How Can Mental Disorders Be Explained Biologically?

Chapter 14 – Addiction, Mood Disorders, Schizophrenia, Autism

Addiction and Drug Use

Addiction appears paradoxical because people repeatedly engage in behaviors that harm them. Although addiction is often associated with alcohol and drugs, it can also involve behaviors such as gambling, gaming, and overeating. Addiction is closely related to changes in the brain’s reward system, particularly dopamine pathways.

Drug Mechanisms

Drugs affect the brain by influencing neurotransmitter activity. Agonists mimic or enhance neurotransmitter effects, while antagonists block them.

Mixed agonist-antagonists have both effects depending on the neurotransmitter.

Drugs can increase or decrease neurotransmitter synthesis, cause leakage, block reuptake, or act on postsynaptic receptors.

Affinity refers to how well a drug binds to a receptor, while efficiency describes how strongly it activates that receptor.

Reward System and Dopamine

- Research by Olds and Milner showed that rats repeatedly stimulated brain areas that increased dopamine release in the nucleus accumbens.
- Sex, video games, gambling, and drugs act on this same reward pathway.
- According to Berridge and Robinson, dopamine is associated with motivation or 'wanting' rather than pleasure or 'liking'. In contrast, people with depression show reduced activity in this reward region.

Craving and Brain Changes

- Craving is central to addiction and involves an intense desire for the substance or behavior, even after long periods of abstinence.
- Craving is driven by environmental cues and does not necessarily involve pleasure.
- Repeated exposure to addictive substances reduces responsiveness to natural rewards such as food and sex and disrupts the prefrontal cortex, impairing impulse control and decision-making.

Tolerance and Withdrawal

- Tolerance occurs when repeated drug use leads to reduced effects, causing individuals to increase dosage. Tolerance is partly learned and context-dependent.
- Withdrawal occurs when the body adapts to drug presence and reacts strongly in its absence.
- Symptoms vary by substance, such as vomiting and sweating for opiates and shaking and nausea for alcohol.
- Although withdrawal avoidance contributes to addiction, it does not fully explain continued craving.

Predisposition and Genetics

- Research demonstrates that some brain differences exist before addiction develops.
- Studies of siblings show shared abnormalities in brain structure regardless of addiction status.
- Genetic studies indicate strong heritability for substance abuse, especially alcohol and cocaine, but no single gene is responsible.
- Many genes contribute small effects and often overlap with other disorders, such as bipolar disorder and ADHD.

Environment and Alcoholism

- Environmental factors significantly influence addiction.
- Prenatal alcohol exposure increases the risk of alcoholism.
- Childhood supervision can reduce impulsive behavior even in genetically vulnerable individuals.
- Two types of alcoholism exist: Type II (early onset, genetic, severe) and Type I (later onset, stress-related, less severe and more treatable).

Treatment of Addiction

- Some individuals quit addiction without assistance, while others require therapy or medication. Antabuse causes nausea when alcohol is consumed, reinforcing abstinence.
- Methadone is used to treat opiate addiction by activating the same receptors as heroin but producing slower and milder effects, reducing withdrawal symptoms and health risks. Research is ongoing into drugs that reduce craving.

Mood Disorders

- Mood disorders result from interactions between biological factors and life experiences.
- Depression can be triggered by traumatic events, genes, hormonal changes, tumors, or head injuries. These disorders involve long-lasting changes in mood rather than temporary emotional reactions.

Major Depression

- Major depression is a prolonged disorder characterized by loss of pleasure, suicidal thoughts, sleep problems, lack of energy, poor concentration, and feelings of helplessness.
- It affects about 10% of people during their lifetime and is more common in women. Depression usually occurs in episodes, and later episodes may arise without clear triggers.

Biological Basis of Depression

- Depression has moderate heritability and is more common among individuals with female relatives who experienced early-onset depression.
- Certain genes increase sensitivity to environmental stress rather than directly causing depression.
- Brain imaging shows reduced activity in the left prefrontal cortex and increased activity in the right prefrontal cortex among depressed individuals.

