

ASAM REVIEW COURSE 2023

Neurobiology of Addiction: Key Concepts and Models

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Financial Disclosure

Petros Levounis, MD, MA

- No relevant disclosures

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LEARNING OBJECTIVE

Identify key neurotransmitters, brain pathways, and brain structures implicated in addiction and addiction treatment.

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Outline

- 1 Neurotransmitters
- 2 The Fundamental Model
- 3 The New and Improved Model
- 4 Treatments

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Neurotransmitters

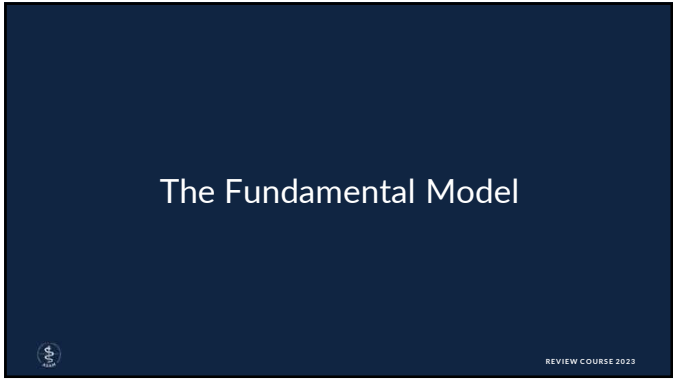
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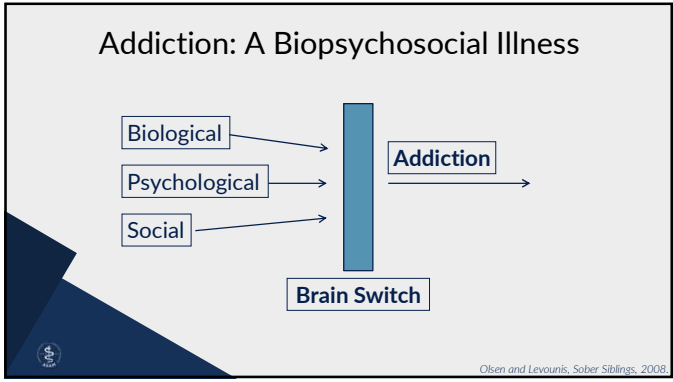
Substance	Endogenous Neurotransmitter
Alcohol	GABA / Glutamate*
Amphetamines & Cocaine	Dopamine
Benzodiazepines & GHB	GABA
Cannabis	Anandamide
Hallucinogens & MDMA	Serotonin
Nicotine	Acetylcholine
Opioids	Endorphins
Phencyclidine & Ketamine	Glutamate*

*Drug acts as an antagonist at the NMDA subtype of the glutamate receptor.

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The Root Cause of the Disaster

ADDICTION RARE IN PATIENTS TREATED WITH NARCOTICS

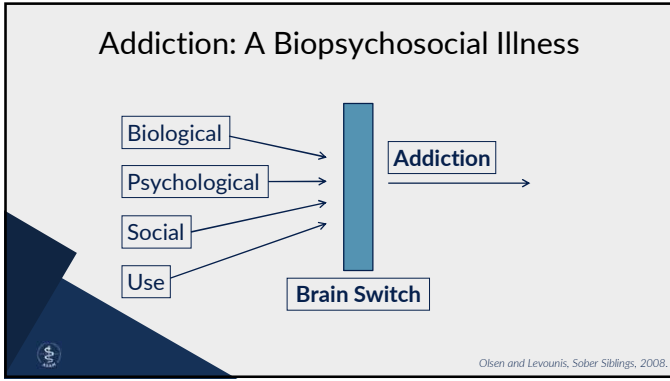
To the Editor: Recently, we examined our current files to determine the incidence of narcotic addiction in 39,746 hospitalized medical patients who were monitored consecutively. Although there were 11,882 patients who received at least one narcotic preparation, there were only four cases of reasonably well documented addiction in patients who had no history of addiction. The addiction was considered major in only one instance. The drugs implicated were meperidine in two patients, Percodan in one, and hydromorphone in one. We conclude that despite widespread use of narcotic drugs in hospitals, the development of addiction is rare in medical patients with no history of addiction.

