

The Science of Addiction

What Brain Research Tells Us About Drug Addiction

Vicodin and OxyContin

Legal but Dangerous

Addiction can occur with many drugs, not just “street drugs” like heroin. Painkilling drugs such as Vicodin and OxyContin may seem safe because they’re available by prescription, but many teens don’t realize that they are also very addictive if not used as directed by a physician. This is not surprising, since the active ingredient in OxyContin acts at the same site in the brain as heroin.

The case of Jacob [name changed] puts the dangers of prescription painkillers in focus. Jacob began using OxyContin at 18, and before long was selling pills to help support his habit. (Selling prescription drugs makes you a drug dealer and subject to criminal prosecution.) Eventually Jacob moved from OxyContin to heroin. “If I’d never touched OxyContin, I wouldn’t have done heroin,” he claims. Luckily, Jacob eventually faced his addiction and entered a drug treatment program.

The impact of addiction can be far-reaching:

- Cardiovascular disease
- Stroke
- Cancer
- HIV/AIDS
- Hepatitis C
- Lung disease
- Obesity
- Mental disorders

How serious is drug addiction?

According to the National Institute on Drug Abuse (NIDA), *drug addiction* is “a chronic, relapsing disease, characterized by compulsive drug seeking and use, and by neurochemical and molecular changes in the brain.” Like other chronic diseases, drug addiction can seriously impair the functioning of the body’s organs. It can also increase the risk of contracting other diseases, such as HIV and viral hepatitis, not just among those who inject drugs, but also through risky behaviors stemming from drug-impaired judgment.

Drug addiction often results from *drug abuse*, which is the use of illegal drugs or the inappropriate use of legal drugs to produce pleasure, to alleviate stress, or to alter or avoid reality (or all three). Risk factors for addiction

AN INDIVIDUAL’S RISK AND PROTECTIVE FACTORS FOR DRUG ADDICTION

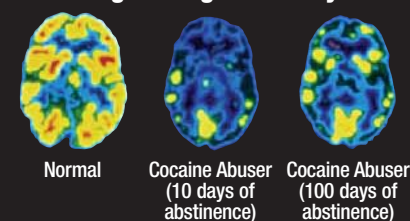
Risk Factors	Influencers	Protective Factors
Early Aggressive Behavior	Self	Self-Control
Lack of Parental Supervision	Family	Parental Monitoring
Substance Abuse	Peers	Academic Competence
Drug Availability	School	Anti-Drug Use Policies
Poverty	Community	Strong Neighborhood Attachment

and protective factors against it (see table below) can be environmental as well as genetic. Scientists estimate that genetic factors, including environmental effects on these genes, account for between 40 and 60 percent of a person’s vulnerability to addiction. Recent research has begun to uncover which genes make a person more vulnerable, which genes protect a person against addiction, and how one’s genes and environment interact. There is also evidence that individuals with mental disorders have a much greater risk of drug abuse and addiction than the general population.

“In the past 30 years, advances in science have revolutionized our understanding of drug abuse and drug addiction. Drug addiction is a brain disease.”

Nora D. Volkow, M.D., Director, National Institute on Drug Abuse

How Drugs Change a Healthy Brain



Cocaine abuse can cause changes in the brain. The PET (positron emission tomography) scans above show a normal brain, the brain of an abuser who hasn’t taken cocaine in 10 days, and the brain of an abuser who hasn’t taken cocaine in 100 days. Even after 100 days without the drug, the activity (yellow) in the cocaine abusers’ brains is still much less than in the normal brain.

What Is Addiction?

• **Addiction is a complex disease.** No single factor can predict who will become addicted to drugs. Addiction is influenced by a tangle of factors involving one’s genes, environment, and age of first use.

• **Addiction is a developmental disease.** It usually begins in adolescence, even childhood, when the brain is continuing to undergo changes. The prefrontal cortex—located just behind the forehead—governs judgment and decision-making functions and is the last part of the brain to develop. This fact may help explain why teens are prone to risk-taking, and why they are also particularly vulnerable to drug abuse. It also explains why exposure to drugs during the teen years may affect the likelihood of someone becoming an addict in the future.

• **Prevention and early intervention work best in the teen years.** Because the teen brain is still developing, it may be more receptive to interventions to alter the course of addiction. Research has shown many risk factors that lead to drug abuse and addiction: mental illness, physical or sexual abuse, aggressive behavior, academic problems, poor social skills, and poor parent-child relations. This knowledge, combined with better understanding of how the teen brain works, can be applied to prevent drug abuse from starting or to intervene early to stop it when warning signs emerge.

LATEST Research

The Science of “Dread”

New research shows that people who substantially dread an adverse experience have a different biology than those who better tolerate the experience.

Dr. Gregory Berns of Emory University School of Medicine and his colleagues used MRI

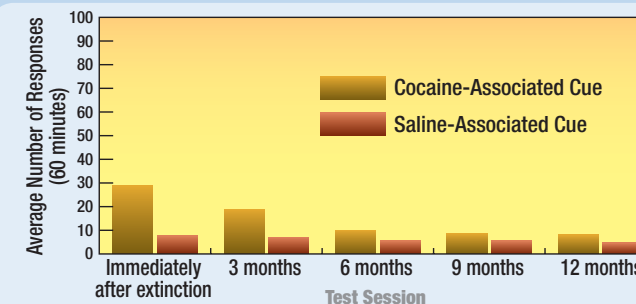
imaging to observe brain activity patterns in non-drug abusers who were awaiting brief electrical shocks (the adverse experience).

The subjects were given the option of a larger shock to occur in a shorter period of time, or a smaller shock after a longer period of time. The

scientists noted two groups: “extreme dreaders,” who could not tolerate a delay and preferred an immediate (and stronger) painful stimulus; and “mild dreaders,” who could tolerate a delay for a milder shock. The findings suggest that dread derives, in part, from attention—and is not simply a fear or anxiety reaction.

Continuing to use drugs despite expecting a bad outcome is a hallmark of addiction. The results of this study form the foundation for future research to determine whether drug abusers exhibit disruption in the brain systems that process “dread”—the anticipation of unpleasant consequences.

One-Time Drug Use Can Set Stage for Relapse



In this experiment, rats pressed a lever in response to a cue (white noise) that had originally indicated access to cocaine even a year after the cue stopped being associated with drug availability. This is because there is a very strong association in the brain between the drug experience and the setting of the drug experience. Even a long-dormant craving may be triggered simply by encountering people, places, and things that were present during a previous drug usage—another reason never to use drugs of abuse even once.

Prevention Resources

- NIDA and other organizations have spearheaded a number of programs to help prevent addiction, including:
 - Family-based:** Teaching parents better communication skills, appropriate discipline styles, and firm and consistent rule enforcement
 - School-based:** Building young people’s skills in the areas of peer relationships, self-control, coping, and drug-refusal
 - Community-based:** Working with civic, religious, law enforcement, and government organizations to strengthen anti-drug norms and pro-social behaviors
- For more information on effective prevention programs, visit: www.nida.nih.gov/drugpages/prevention.html.
- For help with a drug problem, call the National Addiction Treatment Hotline at 1-800-662-HELP or go to www.findtreatment.samhsa.gov.
- For more information on healthy effects of drugs and on effective prevention and treatment approaches based on addiction research, visit NIDA at www.drugabuse.gov and www.teens.drugabuse.gov.