Week 15: Neurochemical Addiction

Psychology 372
Physiological Psychology
Psyc 372 – Physiological Psychology

Week 15 Topics

• Lecture 1:
  • What is addiction?
  • Factors mediating addiction

• Lecture 2:
  • Commonly abused Drugs
    • Mechanisms of addiction
    • Prevention and Treatment
  • Review
  • Wrap-up
Commonly Abused Drugs (from NIDA)

- **Cannabinoids** (Hashish, Marijuana)
- **Depressants** (Barbiturates, Benzodiazepines, flunitrazepam, GHB, methaqualone, alcohol)
- **Dissociative Anesthetics** (ketamine, PCP)
- **Hallucinogens** (LSD, mescaline, psilocybin)
- **Opioids and Morphine Derivatives** (codeine, fentanyl, heroin, morphine, opium, oxycodone HCL, hydrocodone bitartrate, acetaminophen)
- **Stimulants** (amphetamine, cocaine, MDMA, methamphetamine, methylphenidate, nicotine)
- **Others** (anabolic steroids, dextromethorphan, inhalants)
DEA Schedule of Drugs

- **Schedule I ("illegal" drugs)**
  - High potential for abuse
  - Available for research only
  - No approved medical use

- **Schedule II**
  - High potential for abuse
  - Available by unrefillable prescription only

- **Schedule III and IV**
  - Prescription only with 5 refills in 6 months

- **Schedule V**
  - Some available as over-the-counter
<table>
<thead>
<tr>
<th>Types</th>
<th>Aliases</th>
<th>DEA Schedule/How Administered</th>
</tr>
</thead>
<tbody>
<tr>
<td>codeine</td>
<td><em>Empirin with Codeine, Fiorinal with Codeine, Robitussin A-C, Tylenol with Codeine</em>: Captain Cody, schoolboy; (with glutethimide) doors &amp; fours, loads, pancakes and syrup</td>
<td>II, III, IV, V/injected, swallowed</td>
</tr>
<tr>
<td>fentanyl and analogs</td>
<td><em>Actiq, Duragesic, Sublimaze</em>: Apache, China girl, China white, dance fever, friend, goodfella, jackpot, murder 8, TNT, Tango and Cash</td>
<td>I, II/injected, smoked, snorted</td>
</tr>
<tr>
<td>heroin</td>
<td><em>Diacetyl-morphine</em>: brown sugar, dope, H, horse, junk, skag, skunk, smack, white horse</td>
<td>I/injected, smoked, snorted</td>
</tr>
<tr>
<td>morphine</td>
<td><em>Roxanol, Duramorph</em>: M, Miss Emma, monkey, white stuff</td>
<td>II, III/injected, swallowed, smoked</td>
</tr>
<tr>
<td>opium</td>
<td><em>laudanum, paregoric</em>: big O, black stuff, block, gum, hop</td>
<td>II, III, V/swallowed, smoked</td>
</tr>
<tr>
<td>oxycodone HCL</td>
<td><em>Oxycontin</em>: Oxy, O.C., killer</td>
<td>II/swallowed, snorted, injected</td>
</tr>
<tr>
<td>hydrocodone bitartrate, acetaminophen</td>
<td><em>Vicodin</em>: vike, Watson-387</td>
<td>II/swallowed</td>
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</table>
Opioids and Morphine Derivatives

- **Intoxication Effects:** pain relief, euphoria, drowsiness
  - Heroin: staggering gait
- **Potential Health Consequences:** nausea, constipation, confusion, sedation, respiratory depression and arrest, tolerance, addiction, unconsciousness, coma, death
  - Codeine: less analgesia, sedation, and respiratory depression than morphine
Neurophysiological Effects of Opioids

- Direct agonist for opiate receptors
  - In particular, the \( \mu \) (mu) receptor
- Release dopamine in nucleus accumbens
- Both of the above effects are highly reinforcing \( \rightarrow \) highly addictive
  - Blocking either effect reduces reinforcement
  - Nalaxone blocks opiate receptors
  - Pimozide blocks dopamine receptors
- Emergency Treatment: nalaxone
- Long-term Treatment: methadone maintenance
  - Slower uptake \( \rightarrow \) no “high”
  - Alleviates withdrawal symptoms
Non-alcohol Depressants