JANE PORTER
HASKINS, JR., M.D.
Boston Collaborative Drug
Surveillance Program
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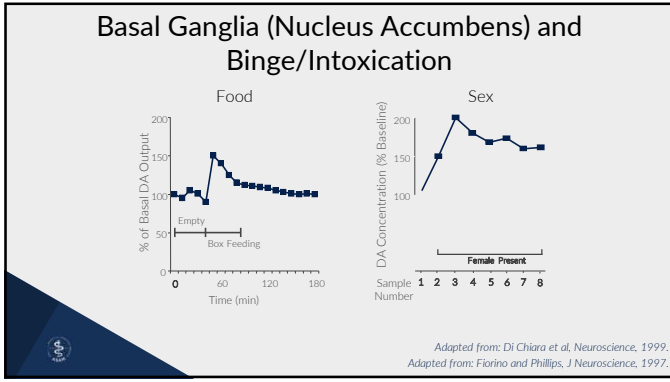
1. Jick H, Mattiello OS, Shapiro S, Lewis GP, Siskind Y, Stone D. Comprehensive drug surveillance. JAMA. 1970; 213:1455-60.
2. Miller RR, Jick H. Clinical effects of meperidine in hospitalized medical patients. J Clin Pharmacol. 1978; 18:169-8.

Porter and Jick, N Engl J Med, January 10, 1980.

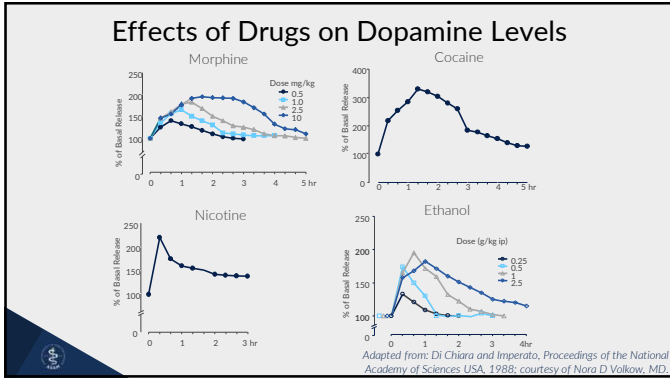
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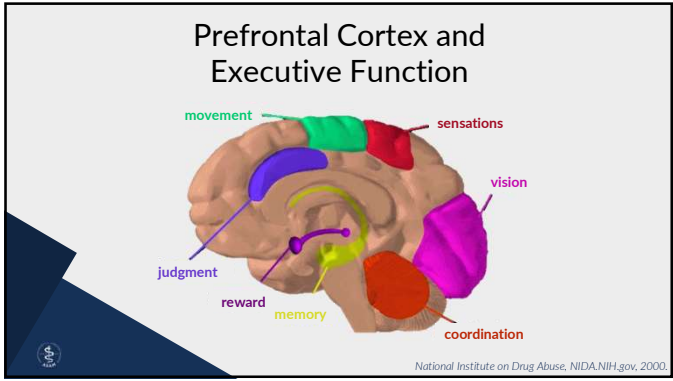
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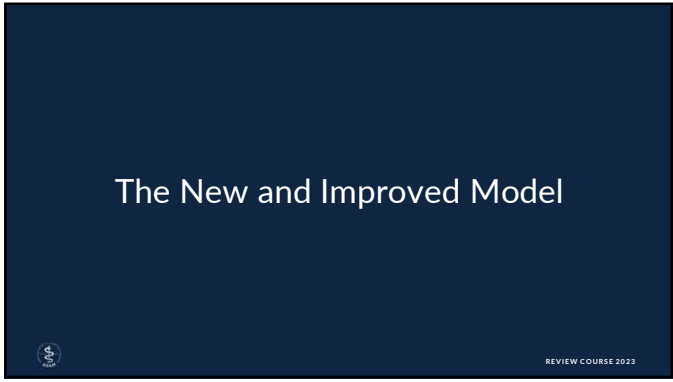
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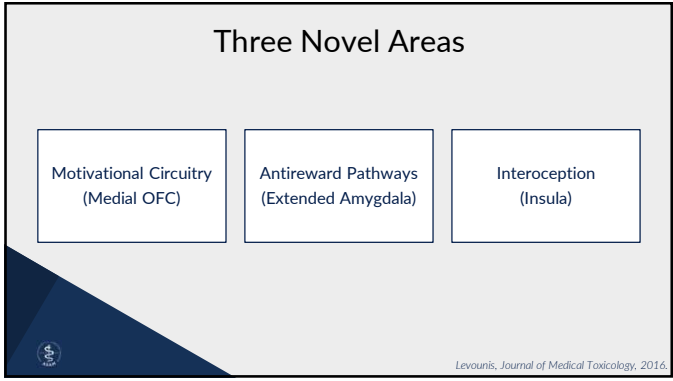
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Medial Orbitofrontal Cortex (OFC) and Preoccupation/Anticipation

Levounis, Amsout, and Marienfeld, Motivational Interviewing for Clinical Practice, 2017.

