Drugs, The Brain, and Behavior

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What is a drug?

Difficult to define

Know it when you see it

Neuroactive vs Non-Neuroactive drugs

Two major categories of neuroactive drugs:

Therapeutic Drugs

Recreational Drugs (Drugs of Abuse)

Both types of neuroactive drugs affect neural functioning and behavior



Different Levels at which drug effects in the brain can be studied



"Good" Therapeutic Drugs vs "Bad" Addictive drugs

No clear boundary!

All "good" drugs have undesirable side effects

Many "good" drugs can be addictive (i.e. "bad") under the right circumstances (i.e. oxycontin abuse)

Two US Federal Agencies decide if a drug is good or bad

Food and Drug Administration (FDA) decides if drug is therapeutic (i.e. good)

Drug Enforcement Administration (DEA) decides whether a drug is illegal (i.e. bad).

A "bad" drug in the US can be a good drug in other countries

Neuroactive Drugs Work by Altering Chemical Signaling in the Brain

Two Classes of Chemical Signals in the brain

Neurotransmitters

Neurohormones

Two Ways a Drug Affects Neural Signaling

Agonist for chemical signal

Antagonist for chemical Signal

In order to understand drug action must have a good understanding of chemical signaling in brain

Neuronal communication



Generalized Synapse (Major Drug Events)

Most neurotransmitters are either AA, modified AA, or peptides



Why are Some Neuroactive Drugs Addictive?

Older Model of Addiction

Tolerance and Withdrawal Problem With Older Model Newer Model of Addiction



Tegmentostriatal branch of Mesolimbic/Mesocortical Pathway

Effects of Different Drugs of Abuse

Type of Drug Major Synaptic Effects

Amphetamine, Methamphetamine	Promote DA release Inhibit Dopamine and NE Reuptake	
Cocaine	Reverses Dopamine Reuptake Transporter	
Heroin, Morphine,Codeine	Activate endogenous opiate receptors	
Alcohol, Benzodiazepines & Barbiturates	GABA _A agonist (allosteric modulators)	
Caffeine	Blocks adenosine receptors	
Nicotine	Activates Acetylcholine nicotinic receptors	
Marijuana (THC)	Activates endogenous cannabinoid receptors	

All Drugs of Abuse cause dopamine release in the nucleus accumbens!! (either directly or indirectly)

Some diseases treated with therapeutic drugs

Diseases are mainly diseases of modulatory neurotransmitters, defects in Glutamic Acid or GABA often fatal

Disorder	Neurotransmitter Malfunction	Problem	Drug Treatment
Schizophrenia	Dopamine	Receptor Hypersensitivity	Dopamine antagonists
ADHD or ADD	Dopamine	Receptor insensitivity	Dopamine agonists
Parkinson's Disease	Dopamine	Neuron Degeneration	Dopamine agonists
Depression	Serotonin/Norepinephrine	Receptor insensitivity	Serotonin/ Norepinephrine agonists
Obsessive/ Compulsive Disorder	Serotonin	Receptor insensitivity	Serotonin agonists
Manic/Depressive Disorder	Serotonin?	Receptor hypersensitivity?	Lithium
Alzheimer's Disease	Acetylcholine	Neuron Degeneration	Acetylcholine agonists

Learning more about Drug Effects in the Brain at Lehigh

Must first learn how Brain works

Bios 120: Biology Core III: Integrative and Comparative

Bios 276: Central Nervous System and Behavior

Bios 315: Neuropharmacology

Most students taking these courses major in BNS, Biology, Molecular Biology, or Biochemistry

