

Here are some things to keep in mind before we start our discussion of:

Annual Review of Psychology

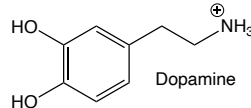
Dopamine and Addiction

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1) Dopamine neurons respond to _____ such as food with reflexive, linked _____.

- Dopamine neurons also come to respond with _____ to stimuli that immediately _____ and reliably _____ the _____.
- _____ (also called phasic firing) of dopamine-containing neurons are necessary to establish _____ associating predictive _____ with _____.

2) Actual dopamine neuron activity is very complicated as there can be shifts in so-called _____ (the overall baseline of activity) as well as phasic activity, that is the _____ associated specifically with an event.

3) Within the striatum, close to half of the output neurons express only _____, and the other half express only _____.

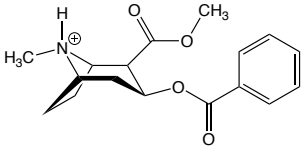
- _____ have low or loose binding to dopamine and are thus _____ by dopamine molecules.
 - Current thinking is that _____ activate when high dopamine is released due to a _____ being received and repeated activation leads to _____.
- _____ have high or tight binding to dopamine and are usually _____ by dopamine molecules.
 - Current thinking is that _____ activate to _____ associated with a _____ and repeated activation of _____ leads to _____.
 - **LOSS of _____ therefore leads to _____ and an ignoring of _____.**
- _____ is a disabling psychiatric disorder with many positive, negative and cognitive symptoms that can be attributable to an imbalance between dopaminergic pathways that signal _____.

4) Addiction is commonly identified _____ . It was usually defined by characteristics of _____ or by characteristics of _____ symptoms.

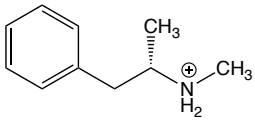
- Addiction is caused by molecules that act to release _____.
- **Unusually high levels of _____ caused by drugs of addiction activate _____ and decrease the number of _____ on neurons**
 - **Both of these effects are _____ with _____.**

Take Home Lessons from Today 10-22-24

Cocaine

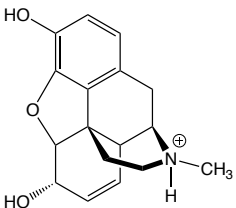


Amphetamines

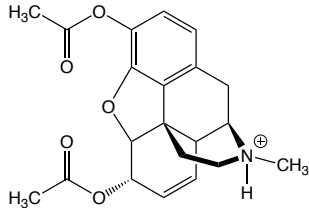


Methamphetamine

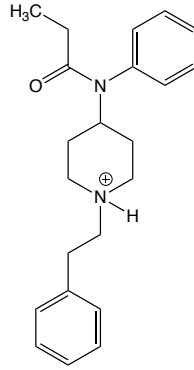
Opiates



Morphine



Heroin



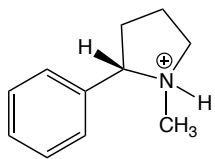
Fentanyl

Alcohol

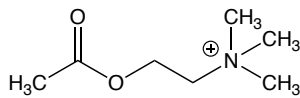


Ethanol

Nicotine

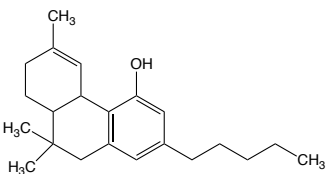


Nicotine

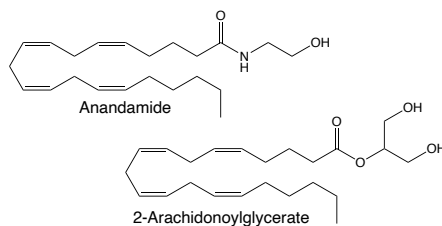


Acetyl Choline

Marijuana



THC

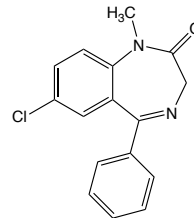


Endocannabinoids

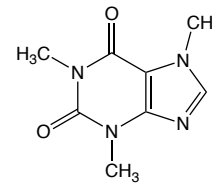
Other Forms of Addiction

Overeating and Gambling

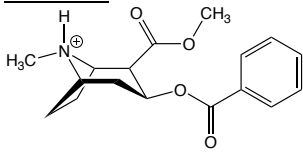
Barbiturates and Benzodiazepines



Caffeine

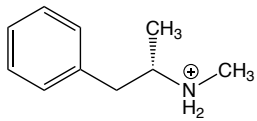


Cocaine



Cocaine activates the dopamine system by blocking reuptake of dopamine, serotonin, and norepinephrine. As a psychomotor stimulant, cocaine elevates extracellular dopamine levels 3-5. times. When given to rats, cocaine activates D1 pathways and when abstinent, their D2 pathways were activated because of an absence of cocaine. In the experiment, the rats preferred places where they could get cocaine and avoided places without it. The rats approached places with immediate cocaine injections and avoided places where they have to wait 15 minutes. Cocaine addicted humans have decreased D2 receptors which leads to reduced sensitivity to non-habitual rewards.

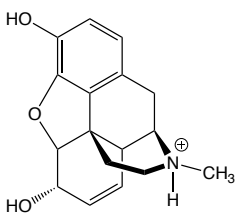
Amphetamines



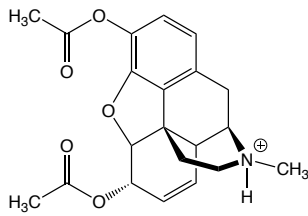
Methamphetamine

Amphetamine, methamphetamine and related drugs are psychomotor Stimulants that elevate dopamine levels and are habit-forming. Direct effects include elevated mood, increased alertness and relief from fatigue. The baseline dopamine level is elevated and causes rapid dopamine release. This causes one to avoid cues that predict delayed access to amphetamine. Methamphetamine causes long-term decreases in D2 receptors, which leads to reduced sensitivity to infrequent rewards and a lack of acknowledgement of punishments.

