

ADDICTIONS

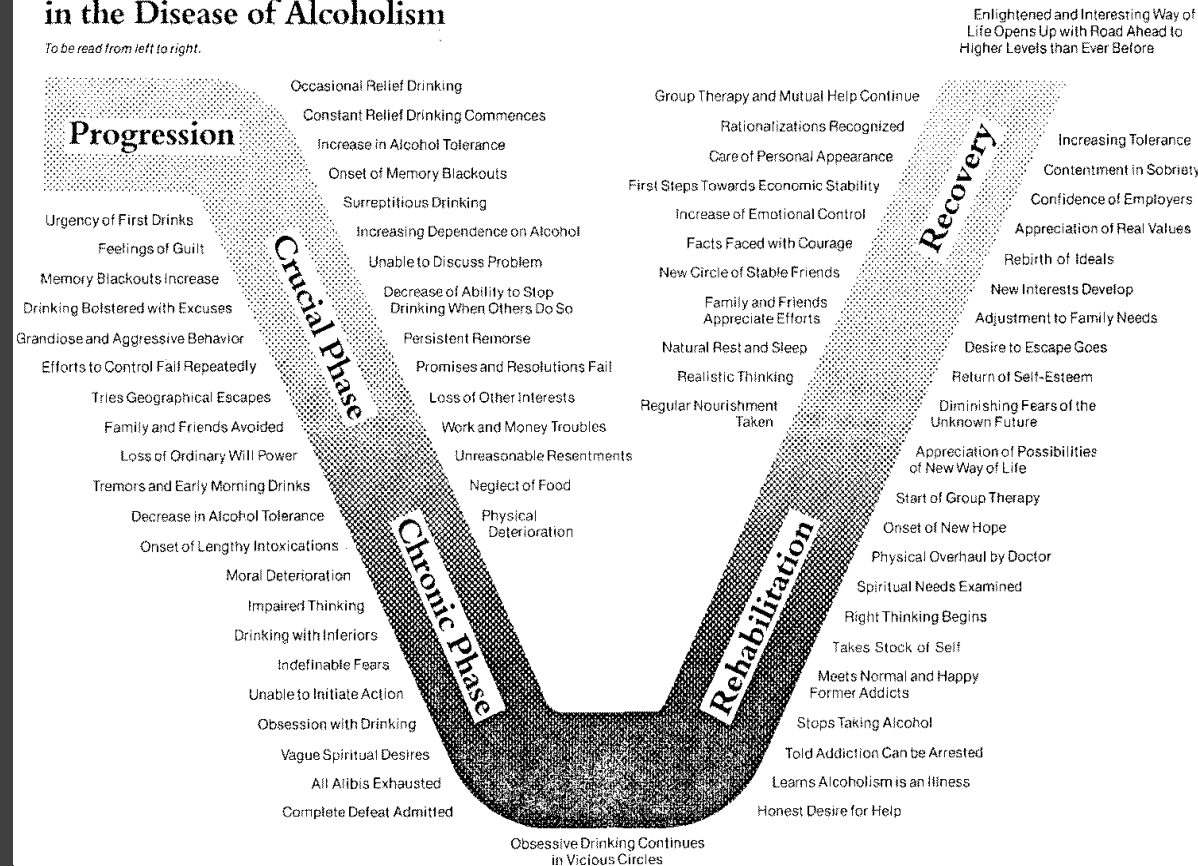
BIOLOGICAL BASIS OF ADDICTIONS

Disease model of addiction

- Created in mid 20th century by Elvin Morton Jellinek
- Addiction comes from underlying disease processes
- The curve of progression and recovery

The Progression and Recovery of the Alcoholic in the Disease of Alcoholism

To be read from left to right.



