Biopsychology

Neuropharmacology
Psychoactive (affecting the mind) Substances

Lecture 9
Intro to Neuropharmacology

• Review steps of chemical transmission

• General drug terms: Affinity and Efficacy

• Drug Classes:
  • CNS Stimulants (e.g. Amphetamine, cocaine and nicotine)
  • CNS Depressants or sedatives or hypnotics (e.g. Barbiturates, alcohol & Valium)
  • Analgesic (Pain killers e.g. Morphine, codeine and heroin)
  • Hallucinogens or Psychedelics (e.g Mescaline, LSD and Psilocybin)
  • Psychotherapeutics (e.g. Prozac and Thorazine)

• So where does Cannabis fall into it is a psychoactive drug? (can be Psychedelic in high doses, which is more than typical recreational use. Is also sedative).
What is useful about psychoactive drugs?

Psychological approach

Experience

Behavior

Neurobiological approach

Experience

Systems level

Cellular level

Molecular

Behavior
The study of the effects of drugs on the nervous system and on behavior (<G: "Pharmakon" = drug)

Drug (pharmacology): An exogenous chemical not necessary for normal cellular functioning that significantly alters the functions of cells of the body when taken in relatively low doses (here, in cells of the nervous system).

Exogenous: Produced outside the body
(ex. Aspirin, morphine)

Endogenous: Produced inside the body
(ex. Acetylcholine, dopamine).

How can we use Exogenous and Endogenous substances to learn something about the brain?
Sample and infuse, then measure molecular-cellular-and system levels effects and relate to behavioral outcome.
These processes depend on Many factors and are variable between everyone. This is why it is important to know the therapeutic-index.

**Adminstration**

Absorption
- Membranes of oral cavity, gastrointestinal tract, peritoneum, skin, muscles, lungs

Inactivation
- Liver

Excretion
- Intestines, kidneys, lungs, sweat glands, etc.

Binding
- Neuron receptor
- Bone and fat

Excretion products
- Feces, urine, water vapor, sweat, saliva

**Administration**

- Oral, intravenous, intraperitoneal, subcutaneous, intramuscular, inhalation

(iv) Intravenous (0.5mg/kg) (iv)

Smoked (100mg base) (inhalation)

Oral (2mg/kg)

Intranasal (2mg/kg)
**DRUG EFFECTS**

Drug effects: the changes observed in an organism’s physiological processes and behavior.

Drugs can have two effects on synaptic transmission: they can *facilitate* or *inhibit* neurotransmission.

AGONISTS: Drugs that *facilitate* the effects of a particular neurotransmitter.

ANTAGONISTS: Drugs that *inhibit* the effects of a particular neurotransmitter.

- Agonists - bind to and activates a receptor
  - (e.g. morphine is opioid receptor agonist)

- Antagonists - bind to receptor, but do not activate it.
  - This blocks ability of agonist to stimulate receptor.
    - (e.g. naloxone is opioid receptor antagonist)
**DRUG ACTIONS**

**Agonists:** *facilitate* synaptic transmission or NT’s effects

1. Act as precursor (ex., L-Dopa - Dopamine)
2. Cause synaptic release (ex., Black widow venom - ACh)
3. Stimulate receptors (ex., nicotine - ACh)
4. Inhibit autoreceptors (ex., clonidine - NE)
5. Prevent inactivate degradation enzymes (physostigmine – ACh)
6. Block reuptake (ex., cocaine – Dopamine)

**Antagonists:** *inhibit* synaptic transmission

1. Inactivate synthetic enzymes (ex., PCPA – serotonin)
2. Prevent synaptic release (ex., botulinum toxin)
3. Make vesicles leaky (ex., reserpine – monoamines)
4. Block postsynaptic receptors (ex., curare – ACh)
5. **Stimulate autoreceptors** (ex., LSD – block inhibitory auto receptors)

**ALL STEPS CAN BE MODULATED BY DRUGS**

1. Synthesis
2. Storage
3. Release  **1. Influence changes in membrane potential**
4. Receptor Binding
5. Termination/Inactivation
   - Metabolism by enzymes
   - Reuptake by transporters

What effect on transmission **Agonist or Antagonist** if bound to an auto receptor? What effect on transmission **Agonist or Antagonist** if bound to Heteroreceptors?
**DOSE-RESPONSE PROPERTIES**

**ED<sub>50</sub>:** Dose of a drug at which 50% of maximal effect is achieved.

**LD<sub>50</sub>:** Dose of a drug at which 50% lethality is observed.

**Therapeutic Index:** Ratio of LD<sub>50</sub>/ED<sub>50** (larger number is better!)

**Margin of safety:** The amount between a therapeutic dose and a lethal dose of a drug. Determined by the therapeutic index.

