapse into substance use than SUD adults without an Axis I psychiatric diagnosis. Especially when relapsing alone, participants consumed over twice as much alcohol as those who did so with others, suggesting that trauma-exposed individuals should be targeted for intervention in those contexts [12]. Here, symptoms associated with PTSD may serve as a prompt to initiate relapse.

Post-traumatic stress disorder (PTSD) and addiction often co-occur, meaning that PTSD can contribute to the development of drug use disorder while addiction can exacerbate PTSD symptoms [13]. For instance, those who are abused emotionally, physically, or sexually may develop post-traumatic stress disorder (PTSD) and use alcohol or drugs as a means of self-medication. Experiences of bigotry, injustice, poverty, as well as military service, can all result in long-term stress or

trauma [13]. When trauma becomes overwhelming, the individual often has severe anxiety in reaction to stressful situations and may use substances such as alcohol or drugs to cope with the subsequent mental turmoil. Although alcohol or opioids may seem to lessen psychological anguish, the consequences might have the opposite effect and cause addiction.

People with substance use disorders (SUD) are frequently exposed to stressful events, albeit not all of them go on to become diagnosed with PTSD. Based on Tate et al.'s work, Norman et al. carried out a more thorough analysis of the association between traumatic experiences and relapse. Results of SUD treatment and indicators of relapse in three cohorts of male veterans undergoing SUD treatment were compared. The first group is referred to as "SUD-only" (n = 68), the second is referred to as "SUD-PTSD" (n = 32), and the third is identified as "SUD-trauma" (n = 34) in which participants have experienced trauma but have not developed PTSD. For a year, veterans' drug use, relapse details and mental health symptoms were evaluated on a quarterly basis [13]. The duration, frequency, or extent of relapses were identical between each group. Compared to SUD-only, SUD-PTSD and SUD-trauma patients reported higher levels of anxiety, PTSD, depression, and overall mental symptoms before relapse. In comparison to SUD-only, SUD-PTSD and SUD-trauma additionally fostered PTSD and overall symptoms after relapse [13]. These results indicate that trauma histories should be taken into account in all SUD patients, independent of PTSD diagnosis, and point to the need for dimensional as opposed to categorical evaluation of trauma exposure when it comes to relapse situations. One mechanism by which individuals with both SUD and PTSD have a worse clinical course can be understood more thoroughly by looking at relapse situations, especially for those with trauma backgrounds and PTSD.

### 3.3 Social norms and social networks

Social norms refer to the spectrum of mindsets and actions deemed appropriate within a particular social group, which are commonly interpreted in two levels. Level 1 introduces a distinction between whether the norm places more emphasis on the acts of others or their views. Level two brings about the difference between perceived and actual [14]. Two explanations are illustrated for why differences between perceived and actual norms matter as follows: First, people are influenced more by their personal opinions instead of by actual norms; Second, people who practice risky conduct often think that their actions are more prevalent than they are in fact [14]. Interventions based on cultural standards seek to dispel such myths to reduce excessive drug abuse. A variety of demographics are covered by the extensive cultural standards study on substance abuse, including minorities, university students, the homeless, and veterans. Despite the fact that social norms have become widely used in prompt interventions, there are still a few areas that merit further investigation.

Important referent groups' norms can vary, which could have special effects on behavior. Although proximal groups—like close friends—have greater influence than distal groups—like the "typical student". Current strategies for intervention have been successful in leveraging this idea to boost efficacy. For instance, Barman's study employed cross-sectional collecting methodologies to evaluate the respective effects of injunctive and descriptive norms among various referent groups on the 30-day injection, heroin, and methamphetamine use behaviors of homeless youth [15]. An intriguing phenomenon has emerged: the perception of peers who are also homeless having illicit substances has a greater impact on homeless teens' decision to experiment with narcotics than pals from before their homelessness [15].

Novel perspectives on social norms and additions can be gained from social network analysis. Being a central member of one's network and having more reciprocating ties and tightly connected networks are correlated with heavy drinking and substance use [16]. Social network analysis was used in an investigation to discover a relationship between college students' alcoholism and perceived and actual social norms around alcohol consumption. The impact of perceived norms instead of the actual norm on drinking was tempered by self-reported resistance to peer pressure [16]. A teeny core collective of 63 people, for instance, linked with 70% of the participants in a network of over 1,000 intravenous drug users [17]. While there was a fairly robust harm reduction network surrounding the sampled injectable addicts, both past and present, however, based on the network strategy, a small number of people were true "champions" of actual harm reduction [17]. Therefore, the most effective strategy to set up network interventions that promote harm reduction practices in this demographic would be to recruit a combination of strategically placed articulation points and well-connected harm reduction representatives. Unwanted behaviors can be influenced by cultural norms, especially if they are widely accepted in the community and the early years.