Disease model of addiction

- At first, these processes were not understood. But it was assumed it is 1) brain disease and with 2) genetic susceptibility
- Addicted person is a victim of this disease - not chosen and not an act of free will
- Loss of control & craving as the common processes in addictions
- Consumption of the substance causes craving for further doses (but at first unknown psychological and neurological mechanism)

Disease model of addiction

- Since the person is ill and suffering, he/she should be subject of medical treatment
- Treatment was based on management of medical complications (stomach ulcer, liver disease,...) and raising patient health education – supervision of a physician
- Therapy-like approach heavily influenced by 12 step program and 12-step programs take ideological support from scientific approach of disease model

Disease model of addiction

- **Addiction as a primary disease** – addiction is not understood a result of another condition (other psychiatric condition, stress,...) but rather their cause
- **Addiction as a progressive disease** - addiction is understood as a disease that has its course: 1) adaptive stage - increasing tolerance 2) dependent stage - withdrawal and maintenance usage 3) deterioration stage - resulting into major health and social problems
- **Addiction as a chronic disease** – addiction is understood as a disease that will never disappear and the person will never be fully cured. Complete sobriety is the only way

Disease model of addiction - pros

- The classic disease model is still very simple to be understood by general public
- Big leap in knowledge, new research
- Removes stigma from suffering people
- When addiction became a disease (alcoholism as disease was acknowledged by American Medical Association in 1954) the help became more accessible