This line indicates the max dose to give patient as determined by the therapeutic index before negative effects kick in.

The blue line indicates a starting dose in which 50% of wanted effects are observed.

Keep in mind that drugs produce many actions (biological and physiological), some are wanted and other are not.

This is why is the therapeutic index important.

Every individual will react physiologically biologically and behaviorally different to drugs.

- Ex: *Tolerance vs. sensitivity OR Body weight and metabolism Or Age (young vs old) Or gender (Male vs female).

So must know the safety margin!
**Affinity (Potency):** Related to the strength of binding potential (will a compound bind or not and if so how strong). **Dose of drug required to produce an observe an effect.** Remember drugs can bind to many things! We will mostly talk about receptors Affinity of drug for site of action. Low affinity = low binding ability to receptor, need larger dose of drug to produce effect. High affinity = better binding to receptor need smaller dose!

**Efficacy:** Related to the biological effect exerted by virtue of the drug binding. maximal effect of drug. Meaning a drug can bind to a receptor but what effect does it produce in relation to the endogenous NT’s that normally binds to the receptor!

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**Drug Efficacy Continuum**

- **Full Agonist** (agent that activates receptor)
- **Partial Agonist**
- **Antagonist** (agent that does not activate a receptor) Blocks it
- **Partial inverse Agonist**
- **Full inverse Agonist** (activate receptor, but produce opposite effects of agonist)

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**Graph:**
- **Drug A** has better affinity than **B**
- **Max response**
- **Increasing effect with dose**
- **No effect**
- **Drug B** more efficacious than **A**

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- **Affinity**
- **Good** → **Bad**

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Monday, March 19, 2012
Rightward and Leftward shift in dose-response curves of the same drug

- **Right shift OR downward shift** of the same drug (A) indicates a **reduction** in drug sensitivity (habituation or tolerance). More drug (dose) is needed to produce effects.

- **Leftward shift OR upward shift** of drug (A) indicates an **increase** in sensitivity to drug. Less drug is needed to produce effects.

**Drug A is the same drug, but its dose may need to be changed for many reasons, as listed on previous page.**

**Variations effects of different drugs on the same receptor**

- **Drug A** has great affinity and efficacy.
- **Drug B** has good affinity, but poor efficacy.
- **Drug C** had great efficacy, but poor affinity.
- **Drug D** is What?
  - Antagonist, has great affinity but almost no efficacy. This means Drug D binds to the receptor, but produces no biological action!

Which Drug is the best A, B, or C? Depends on therapeutic index! Which is the safest.

**Drugs: A, B, C, and D act on the same receptor!**
Three end results of Combining Substances

A. Reduce actions of both, remember that not only will the antagonist influence the agonist but the agonist can influence the antagonist (if competitive!).

**Competitive Antagonist:** Are substances (drugs) that produce inhibitory action on the same exact mechanism that is facilitated by an Agonist. EX: Both Drugs compete for same receptor!
- Agonists - bind to and activates a receptor
  - (e.g. morphine is opioid receptor agonist)
- Antagonists - bind to receptor, but do not activate it.
  - This blocks ability of agonist to stimulate receptor.
  - (e.g. naloxone is opioid receptor antagonist)

**Non-Competitive Antagonist:** Are substances that produce inhibitor actions through indirect mechanism that ultimately influence how an Agonist drug will work.

Why treat a patient with a Competitive substances?

Why the difference in inhibitory actions between Drugs B and C on drug A?

Three end results of Combining Substances

A. Reduce actions of both, remember that not only will the antagonist influence the agonist but the agonist can influence the antagonist (if competitive!).
Acetylcholine: CNS maintains waking state, and neuronal excitability. Death of these neurons associated with Alzheimer’s disease. PNS for muscle contraction and ANS Parasympathetic control.