## 4 Addictive personalities

In their quest to understand the causes of addiction, many psychologists have turned to personality disorders for two reasons: first, environmental factors do not always fully explain vulnerability; and second, some addicts engage in multiple addictive behaviors and are addicted to multiple substances or activities [18]. One is believed to be more susceptible to substance abuse and behavioral compulsions if they have an addictive personality. Numerous characteristics are indicative of an addicted nature. Individuals who are easily agitated and require continuous stimulation may exhibit traits of an addictive personality [18]. This can involve someone acquiring an intense enthusiasm and turning it into an obsession or fixation. Underlying feelings of sadness, anxiety, and poor impulse control are the root causes of overindulging in food, sex, or narcotics.

The Munno et al's study gathered behavioral addiction data from 109 high school students in Turin, Italy, between the ages of 15 and 18. It then investigated the relationship between addictive personality traits to identify risk factors and protective factors against the emergence of behavioral addiction [19]. Three self-report questionnaires were completed by the participants in addition to a demographic questionnaire: the Multidimensional Adolescent Questionnaire (QMA), the Short-Time Questionnaire (SPQ), and the Internet Addiction Test (IAT). The statistically significant data on the correlation between IAT and SPQ sub-scale scores and QMA scores indicates an association between disinhibition, recreational drug use, and nicotine; impulsiveness, sex addiction, and disinhibition; and low drive for autonomy and aggressiveness [19]. This study points to an epidemiological indicator of this growing problem among adolescents.

The first study to look into the connections between behavioral addictions and the "big five" personality traits was conducted by Andreassen et al. Two surveys measuring seven behavioral addictions and an instrument measuring the primary aspects of the five-factor model of personality were filled out by 218 college students [20]. The seven behavioral addictions have positive correlations with one another, indicating the presence of one or more underlying pathological causes [20]. The seven behavioral addictions were shown to have personality traits that explained between 6% and 17% of the variance, according to hierarchical multiple regressions. This suggests that personality influences scores on measures of addictive behaviors to varied degrees [20].

It is evident that a wide range of addictions have commonalities, and various studies have discovered connections between personality disorders and drug addiction. However, it can be challenging to determine whether these characteristics precede or result from the addiction. There seem to be several addict subtypes within most addictions, indicating distinct routes for how and why people could develop different addictions. Certain personality features may be seen by practitioners as warning indicators. However, no personality feature can ensure someone will become addicted, and there is less evidence to support the idea that an "addictive personality" is a predictor of addiction on its own. Therefore, personality traits should be combined with contextual circumstances and the patient's biological indicators to get more comprehensive findings while investigating the causes of drug addiction and substance abuse.

## 5 Conclusion

It is essential to take into account an array of biological mechanisms, environmental circumstances, and personality traits when investigating the causes of drug addiction. This article overviews some important investigations. PET scans have shown that a variety of drugs raise Dopamine (DA) levels in the dorsal and ventral striatum, which houses the nucleus accumbens

(NAc). Additionally, research has demonstrated that drug-associated stimuli cause an addict's typically low brain activity to spike in regions involved in emotion and learning. These results shed light on the relationship between drug addiction and the brain mechanism, as well as the role played by the innate reward circuit in the development of addiction and the persistence of cravings. Both routine and deliberate drug exposure can serve as a primary catalyst for drug initiation. However, deliberate drug exposure was intended to have the opposite effect on the likelihood that a sibling might experiment with narcotics like heroin in a few different cases. Social networks and trauma histories can also have a significant impact since peers and trauma-related stresses can often act as powerful triggers for substance abuse. Since drug users are frequently inclined to move toward different drugs after developing an addiction to one, plus contextual variables do not always explain the root cause behind addiction, psychologists have tried to and been successful in identifying certain commonalities in the personalities of addicts. Practitioners may view specific personality traits as warning signs. However, no personality trait is certain to indicate addiction, and the premise that an "addictive personality" is an accurate proxy of addiction on its own is not well supported by data.

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