Antidepressant Drugs

- Tricyclic antidepressants block reuptake of serotonin, dopamine, and norepinephrine but have strong side effects. SSRIs selectively block serotonin reuptake with milder side effects.
- MAOIs inhibit monoamine oxidase and are used when other drugs fail.
- Atypical antidepressants, such as St. John's wort, operate similarly to SSRIs. Behavioral improvement occurs weeks after synaptic changes.

Alternative Treatments for Depression

- Electroconvulsive therapy (ECT) is effective for treatment-resistant depression but may cause memory loss. Repetitive transcranial magnetic stimulation is moderately effective.
- Sleep deprivation can temporarily relieve depression, and regular exercise is an effective supportive treatment. These methods increase neurogenesis in the hippocampus.

Types of Mood Disorder

- **Unipolar depression** is characterized by recurrent depressive episodes, with mood fluctuating between normal functioning and depression, and **no history of manic or hypomanic episodes**.
- **Bipolar disorder** involves alternating mood states of depression and elevated mood and is divided into **Bipolar I** and **Bipolar II** disorders.

antidepressants.

Types of Mood Disorder

- **Bipolar I disorder** includes at least one **manic episode**, characterized by abnormally elevated or irritable mood, excessive confidence, increased energy, decreased need for sleep, and poor impulse control; depressive episodes commonly also occur.
- **Bipolar II disorder** involves **hypomanic episodes**, which are less severe and shorter than full mania, along with major depressive episodes; hypomania does not typically cause severe impairment or require hospitalization.

Types of Mood Disorder

Bipolar disorders have a strong genetic basis and are primarily treated with **mood stabilizers** such as **lithium**, **valproate**, or **carbamazepine**, rather than antidepressants alone, which may trigger manic or hypomanic episodes

Schizophrenia Overview

- Schizophrenia is marked by hallucinations, delusions, disorganized thinking, movement abnormalities, and inappropriate emotional expressions.
- It can be acute with sudden onset or chronic with gradual development. The disorder affects about 1% of the population and is slightly more common in men.

Symptoms of Schizophrenia

- Positive symptoms include hallucinations, delusions, and disorganized behavior.
- Negative symptoms involve reduced emotional expression, social withdrawal, impaired memory, and lack of motivation.
- Disordered thinking and working memory impairment are central features.

Symptoms of Schizophrenia

Positive:

Delusions

Hallucinations

Disorganized speech

Negative:

Flattened affect

Reduced speech

Lack of initiative

Biological and Developmental Factors

- Schizophrenia is associated with high dopamine activity and has a strong genetic component, although no single gene causes it.
- The DISC1 gene has been implicated.
- The disorder may result from new mutations, especially in children of older fathers. Neurodevelopmental problems before or during birth increase risk.

Brain Abnormalities in Schizophrenia

- Observed brain differences include smaller thalamus, enlarged ventricles, reduced cortical and hippocampal volume, delayed maturation of the prefrontal cortex, and reduced activity in the left hemisphere.
- It is unclear whether these changes cause schizophrenia or result from treatment.

Treatment of Schizophrenia

- Antipsychotic drugs block dopamine receptors in the mesolimbic system.
- First-generation drugs may cause tardive dyskinesia. Second-generation drugs have fewer motor side effects but can impair immune function.
- The glutamate hypothesis suggests underactive NMDA receptors contribute to symptoms.

Autism Spectrum Disorder

- Autism is a neurodevelopmental disorder affecting social interaction, communication, and behavior.
- It affects approximately 1 in 160 people worldwide and is more common in boys.
- Increased diagnosis reflects greater awareness and broader diagnostic criteria.

Symptoms of Autism

- Autism involves deficits in social and emotional interaction, limited nonverbal communication, repetitive behaviors, resistance to change, and abnormal sensory responses.
- Many individuals with autism also have ADHD, motor coordination problems, or exceptional perceptual abilities.

Genetic and Prenatal Influences

- Autism results from numerous genetic mutations and microdeletions rather than a single gene. Mutations often originate from the father and are more common with advanced paternal age.
- Prenatal influences include maternal antibodies affecting brain proteins and folic acid deficiency.

Treatment of Autism

- There is no medication that cures core social and communication difficulties.
- Risperidone can reduce repetitive behaviors but has side effects. Behavioral interventions involving therapists, parents, and teachers are most effective.
- Alternative treatments lack scientific evidence of effectiveness.