National Core Curriculum –Three Hour Virtual Overview

Part 2: Stimulants: Impact of Use on the Brain and Body

ATTC

Addiction Technology Transfer Center Network

Funded by Substance Abuse and Mental Health Services Administration

Curriculum Overview and Introductions

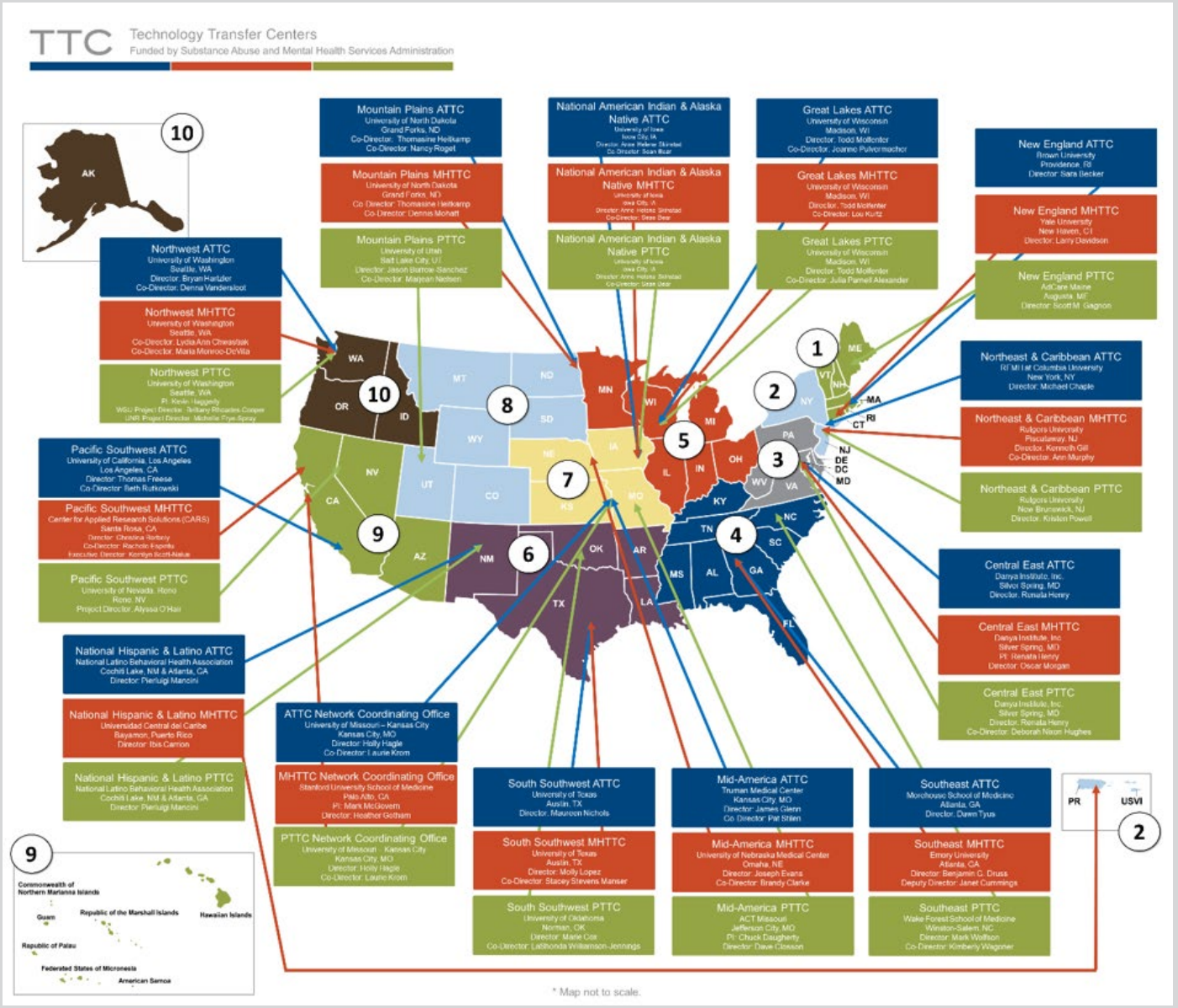
ATTC

SAMHSA
Substance Abuse and Mental Health Services Administration

About the ATTC Network

- **The ATTC Network is an international, multidisciplinary resource for professionals in the addictions treatment and recovery services field.**
- Established in 1993 by the Substance Abuse and Mental Health Services Administration (SAMHSA), the ATTC Network is comprised of 10 U.S.-based Centers, 6 International HIV Centers (funded by PEPFAR), 2 National Focus Area Centers, and a Network Coordinating Office.
- Together the Network serves the 50 U.S. states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and the Pacific Islands of Guam, American Samoa, Palau, the Marshall Islands, Micronesia, and the Mariana Islands. The International HIV ATTCs serve Vietnam, Southeast Asia, South Africa, and Ukraine.

The U.S.-Based TTC Network



ATTC Stimulant Workgroup Members

Co-Chairs

- Thomas E. Freese, Region 9
- Jeanne Pulvermacher, Region 5
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Members

- James Campbell, Region 4
- Bryan Hartzler, Region 10
- Holly Ireland, Region 3
- Laurie Krom, Lena Marceno, and Viannella Halsall, ATTC NCO
- Mary McCarty-Arias, Region 2
- Maureen Nichols, Region 6
- Nancy Roget, Region 8

Stimulant 101 National Curriculum

- Core Daylong Curriculum
- Condensed Three-Hour Virtual Overview
- Supplemental Modules
  - Child welfare issues, gender differences, stimulant use in the context of polysubstance use, rural vs. urban differences, stimulants and HIV, and recovery approaches
- Culture Modules
  - African American, American Indian/Alaska Native, and Latinx Populations

Three-Hour Virtual Overview

- Core Curriculum content provided in three 1-hour sessions:
  - Part 1: Stimulants - What are they and who uses them?
  - Part 2: Impact of Stimulant Use on the Brain and Body