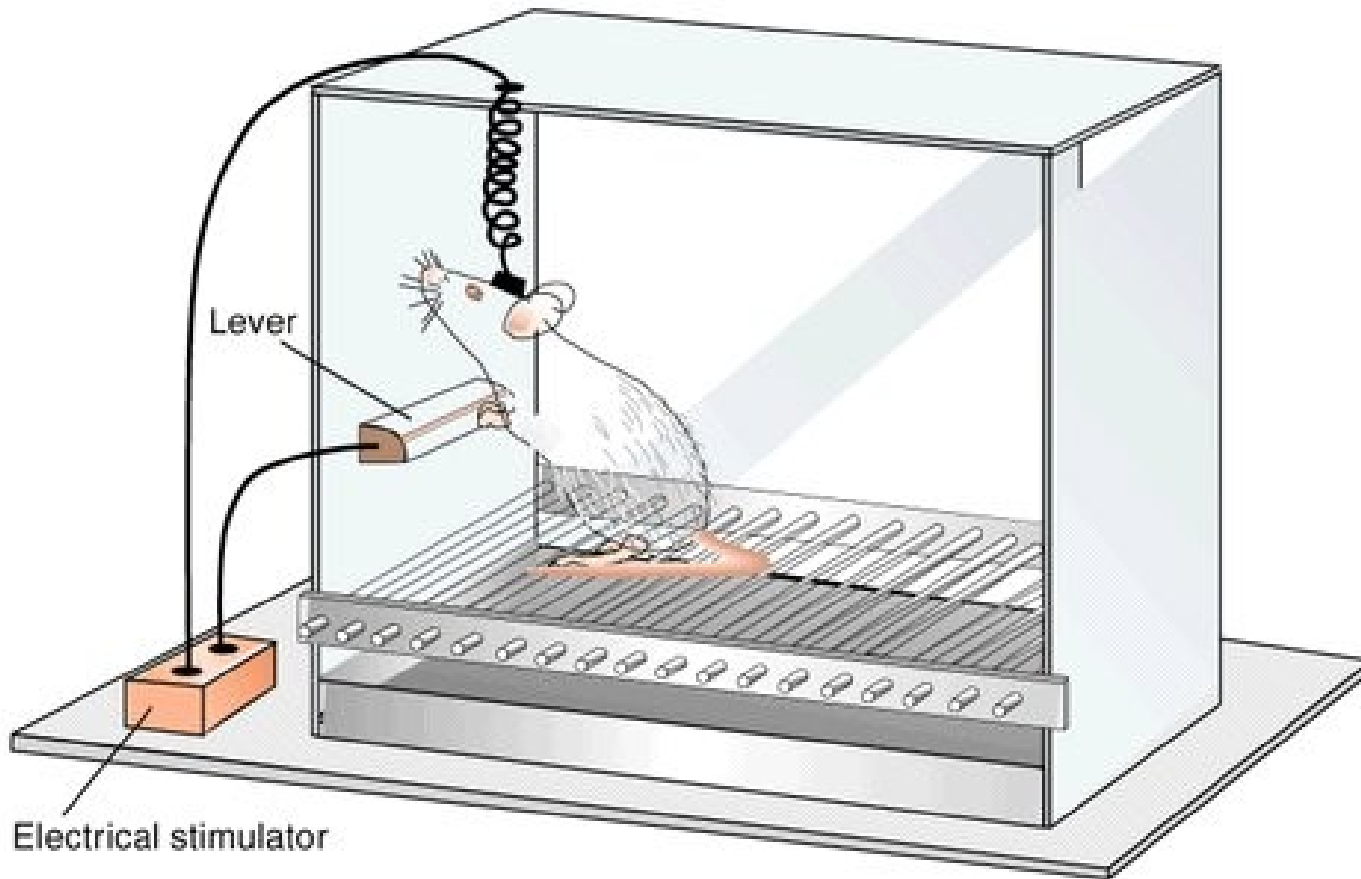
Disease model of addiction - cons

- Despite huge advancement in knowledge, it was only poorly incorporated into this model. E.g. proofed usefulness of light substance taking contradicts chronic disease; natural remission and maturing out contradicts progressive disease; much stronger environmental factors contradict primary disease
- Ignoring context - too little emphasis on psychological and social factors
- The treatment method, although advancement at the beginning, is way behind treatments based on psychological and social models

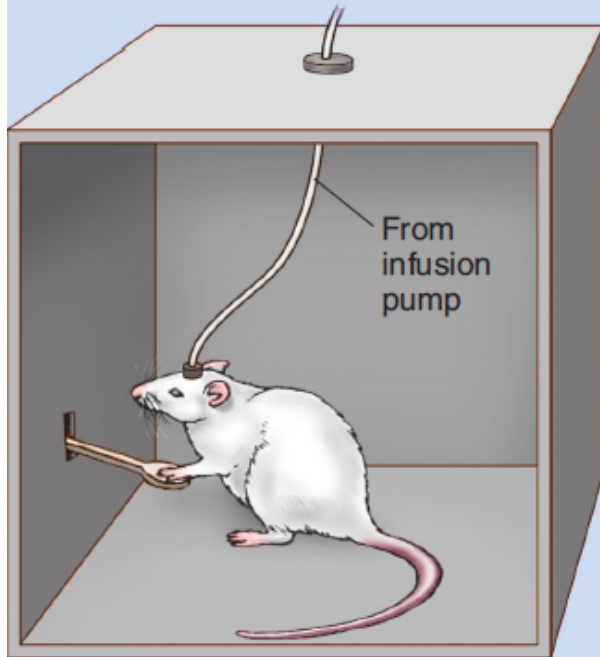
Physical
dependency
theory

It is about
(anticipated)
pleasure

Intracranial self-stimulation



Drug Self-Administration




The rat presses the lever to self-inject a drug, either into an area of its brain or into general circulation.