Cholinergic Agonists
- Examples
  - Bethanechol
  - Carbecol
  - Pilocarpine
- Physiological Effects
  - Pupillary constriction
  - Salivation
  - Bronchioconstriction
  - Decreased HR
  - Digestion
  - Bladder contraction (elimination)
  - Increased GI motility

Anticholinergics
- Examples
  - Atropine (muscle relaxant)
  - Scopolamine (motion sick)
- Physiological Effects
  - Pupillary dilation
  - Dry-mouth
  - Bronchiodilation
  - Increased HR
  - Decreased digestion
  - Decreased urination
  - Constipation

Acetylcholine terminal
Remember many types of receptors exist!

Autonomic Nervous System

Storage and release
- Agonist
  - Black widow spider venom promotes release of ACh.
- Antagonist
  - Botulin toxin blocks release of ACh.

Release
- Agonist
  - Nicotine stimulates ACh receptors.
- Antagonist
  - Curare blocks ACh receptors.
- Receptor
  - Phystostigmine and organophosphates block inactivation of ACh.

Synthesis
- Choline-rich diet increases available acetylcholine (ACh).
Remember many types of receptors exist!

**Dopamine**: Active in maintaining and **initiating** normal motor behavior. Strongly involved in Reward of specific behaviors (Sex, eating etc).
Serotonin: Active in maintaining waking states (inhibit = sleep). Abnormal increases are associated with OCD, tics and Schizophrenia. Decreases are related to major depressive states.

**Serotonin syndrome:** occurs when you take medications that cause high levels of serotonin to accumulate in your body. OR can occur when you increase the dose of such a drug or add a new drug to your regimen. Certain illicit drugs and dietary supplements are also associated with serotonin syndrome.

- Symptoms
  - Restlessness
  - Hallucinations
  - Loss of coordination
  - Fast heart beat
  - Rapid changes in blood pressure
  - Increased body temperature
  - Overactive reflexes
  - Nausea
  - Vomiting
  - Diarrhea

- Pathophysiology
  - Serotonin overdose

- Cause
  - Self-poisoning
  - Therapeutic drug use
  - Drug reactions.

- Treatment
  - Withdrawal of medicine
  - Fluids by IV
  - Cyproheptadine
  - Benzodiazepines

Both these drugs reduce symptoms of depression by increased activation of postsynaptic cells.
Why not go out and take Tryptophan?

All patients were in a remission state (non-depressed state). Patients were given one of two mixtures. **Blue-line Given tryptophan + a cocktail of Large Neutral AA’s.** **Red-line** given a mixture with Large neutral AA’s with NO Tryptophan.

A surge in AA’s (amino acid) intake triggers the Liver to breakdown AA’s (including tryptophan). **Second**, a surge in AA’s inhibits the entry/transport of tryptophan into the brain (figure 2).

Together, the cocktail of **AA’s leads to endogenous tryptophan depletion in body and Brain** (red-line). This increases clinically significant depressive states. Patients given extra tryptophan “blue-line” did not result in a better self mood report, because placing extra tryptophan in the cocktail **probably helped restore the depletion** caused by the large neutral AA’s (remember the cocktail also contained other AA’s).

What can be concluded is “Rapid depletion of Tryptophan facilitates a relapse in depressive mood states.” This suggest that both 5-HT and its complement receptors play a role in depressive states!

What is missing in this experiment? We do not know if Tryptophan can decrease depressed mood states the loss can lead to it, does mean replacing it will effectively treat patients!
Norepinephrine

Norepinephrine: Active in maintaining **emotional tone AND excitatory behavior**. Decrease in NE activity related to some **depressive** states and **increase is related to mania**. Stimulates eating!

**NE-receptor involvement in eating behavior.**

Drugs above are NE-receptor agonists of different NE receptors, control is the vehicle. Infusion into the LC promotes an excitatory state!

**Above is an example of using synthetic Endogenous substances to learn something about behavior.**

**Above is an example of using synthetic exogenous substances to learn something about excitatory behavior.**
PSYCHOACTIVE DRUGS

What are Psychoactive drugs? substances that influence subjective experience and behavior by acting on the nervous system.

There are several classes of psychoactive drugs:

I. Sedative hypnotics and antianxiety drugs

Most common are:

1. Alcoh_ol (everything that contains ethyl alcohol).

2. Barbiturates (ex., pentobarbital).


- they are also known as “mild tranquilizers”.

