

**The Science of Addiction  
for Non-Scientists**  
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**In proportion to our body mass, our brain is three times as large as that of our nearest relatives. This huge organ is dangerous and painful to give birth to, expensive to build and, in a resting human, uses about 20 per cent of the body's energy even though it is just 2 percent of the body's weight. There must be some reason for all this evolutionary expenses.**

*Susan Blakemore, March, 1999*

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**How the brain behaves in health and disease may well be the most important question in our lifetime.**

*Richard D. Broadwell, 1995*

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# What Can Neuroscience Teach Us About Addiction?

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## The Problem With Addiction Throughout History



### The Big Question

#### What is it?

- Disease?
- Behavioral Problem?
- Self-inflicted Vice?
- Moral/Emotional Weakness?

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- Abuse of alcohol and other drugs are preventable behaviors
- Alcohol and drug addiction is a disease that people can recover from
- Recovery from addiction is a reality and happens *every day*

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1) That it is a disease

- a) Can be reliably produced and easily recognized in animals.
- b) Patterns of intake resemble humans' - drug for drug.

2) Follows behavioral symptoms of other chronic diseases.

(resistance, denial, anger, relapse etc)

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3. Some scientific explanation for irrational behavior in otherwise rational people

Helps explain the unexplainable.

Why is this important ?

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**Does not excuse the addict from taking care of his/her disease BUT it can:**

- 1. Help person understand their cravings (for relapse prevention planning).**
- 2. Reduce stigma, blame and anger (both for family and self).**

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Why do people use alcohol and other drugs?



*Drawings courtesy of Vivian Felsen*

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## Neuroscience of Addiction

### The Brain

- Unique among all other organs of the body.
- Each area is highly specialized yet works intimately together to perform functions.

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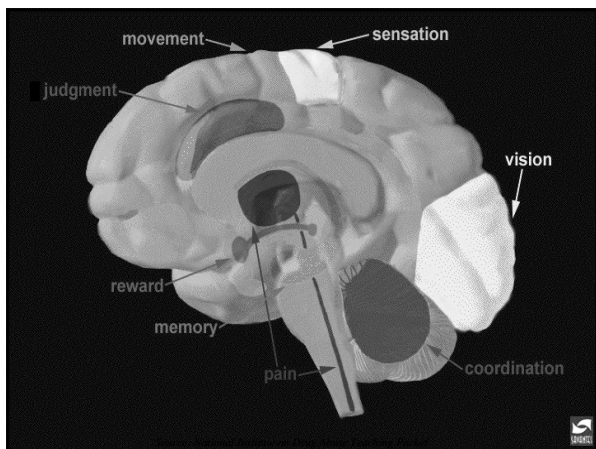
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## Communication of the Brain

- ☐ Neuron = Nerve Cell
- ☐ We have around 100 billion of them
  
- ☐ Nerve cells have many different shapes, depending on the cluster of specialization in the brain.

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## Neuroscience of Addiction

### *Key Concept:*

Synapse - Specialized contact between two nerve cells where signals are transmitted from one nerve cell to the other via the Neurotransmitters.

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Contain a detection mechanism for threshold:  
small voltage - dismiss  
large voltage - light up

Electric signal (in nerve cell) changes to chemical signal at the synaptic cleft, and then back to electrical in the next nerve cell (in 1/1000 of a second).

The chemicals are the Neurotransmitters.

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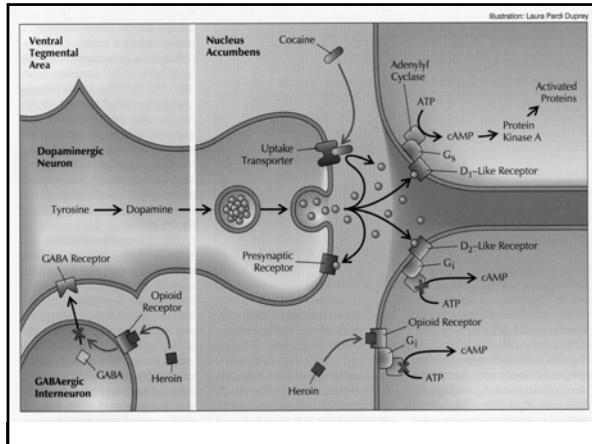
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The system that has been captured by the drug of abuse is a complex system that sets behavioral priorities.

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**Where Addiction Starts!**

- ☑ Called by many names (mesolimbic system, old brain, primitive brain, reptilian brain etc)
- ☑ Creates powerful “emotional memories” (both fear and pleasure) that drive behavior in all of us for survival.

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***Key Concept:***

- ▣ Takes place in “primitive” part of the brain built for survival.
- ▣ Connected to the Amygdala – factory of emotions.
- ▣ Affects the part connected to prefrontal cortex – “thinking” brain.

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**The Neuroscience Model of Addiction**

**Personal vulnerability modulating  
the effects of a drug on  
powerful motivational systems  
in the brain.**

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***Key Concepts cont:***

- ▣ Overrides the factual memory storage of the hippocampus.
- ▣ Thus behavior (e.g.. repeated relapses) that “flies” in the face of logic now makes sense.
- ▣ Does not imply that it is untreatable or unavoidable!

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# Neuroscience of Addiction

## What is addiction?

### Different From Tolerance

“Reduced drug effect with repeated administration of the same dose of a drug, or need for an increased dose to maintain the same level of effect.”

### Difference From Dependence

“When drug cessation produces pathologic symptoms and signs.”

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## Addiction is . . .

A special case of dependence which:

- manifests as compulsive non-medical use of a substance
- loss of control over its use
- despite negative consequences

Physical dependence (i.e. withdrawal symptoms when drug is removed from the body) although often involved, is not an adequate indicator of addiction.

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### EXAMPLE:

- Cocaine - highly addictive, however, no classic withdrawal.
- Clonidine - produces physical dependence without producing addictive behaviors.

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**Other Factors Contributing to Onset of Addiction**

**Vulnerabilities: (Individual)**

- Genetic
- Developmental / Emotional
- Psychiatric Co-morbidity
- Chronic Pain
- Stress
- Users Goals (experimentation, escape, self-medication)

These vulnerabilities can change over time.

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**Other Factors Contributing to Onset of Addiction**

**Environmental Vulnerabilities:**

- Availability
- Acceptability = Pressure
- Alternatives to Drug Use
- Settings (religious, parties, alone)
- Presence of Conditioned Cues

**Drug Effects:**

- Drug Itself
- Purity
- Route of Administration
- Dose
- Frequency
- Chronic Use

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**Neuroscience of Relapse**

1. Complex triggers and anchors which can be internal and/or external sets off physiological chain reaction in the body
2. Examples of external triggers:
  - Cash
  - Fridays
  - Using “buddies”
3. Examples of internal triggers:
  - Loneliness
  - Celebration
  - Emotional pain

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