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Extended Amygdala and Withdrawal/Negative Affect

Koob, American Journal of Psychiatry, 2020.

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Reward Systems

Game #1

- A. A sure gain of \$250
- B. 25% chance to gain \$1,000, 75% chance to gain nothing.


Adapted from: Tversky and Kahneman, Science, 1981.

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Reward Systems

Game #1

- A. A sure gain of \$250 84%
- B. 25% chance to gain \$1,000, 75% chance to gain nothing 16%




Adapted from: Tversky and Kahneman, Science, 1981.

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Anti-Reward Systems

Game #2

- A. A sure loss of \$750
- B. 25% chance to lose nothing, 75% chance to lose \$1,000.




Adapted from: Tversky and Kahneman, Science, 1981.

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Anti-Reward Systems

Game #2

- A. A sure loss of \$750 13%
- B. 25% chance to lose nothing, 75% chance to lose \$1,000. 87%



Adapted from: Tversky and Kahneman, Science, 1981.

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Human Nature

People avoid risks to ensure gains.	People take risks to avoid definite losses.	Psychology trumps probability.
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The Ultimate Gatekeeper: Insula

sensual touch
thirst temperature
INTEROCEPTION
PAIN hunger
itch breathlessness

Zerbo, Schlechter, Desai, and Levounis, *Becoming Mindful*, 2017.

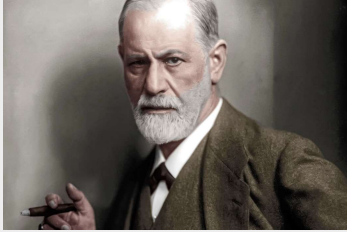
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Treatments

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1st Wave: Psychoanalysis



A portrait of Sigmund Freud, an elderly man with a white beard, wearing a dark suit and tie, holding a cigar.

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2nd Wave: Boot Camps

The prototype, synanon, was founded in California in 1958 to address heroin addiction. The goal was to:

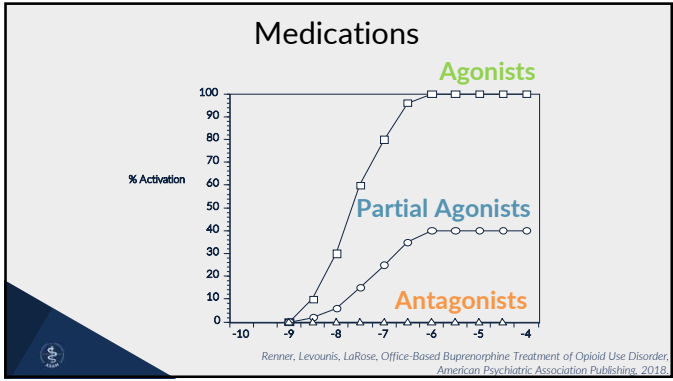
- break down defenses,
- bust through denial, and
- reshape the individual's personality.

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3rd Wave: Current Treatments

Medications	Mutual Help	Psychotherapy and Counseling
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Mutual Help

MEDICAL STAFF	PATIENTS	WHAT MEDICAL STAFF THINK PATIENTS THINK
1. Housing	1. Inner Peace	1. Housing
2. Government	2. God	2. Outpatient Treatment
3. Medical Services	3. Medical Services	3. Medical Services
4. Outpatient Treatment	4. AA	4. Job
5. Job	5. Housing	5. Trusting People
6. Community	6. Spirituality	6. AA
7. Trusting People	7. Outpatient Treatment	7. Inner Peace
8. Inner Peace	8. Community	8. Community
9. God	9. Government	9. Government
10. Spirituality	10. Trusting People	10. Spirituality
11. AA	11. Job	11. God

Goldfarb, American Journal of Drug and Alcohol Abuse, 1996.

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4th Wave: Mindfulness

“Between stimulus and response there is a space. In that space is our power to choose our response. In our response lie our growth and our freedom.”

Victor E. Frankl

Frankl, Man's Search for Meaning, 1959.
Zerbo, Schlechter, Desai, and Levounis, Becoming Mindful, 2017.

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Digital Therapeutics (CBT Apps)

Report Your Status

Have you used today? Yes No

How strong is your craving right now?
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What triggers are affecting this craving?