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<tr>
<td>barbiturates</td>
<td>Amytal, Nembutal, Seconal, Phenobarbital: barbs, reds, red birds, phennies, tooies, yellows, yellow jackets</td>
<td>II, III, V/injected, swallowed</td>
</tr>
<tr>
<td>benzodiazepines (other than flunitrazepam)</td>
<td>Ativan, Halcion, Librium, Valium, Xanax: candy, downers, sleeping pills, tranks</td>
<td>IV/swallowed, injected</td>
</tr>
<tr>
<td>flunitrazepam</td>
<td>Rohypnol: forget-me pill, Mexican Valium, R2, Roche, roofies, roofinol, rope, rophies</td>
<td>IV/swallowed, snorted</td>
</tr>
<tr>
<td>GHB</td>
<td>gamma-hydroxybutyrate: G, Georgia home boy, grievous bodily harm, liquid ecstasy</td>
<td>I/swallowed</td>
</tr>
<tr>
<td>methaqualone</td>
<td>Quaalude, Sopor, Parest: ludes, mandrex, quad, quay</td>
<td>I/injected, swallowed</td>
</tr>
</tbody>
</table>
Depressants (including alcohol)

- **Intoxication Effects**: reduced anxiety; feeling of well-being; lowered inhibitions; slowed pulse and breathing; lowered blood pressure; poor concentration
  - Barbiturates, benzodiazepines, alcohol: sedation, drowsiness
  - Methaqualone, alcohol: euphoria

- **Potential Health Consequences**: fatigue; confusion; impaired coordination, memory, judgment; addiction; respiratory depression and arrest; death
  - Barbiturates, alcohol: unusual excitement, fever, irritability, slurred speech, dizziness, life-threatening withdrawal
  - Benzodiazepines, alcohol: dizziness
  - Flunitrazepam: visual and gastrointestinal disturbances, urinary retention, memory loss
  - GHB: drowsiness, nausea, vomiting, headache, loss of consciousness, loss of reflexes, seizures, coma, death
  - Methaqualone: poor reflexes, slurred speech, coma
Neurophysiological Effects of Depressants

- Many increase GABA activity
  - GABA is the prime inhibitory neurotransmitter in the brain
  - Produces slowed brain function, drowsiness, calmness (anxiolytic)
- Can trigger apoptosis (neuronal death)
- Alcohol also produces euphoria
  - NMDA antagonist
  - Increases activity of dopaminergic neurons and release of dopamine in nucleus accumbens → addiction
  - Disrupts long term potentiation in hippocampus
  - Tolerance and withdrawal are due to release from long-term suppression of NMDA receptors and decreased levels of dopamine receptors
  - Triggers release of endogenous opioids
Treatment of Alcohol Abuse

- Use opiate antagonists to block “euphoric” reinforcing effects
  - Nalaxone
  - Naltrexone
  - Acamprosate (NMDA antagonist) can help reduce seizures
Cannabinoids

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<tr>
<td>hashish</td>
<td>boom, chronic, gangster, hash, hash oil, hemp</td>
<td>I/swallowed, smoked</td>
</tr>
<tr>
<td>marijuana</td>
<td>blunt, dope, ganja, grass, herb, joints, Mary Jane, pot, reefer, sinsemilla, skunk, weed</td>
<td>I/swallowed, smoked</td>
</tr>
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- **Intoxication Effects:** euphoria, slowed thinking and reaction time, confusion, impaired balance and coordination
- **Potential Health Consequences:** cough, frequent respiratory infections; impaired memory and learning; increased heart rate, anxiety; panic attacks; tolerance, addiction
Neurophysiological Effects of Cannabinoids