- Induces sedation, reduces anxiety (anxiolytic), mild to strong euphoric effects

- Alcohol, Barbiturates and Benzodiazepines are agonists of the GABA receptor

Behavioral effects:

<table>
<thead>
<tr>
<th>Normal</th>
<th>Relief from anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disinhibition</td>
</tr>
<tr>
<td></td>
<td>Sedation</td>
</tr>
<tr>
<td></td>
<td>Sleep</td>
</tr>
<tr>
<td></td>
<td>General anesthesia</td>
</tr>
<tr>
<td></td>
<td>Coma</td>
</tr>
<tr>
<td></td>
<td>Death</td>
</tr>
</tbody>
</table>

Increasing dose of sedative-hypnotic drug →
**PSYCHOACTIVE DRUGS**

Characteristics of sedative-hypnotic drugs:

**Tolerance**: decreased susceptibility to a drug that develops as a result of repeated exposure to the drug; compensatory mechanisms opposite to the initial drug effect [Compensatory = reducing or **offsetting**]

**Cross-tolerance**: tolerance that develops to one drug carries over to other drugs suggesting that they act through the same target.

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**PSYCHOACTIVE DRUGS**

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Most common are:

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2. **Barbiturates** (ex., pentobarbital).
3. **Benzodiazepines** (ex., valium, librium).

They are also known as "**mild tranquilizers**".

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**Behavioral effects**:

**Binding of sedative/hypnotic** (Barbiturates or alcohol) = acts like GABA NT’s = increase chloride conductance!

**Binding of anti-anxiety drugs** (benzodiazepines) enhance GABA too!

**Taken individually can = cross tolerance**

**Taken together have additive action on efficacy!**

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*Because these substance can interact with same receptor but different locations have additive actions!*
II. Antipsychotic drugs: used to reduce psychotic symptoms in schizophrenia, paranoia, etc. 

Most common are: 
1. Phenothiazines (ex., chlorpromazine - Thorazine)  
2. Butyrophenones (ex., haloperidol - Haldol) 
- they are also known as “major tranquilizers ” 

One mechanism of action: block dopamine receptors, particularly the D2 subtype. 

Activation of D2 receptors by indirect agonist like cocaine and Amphetamines (heavy users or large doses) can lead to psychotic like behaviors 

Haloperidol: A D2-receptor blocker that can induce catalepsy (trance or seizure with a loss of sensation and consciousness accompanied by rigidity of the body) in animals when in high doses
III. Antidepressant drugs: used to treat depressive illnesses

Most common are:
1. Monoamine oxidase inhibitors (MAOI)
2. Tricyclics (ex., imipramine - Tofranil)
3. Serotonin-specific reuptake inhibitors (SSRIs ex., fluoxetine - Prozac)

Mechanisms of action:
- MAOIs block the breakdown of **monoamines** (especially serotonin [5-HT] and noradrenaline)
- Tricyclics and SSRIs block the reuptake of **monoamines** (especially noradrenaline and 5-HT)
IV. **Opiates** (analgesics): clinically employed in the treatment of pain - high potential for addiction (see next section)

Most common are:

1. **Opium poppy derivatives** (morphine, codeine)
2. **Derivatives of morphine** (heroin)
3. **Endogenous opiates**: made in the body = endorphins (enkephalins, dynorphin)

**Mechanism of action**: all work by binding **opiate receptors** in the nervous system (mu, delta, and kappa subtypes of opiate receptors)

*Psychoactive ingredients of opium poppy: morphine and codeine can in high doses can cause confusion (mild hallucinations or delusions).*
Opiates inhibit activity of Inhibitory interneurons in the PAG Mid-brain. This increases activity of other descending neurons to the Raphe Nucleus neurons.

PAG neurons then excite Raphe neurons.

Raphe Neurons send projections to appropriate spinal interneuron to inhibit incoming pain signals!
V. Stimulants: in general, increase activity of the nervous system

Several classes of stimulants:

1. Behavioral stimulants (ex., cocaine, “crack”, amphetamine)
2. Convulsant stimulants (ex., pentylenetetrazol)
3. General stimulants (ex., caffeine)
4. Psychedelic drugs (ex., lysergic acid diethylamide [LSD], mescaline, marijuana, psilocybin [from some mushroom])

Varied mechanisms of action.

1.) General Effects of “Behavioral Stimulants” (Moderate Doses)

Stimulants: increase blood pressure, heart rate, blood flow, arousal (similar to actions of DA, NE, E). Sustained euphoria (Amph, Coc). Increased assertiveness, confidence. Improves performance during boredom and fatigue

Stereotypic behaviors: repetitive or ritualistic movement, posture (rocking, crossing and uncrossing of legs, and marching in place etc).

rats - gnawing, biting, rhythmic head movements. chimpanzees - rocking, swaying smacking lips.