HUNGRY n/a 4

ANGRY n/a 2

LONELY n/a 3

TIRED n/a 0

SOCIAL PRESSURE n/a 3

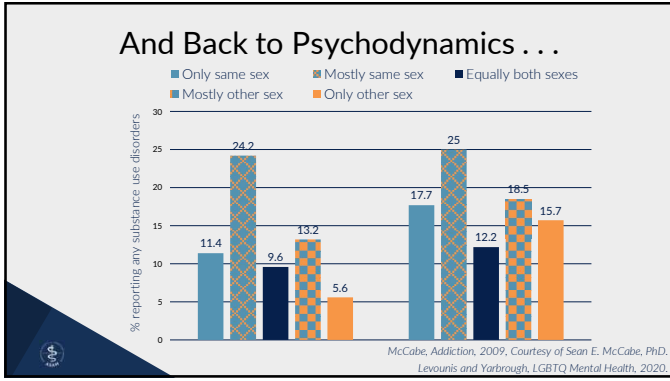
PAIN n/a 10

OTHER n/a 6

SUBMIT

Mood Tools.org

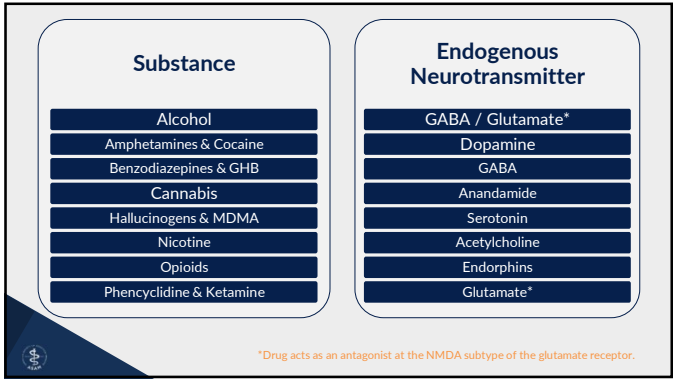
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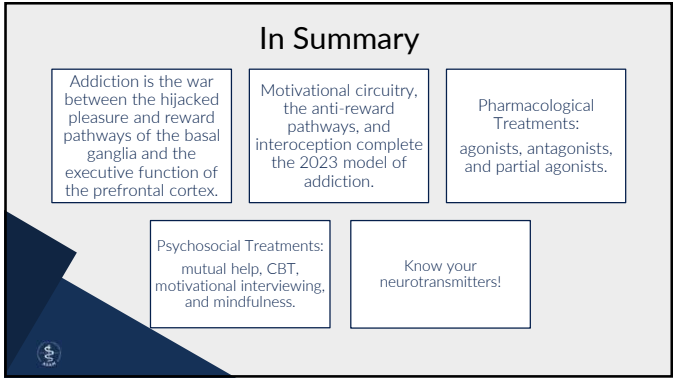
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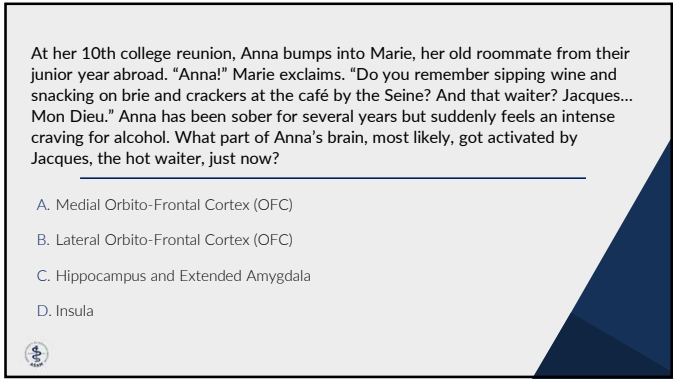
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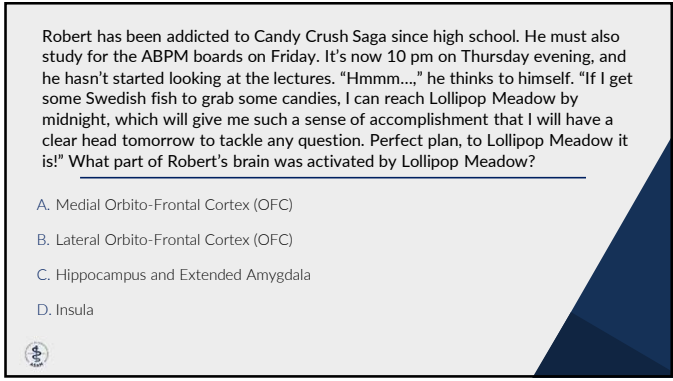
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Which part of the brain is responsible for integrating, giving meaning, and helping people understand sensations such as hot, cold, hungry, full, and thirsty—along with cravings for a drug such as tobacco?

- A. Medial Orbito-Frontal Cortex (OFC)
- B. Lateral Orbito-Frontal Cortex (OFC)
- C. Hippocampus and Extended Amygdala
- D. Insula




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Thank You






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