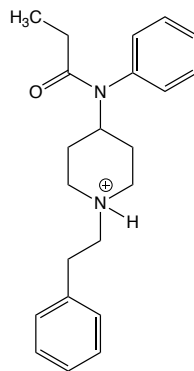
Opiates



Morphine



Heroin



Fentanyl

- Opiates are sedative hypnotics that increase dopamine levels in the brain, leading to a decrease in tension and pain, along with addiction.
- Affects μ -opioid receptors in the ventral tegmental area, which contributes to habit-forming nature.
- Inhibits reuptake (take up) in GABA-containing neurons that usually keep the dopamine system under control, leading to uncontrolled firing of the system.
- Long-term use of opioids leads to the loss of D2 receptors.
- Mice learned to predict reward as well as avoid conditions where opiates aren't available.

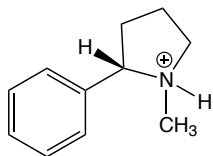
Alcohol



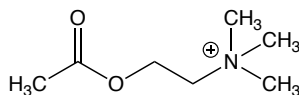
Ethanol

- Is a depressant drug that, at lower doses, gives immediate effects of euphoria and a decrease in inhibitions. At higher doses, gives experiences of depression.
- Alcohol can activate temporary increases in dopamine levels, which reach over about 50% over normal baseline.
- Unlike other addictive drugs, there is no single receptor for alcohol and therefore it is connected to multiple sites of rewarding action.
- Alcoholics develop a long-term decrease in D2 dopamine receptors, making them less aware of consequences to their actions.

Nicotine



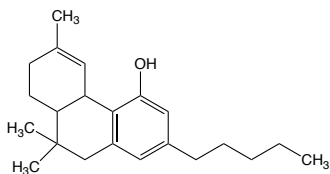
Nicotine



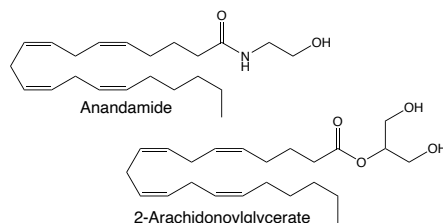
Acetyl Choline

- Nicotine is a stimulant that causes a burst firing of dopamine neurons, and is habit-forming.
 - Nicotine elevates dopamine levels in the brain by acting on receptors localized in specific brain regions
 - Acts at subsets of acetylcholine receptors initially, for new users, nicotine is unpleasant, after a delay it hits dopamine receptors.
- Long-term use causes a decrease in the expression of D2 dopamine receptors.
- Impacts sensitivity to rewards → nicotine-addicted individuals may find it more challenging to derive satisfaction from rewards that are not associated with their addiction

Marijuana



THC

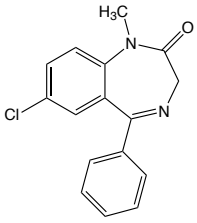


Endocannabinoids

The addictive agent in marijuana is THC, which is a depressant, and causes feelings of relaxation and euphoria by elevating extracellular dopamine levels. The result of cannabinoid treatment is increased burst firing of dopamine neurons and increased dopamine flow into the striatum and prefrontal cortex.

Cannabinoids are rewarding but pharmaceuticals can block the CB1 cannabinoid receptor, inhibiting rewarding effects of other drugs and food seeking. Sudden withdrawal via treatment with a CB1 receptor antagonist leads a withdrawal state and symptoms in humans. Similar to other drugs, human addicts develop long-term decreases in expression of D2 receptors, leading to risk-taking and ignoring of negative consequences.

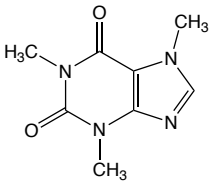
Barbiturates and Benzodiazepines



Diazepam (“Valium”)

Barbiturates and benzodiazepines are depressants that produce withdrawal symptoms. They also activate and disinhibit the dopamine system. They target the central nervous system to cause drowsiness. They are sometimes used to treat insomnia and seizures. Often mixed with alcohol, the overuse of these chemicals can suppress brain activity and the withdrawal suppresses dopamine signaling. This leads to more irrational decision-making and violence (D2 receptor reduction) and less drive (D1 receptor reduction).

Caffeine



Caffeine produces the feelings of well-being and happiness as it suppresses adenosine and adenosine receptors while elevating dopamine levels. Caffeine produces similar rewarding effects to alcohol and nicotine, as well as non-drug reinforcers. It binds to both the D1 and D2 receptors, leading to the common question of whether or not caffeine is actually addictive. Withdrawal symptoms overlap with symptoms of anxiety, depression and insomnia. An aggressive amount of caffeine exposure leads to induced changes in the D2 receptors in the striatum.

Other Forms of Addiction

- Gambling or overeating, anything that presents rewards can become an addiction.
- Food-seeking is decreased when dopamine in the brain is decreased.
- Food causes a burst of dopamine release. People who overeat get much of their dopamine while eating, so when they are not eating, they have low dopamine levels and are therefore depressed.
- These mirror the effects of drug use. When not using, dopamine is no longer at the same level, increasing depression.
- Overeaters have decreased D2 receptor levels, reducing their sensitivity to negative consequences.
- Increased dopamine levels correlate with increased impulsivity, increasing gambling and substance use.