Conditioned Place Preference



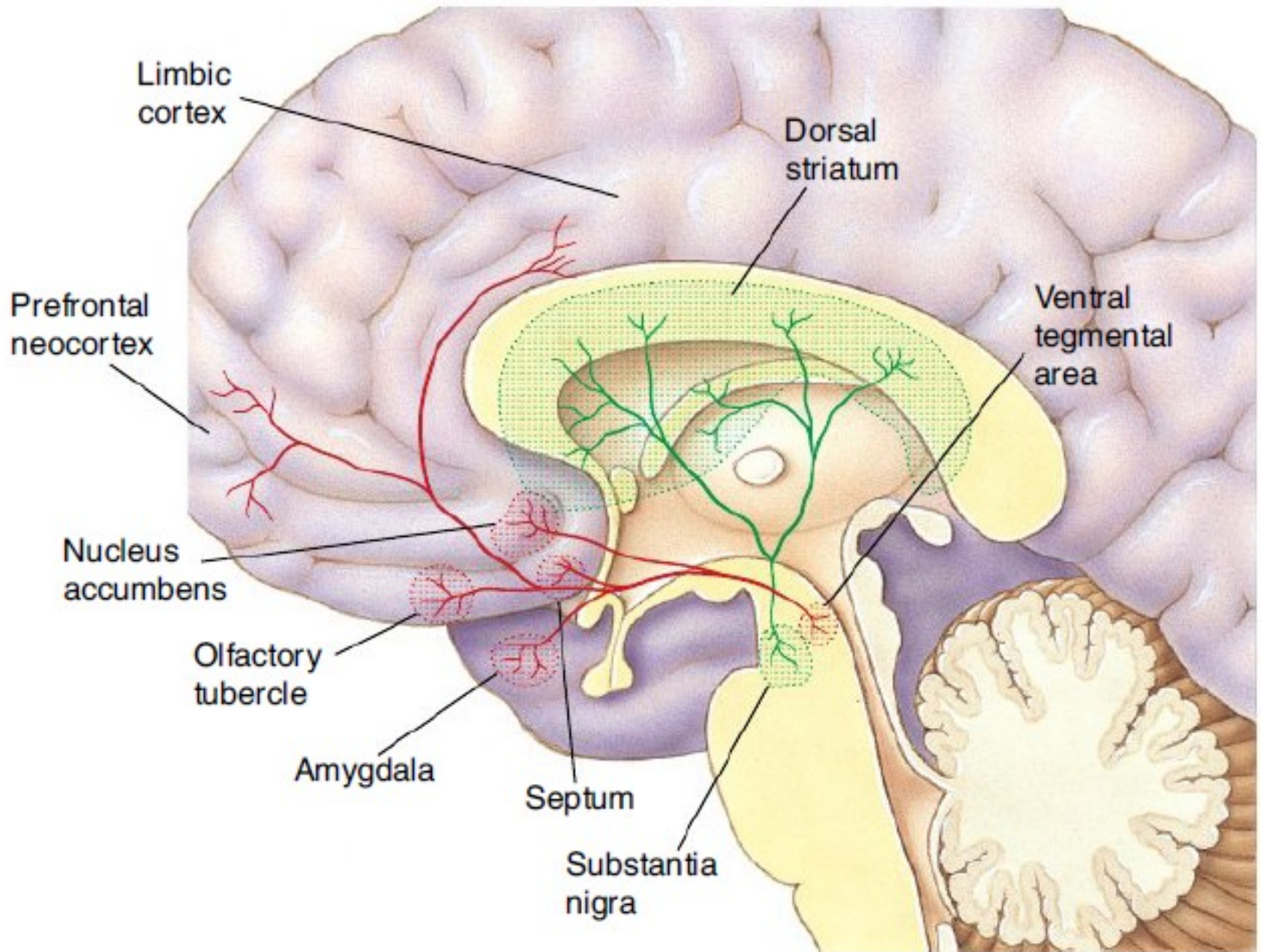
A rat repeatedly receives a drug in one of two distinctive compartments. Then, on the test, the tendency of the rat, now drug-free, to prefer the drug compartment is assessed.