Humans: Display organized behavior with minimal purpose and excessive chewing and teeth grinding.

Paranoid Psychosis: Delusions, hallucinations, paranoid thought patterns
Marijuana

Cannabinoid (Cannabis) Receptors

- CB1
  - Brain
  - Metabotropic

- CB2
  - Immune system
  - Metabotropic

- Sedative = anxiolytic (reduces anxiety)
- Hypnotic = produces drowsiness, sleep Pleasant, relaxed state
- Motor impairment
- Change in spatial relationships/time
- Stimulation of appetite
- Colors, music more intense
- In social situations: talkativeness, contagious hilarity
- Short-term memory deficits
- Psychoactive ingredient of cannabis plant: delta-9-tetrahydrocannabinol (THC)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Mode of Administration</th>
<th>Peak Effect</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ-THC</td>
<td>Oral 20 mg</td>
<td>6</td>
<td>180 min</td>
</tr>
<tr>
<td></td>
<td>IV 19 mg</td>
<td>3</td>
<td>30 min</td>
</tr>
<tr>
<td></td>
<td>Smoking 5 mg</td>
<td>3</td>
<td>30 min</td>
</tr>
</tbody>
</table>

- THC (exogenous) or endocannabinoid (endogenous, e.g. Anandamide, 2-AG: are lipid soluble compounds or NT’s).
- Stimulate postsynaptic receptors to exert effects by inhibiting Ca++ ion channels!
- Two Cannabinoid Receptors: CB-1: found in brain and CB-2: found in periphery
Marijuana

A variety of behavioral and physiological response to cannabinoids exist!

THC administration does NOT appear to disrupt subjects ability to recall SIMPLE “real world” information.

Although, drug-induced reductions (dose dependency) on a variety of tasks (e.g. Verbal, spatial tasks) exist.

Above: Dose dependent deficit in verbal recall of learned information (events in a story) are dramatically reduced in higher dose of THC, but the lower dose produced no significant differences.

Time zero = 1 hour before treatment (No THC) 2 and 6 hrs = after treatment recall drops significantly!

Thus THC (via CB-1 receptors) blunts ability to recall learned information (explicit).

CB1\(^{-/-}\) receptor gene knock out mice show impaired reversal learning in Morris water maze.

Acquisition of initial platform was no different between mice.

(A) Reversal (flip platform on opposite side) of platform, however, resulted in CB1\(^{-/-}\) learning impairment of new platform location. (longer latency [time] to find).

(B) Swim path increased as well in CB1\(^{-/-}\) mice.

(C) And greater number in returns to previous platform.

This indicates a deficit in the ability to eliminating old (previous) memories. Thus CB-1 receptors are required for the facilitation forgetting old useless information (extinction).
**Marijuana**

**Therapeutic or Medicinal Effects**

- Analgesic - chronic pain
- Lowering intraocular pressure - glaucoma
- Reduces nausea (antiemetic) and stimulates appetite - AIDS patients and following chemotherapy

**Dependence and Withdrawal**

- Human
  - Craving
  - Irritability
  - Increased anxiety
  - Depressed mood
  - Sleep disturbances
  - Heightened aggressiveness – Hyperactivity
  - Decreased appetite

- Animal
  - Wet-dog shakes
  - Increased grooming
  - Facial rubbing
  - Licking
  - Scratching

**Chronic (extremely heavy use)** use can be (but not always) Characterized with symptoms of: Apathy, Aimlessness, Loss of Achievement Motivation, Lack of long-range planning and decreased productivity (Amotivational Syndrome).

*Although there is evidence of Amotivational Syndrome* it is more likely certain personality characteristics are prone to amotivational behaviors.

* Also lack of motivation can be attributed to the ongoing over intoxication of the user
WHAT IS DRUG ADDICTION (DEPENDENCE)

Substance Abuse: pattern of drug use in which chronic and excessive intake takes a central place in ones life.

Drug Dependence (Addiction): advanced state of abuse in which physical and psychological dependence have developed.

Important concepts:

1. **Drug tolerance**: decreased susceptibility to a drug that develops as a result of repeated exposure to a drug; compensatory mechanisms opposite to initial drug effect

- **metabolic tolerance**: reduced sensitivity to a drug that results from the increased ability of the body to metabolize the drug

- **cellular tolerance**: a change that takes place in nerve cells in which the activity of neurons adjust to the excitatory or inhibitory effects of a drug (ex., receptor downregulation)

- **learned tolerance**: behavior change acquired through associative learning

Example of tolerance to some drug actions
2. **Sensitization**: increased behavioral response to the same dose of a drug

- for example, the behavioral activity of animals in response to repeated injections of amphetamine increases over time.