- Tetrahydrocannabinol (THC)
  - Acts on CB1 receptors (also stimulated by endogenous cannabinoids)
    - Block CB1 receptors → no “high”
  - Stimulates dopaminergic neurons
    - if injected into nucleus accumbens → addiction
    - but not for injection in ventral tegmental area
  - Causes excessive activation of CB1 receptors in CA1 region of hippocampus
    - Disrupts formation of long-term memories
## Dissociative Anesthetics

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<tr>
<td>ketamine</td>
<td><em>Ketalar SV:</em> cat Valiums, K, Special K, vitamin K</td>
<td>III/injected, snorted, smoked</td>
</tr>
<tr>
<td>PCP and analogs</td>
<td><em>Phencyclidine:</em> angel dust, boat, hog, love boat, peace pill</td>
<td>I, II/injected, swallowed, smoked</td>
</tr>
</tbody>
</table>

- **Intoxication Effects:** increased heart rate and blood pressure, impaired motor function
  - Ketamine (at high doses): delirium, depression, respiratory depression and arrest
  - PCP: possible decrease in heart rate and blood pressure, panic, aggression, violence
- **Potential Health Consequences:** numbness, memory loss, nausea, vomiting (PCP: loss of appetite, depression)
Neurophysiological Effects of Dissociative Anesthetics

- PCP: indirect antagonist for Ca+ in NMDA receptors, which regulate the number of dopamine receptors
  - Decreased dopamine receptors in frontal lobe produces decreased metabolic activity in frontal lobes
  - Hyperactivity of dopamine receptors in nucleus accumbens → addiction
- Produces schizophrenic symptoms
# Psyc 372 – Physiological Psychology

## Stimulants

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<tr>
<td>amphetamine</td>
<td><em>Biphetamine, Dextedrine:</em> bennies, black beauties, crosses, hearts, LA turnaround, speed, truck drivers, uppers</td>
<td>II/injected, swallowed, smoked, snorted</td>
</tr>
<tr>
<td>cocaine</td>
<td><em>Cocaine hydrochloride:</em> blow, bump, C, candy, Charlie, coke, crack, flake, rock, snow, toot</td>
<td>II/injected, smoked, snorted</td>
</tr>
<tr>
<td>MDMA (methyleneoxy-methamphetamine)</td>
<td>Adam, clarity, ecstasy, Eve, lover's speed, peace, STP, X, XTC</td>
<td>I/swallowed</td>
</tr>
<tr>
<td>methamphetamine</td>
<td><em>Desoxyn:</em> chalk, crank, crystal, fire, glass, go fast, ice, meth, speed</td>
<td>II/injected, swallowed, smoked, snorted</td>
</tr>
<tr>
<td>methylphenidate (safe and effective for treatment of ADHD)</td>
<td><em>Ritalin:</em> JIF, MPH, R-ball, Skippy, the smart drug, vitamin R</td>
<td>II/injected, swallowed, snorted</td>
</tr>
<tr>
<td>nicotine</td>
<td>cigarettes, cigars, smokeless tobacco, snuff, spit tobacco, bidis, chew</td>
<td>not scheduled/ smoked, snorted, taken in snuff and spit tobacco</td>
</tr>
</tbody>
</table>
Stimulants

- **Intoxication Effects**: increased heart rate, blood pressure, metabolism; feelings of exhilaration, energy, increased mental alertness
  - Amphetamine: rapid breathing
  - Cocaine: increased body temperature
  - MDMA: mild hallucinogenic effects, increased tactile sensitivity, empathic feelings
  - Methamphetamine: aggression, violence, psychotic behavior
Stimulants

- **Potential Health Consequences:** rapid or irregular heart beat; reduced appetite, weight loss, heart failure, nervousness, insomnia
  - Amphetamine: tremor, loss of coordination, irritability, anxiousness, restlessness, delirium, panic, paranoia, impulsiveness, aggressiveness, tolerance, addiction, psychosis
  - Cocaine: chest pain, respiratory failure, nausea, abdominal pain, storkes, seizures, headaches, malnutrition, panic attacks
  - MDMA: impaired memory and learning, hyperthermia, cardiac toxicity, renal failure, liver toxicity
  - Methamphetamine: memory loss, cardiac and neurological damage, impaired memory and learning, tolerance, addiction
  - Nicotine: tobacco exposure effects including adverse pregnancy outcomes, chronic lung disease, cardiovascular disease, stroke, cancer, tolerance, addiction
Neurophysiological Effects of Stimulants