Mesolimbic
dopamine
pathway



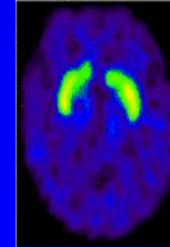
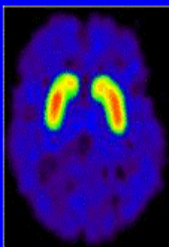
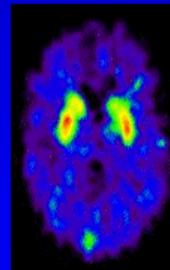
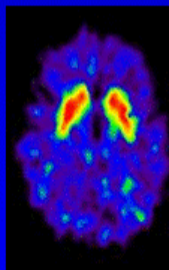
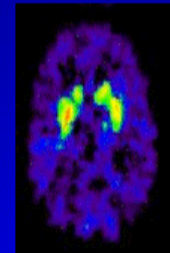
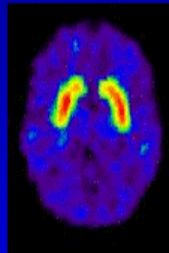
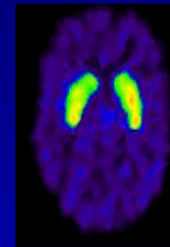
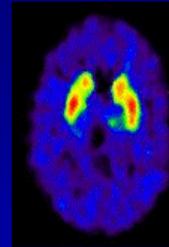
Mesolimbic pathway and addiction

- In animals, drugs self-administered to nucleus accumbens had stronger effect and were preferred. It correlated with increase on dopamine release
- All drugs affect dopamine functions. Many drugs work as direct dopamine agonists while the rest of drugs have indirect effect
- Brain imaging techniques showed massive dopamine involvement in nucleus accumbens. They also showed decrease of dopamine D2 receptors availability in addicts leading to increasing tolerance
- Mesolimbic pathway gradually sticks to the addiction object to which it is hypersensitive while under sensitive to other stimuli – *hijacked brain*
- <https://www.youtube.com/watch?v=NxHNxmJv2bQ>



Functionally...

Dopamine D2 Receptors are Decreased by Addiction



Control

Addicted



Genetics
and
addiction

Genetics and addiction

- Genes and environment determine addiction together
- Inherited characteristic is a predisposition/risk factor, not a disease itself – addiction is a complex phenomenon with no single one determining factor
- Research on genetics of addiction is not to push people back and feel miserable of unchangeable. It is for better treatment and prevention

Genetics and addiction

- Candidate gene studies – they try to find the concrete gene that is associated with the disease
- Difficult to find such gene – many possible candidates and often contradicting results
- Uncertainty about how much unique impact these genes have

Reward- deficiency syndrome

Reward-deficiency syndrome

TABLE 1
The Reward Deficiency Syndrome Behaviors (RDS)*

Addictive Behaviors	Impulsive Behaviors	Compulsive Behaviors	Personality Disorders
Severe Alcoholism	Attention-Deficit Disorder & Hyperactivity	Aberrant Sexual Behavior	Conduct Disorder
Polysubstance Abuse	Tourette Syndrome	Internet Gaming	Antisocial Personality
Smoking	Autism	Pathological Gambling	Aggressive Behavior
Obesity			Generalized Anxiety

*Reproduced from Blum et al. 1996a with permission

Evolution and addiction

- **Mismatch hypothesis**
- Addiction is a by-product of our brain structure
- Reward system has significant evolutionary advantage, however, it brings susceptibility when high-dopamine sources become vastly available
- **High-dopamine society** – humans have much stronger dopamine system than other primates. That probably evolved with increased consumption of meat and fish oil. Higher levels of dopamine in reward system increased our activity, motivation, orientation to goals, intelligence. People with lower dopamine functions (reward deficiency syndrome) have higher chance to misuse high dopamine sources

Evolution and addiction

- **Mutualism hypothesis** – plant-herbivore coevolution
- Mammals have a long history of drugs-in-plants preference
- Humans and mammals have preferences to consume toxins in plants (e.g. nicotine, caffeine) as they were useful against parasites and bacteria
- Humans and some mammals have preferences to ethanol (fermented in fallen fruits)

Evolution and addiction

- **Life-history theory**
- Clear demographic pattern – males in their teenage and twenties are by far the most susceptible group
- The same group is also at risk of risk-taking, violence, sensation-seeking,... - product of sexual selection – young male syndrome
- Substance use and abuse is part of general risk-taking behaviours
- Both risk taking and addictive behaviours decrease after mid 30s and after the person settles down
- Higher risk taking is evolutionary effective in certain scenarios (e.g. during migration). Quantity vs quality investment strategy