3. **Physical dependence**: state in which discontinuation of drug taking will induce withdrawal syndrome

Withdrawal syndrome: illness induced by the elimination or absence from the body of a drug on which a person is physically dependent

- physical dependence was originally thought to be responsible for addictive behavior
- however, if true, treating addicts until physical withdrawal is over should treat addiction; it does not

**Psychological dependence** is the most important factor in addictive behavior - produces “compulsive” drug taking behavior
Learning, through associative conditioning,
produce psychological dependence (Siegel)
- associative learning = conditioned drug tolerance:
  only places and cues associated with drug taking
  will produce tolerance;
- if high drug dose taken somewhere else, can be lethal

Siegel injected morphine in rats for several days in a very distinct environment
- on the last day he compared the lethal effects of
  a large dose of morphine in animals placed in the same distinct context where they had received prior morphine injections or in a context where they had not received morphine
- many rats receiving morphine in the new context did not survive the higher dose.

- produces conditioned withdrawal effects:
- places and cues associated with drug can also produce withdrawal symptoms
- if eliminate cues associated with drug, can reduce addiction (ex., Vietnam vets.)
The brain and rewarding processes

Reinforcement: reinforcement is the process by which there is an increase in the likelihood of occurrence of most recent behavior preceding the reinforcement
- important factor in producing addiction

Addictive drugs have reinforcing effects:
- they activate reinforcement mechanisms
- reinforcement strengthens behavior just preceding it

Discovery of Reinforcing Brain Stimulation: (Olds & Milner, 1954) Classic study

Electrodes implanted in medial forebrain bundle (MFB)
- rats found to press a lever thousands of times an hour to receive electrical stimulation

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THEORY of ADDICTION

Believed to develop in stages:
1. Seeking the sensation of pleasure from drug taking;
2. Pleasure is linked to mental representations (cues) associated with drug taking;
3. Cues associated with drug taking cues become incentives, through sensitization process.

Substance abuse progresses such that increasing doses of drugs are required to produce a pleasurable effect, and are eventually incapable of producing pleasurable feelings.

So why do people keep taking these substances? Theory of incentive-sensitization: cues associated with drug taking become “attached” with motivational properties, which become “sensitized” (increase) with repeated drug taking.

- greatly increases the “wanting” for a drug even if the “liking” is reduced.
Neural System of Reinforcement

Mesolimbic system involved in reinforcement
- system starts in a collection of neurons called ventral tegmental area (VTA), which contains dopamine as a neurotransmitter
- most important projections of VTA axons to nucleus accumbens (dopamine receptor antagonists in this region block Medial Forebrain Bundle (MFB) self-stim.)
- blockade of dopamine receptors in nucleus accumbens can also block drug taking behavior in animal models of addiction.
Reward Pathways (Dopamine)

- Nigrostriatal Dopamine System
  - Substantia nigra to caudate nucleus
  - Involved in stereotyped behaviors

- Mesolimbic Dopamine System (‘Hedonic Highway’)
  - Ventral tegmental area to nucleus accumbens
  - Mediates reward/euphoria effects of drugs
  - Activated by all drugs of abuse and primary reinforcers (food, sex)

Treatments of Commonly Abused Substances

General adverse consequences of abused drugs:
- Expensive habit (associated with crime);
- IV injections – health risks (HIV, hepatitis);
- Source can be doubtful and plain dangerous;
- Crosses placental barrier, making fetus depend;
- Overdose can produce death;
- Some drugs can lead to neurological disorders and brain damage.

Neural mechanisms of drug action: act at specific, and often, multiple, synaptic receptors.

Common withdrawal symptoms: from 2-3 hours until 6-7 days after last ingestion/dose;
- some withdrawal symptoms: increased fidgeting, sweat, sleep, shiver, nausea, vomiting, diarrhea, cramps, tremors, muscle spasms (legs – going “cold turkey” and “kicking” the habit!)

Specific Treatments:
- in some cases, drug specific treatments are available (ex. methadone maintenance for opiates)
- in general NO GOOD TREATMENTS for any addictive drugs!

What about LSD/ibogaine as Treatments?