- Potent Dopamine agonists that increase dopamine levels in nucleus accumbens → addiction
  - Cocaine
    - deactivates dopamine transporter proteins and blocks reuptake by pre-synaptic neuron
  - Amphetamine
    - Inhibits reuptake
    - Stimulates release of dopamine by pre-synaptic neuron
- Chronic abuse associated with
  - Reduction in dopamine transporters & receptors
  - Lower frontal lobe activity (hypofrontality)
Treatments for Stimulants

- Excessive Dopamine
  - Gamma-vinyl GABA (GVG) injections act as GABA agonists and decrease dopamine release in nucleus accumbens
- Stimulate immune system to develop antibodies to prevent cocaine molecules from crossing the blood-brain barrier
- Nicotine
  - Substitute chewing gum or patch to break smoking habit
  - Reduce nicotine levels slowly
  - Drugs that block CB1 receptors
# Hallucinogens

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<tr>
<td>LSD</td>
<td><em>lysergic acid diethylamide:</em> acid, blotter, boomers, cubes, microdot, yellow sunshines</td>
<td>I/swallowed, absorbed through mouth tissues</td>
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<tr>
<td>mescaline</td>
<td>buttons, cactus, mesc, peyote</td>
<td>I/swallowed, smoked</td>
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<tr>
<td>psilocybin</td>
<td>magic mushroom, purple passion, shrooms</td>
<td>I/swallowed</td>
</tr>
</tbody>
</table>
Hallucinogens

- **Intoxication Effects**: altered states of perception and feeling, nausea
  - LSD, mescaline: increased body temperature, heart rate, blood pressure, loss of appetite, sleeplessness, numbness, weakness, tremors
  - LSD: persistent mental disorders
  - Psilocybin: nervousness, paranoia

- **Potential Health Consequences**: persisting perception disorder (flashbacks)

- **Neurophysiological Effects**
  - Agonist for Serotonin 5-HT2A
  - Inhibitory effects on visual cortex and orbitofrontal cortex
  - No apparent effects on dopaminergic neurons → non-addictive
### Other Compounds

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<th>Intoxication Effects/ Potential Health Consequences</th>
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<tr>
<td>anabolic steroids</td>
<td>Anadrol, Oxandrin, Durabolin, Depo-Testosterone, Equipoise: roids, juice</td>
<td>III/injected, swallowed, applied to skin</td>
<td>no intoxication effects/hypertension, blood clotting and cholesterol changes, liver cysts and cancer, kidney cancer, hostility and aggression, acne; in adolescents, premature stoppage of growth; in males, prostate cancer, reduced sperm production, shrunken testicles, breast enlargement; in females, menstrual irregularities, development of beard and other masculine characteristics</td>
</tr>
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<tr>
<td>Dextromethorphan (DXM)</td>
<td><em>cough and cold medications; Robotripping, Robo, Triple C</em></td>
<td>not scheduled/swallowed</td>
<td>Dissociative effects, distorted visual perceptions to complete dissociative effects</td>
</tr>
<tr>
<td>inhalants</td>
<td><em>Solvents (paint thinners, gasoline, glues), gases (butane, propane, aerosol propellants, nitrous oxide), nitrites (isoamyl, isobutyl, cyclohexyl): laughing gas, poppers, snappers, whippets</em></td>
<td>not scheduled/inhaled through nose or mouth</td>
<td>stimulation, loss of inhibition; headache; nausea or vomiting; slurred speech, loss of motor coordination; wheezing/unconsciousness, cramps, weight loss, muscle weakness, depression, memory impairment, damage to cardiovascular and nervous systems, sudden death</td>
</tr>
</tbody>
</table>