  - Part 3: Effective Treatment Approaches and Recovery Supports

Core and Virtual Curriculum Authors

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Special Acknowledgements

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- **UCLA Integrated Substance Abuse Programs Training Department**

Daylong Curriculum Outline

- **Module 1:** Curriculum Overview and Introductions
- **Module 2:** The Scope of Stimulant Use in the United States and Beyond
- **Module 3:** Impact of Stimulant Use on the Brain and Body
- **Module 4:** Stimulant Use among Populations with Unique Concerns
- **Module 5:** Stimulants and HIV
- **Module 6:** Treatment Considerations for People who Use Stimulants
- **Module 7:** Long-Term Recovery Supports

Educational Objectives

At the end of Part 2 of the Stimulant 101 virtual training, participants will be able to:

1. Specify two examples of the cognitive impact associated with stimulant use.
2. Recall three ways stimulants physically impact the body.
3. Identify at least two factors that increase risk of violence among people who use stimulants.

Language Matters

SOURCE: Mid-America ATTC, 2017

Part 2 – Stimulant 101 Virtual Overview

The Impact of Stimulants on the Brain and Body

Let’s Start by Looking at What Happens in the Brain

Substance Use Disorder is a Brain Disease

- “Addiction is a brain disease”

  Alan Leshner, Ph.D.

  Former Director, National Institute on Drug Abuse
- This statement in the late 1990’s began to change the way drug abuse/dependence were viewed, at least by the medical and scientific communities
- Unfortunately, much stigma remains among general public as well as among healthcare providers

SOURCE: Leschner, 1997

A Quick Primer on the Human Brain - Neurons

- Primary information processors
- Communicate by sending electrical impulses down axon to dendrites
- Rate of firing on average is about 150 miles per hour
- Transmitting neuron communicates with receiving neuron by releasing neurotransmitters
- Neurotransmitters fit into receptors on receiving neuron and then are taken back into transmitting neuron to be used again (reuptake)

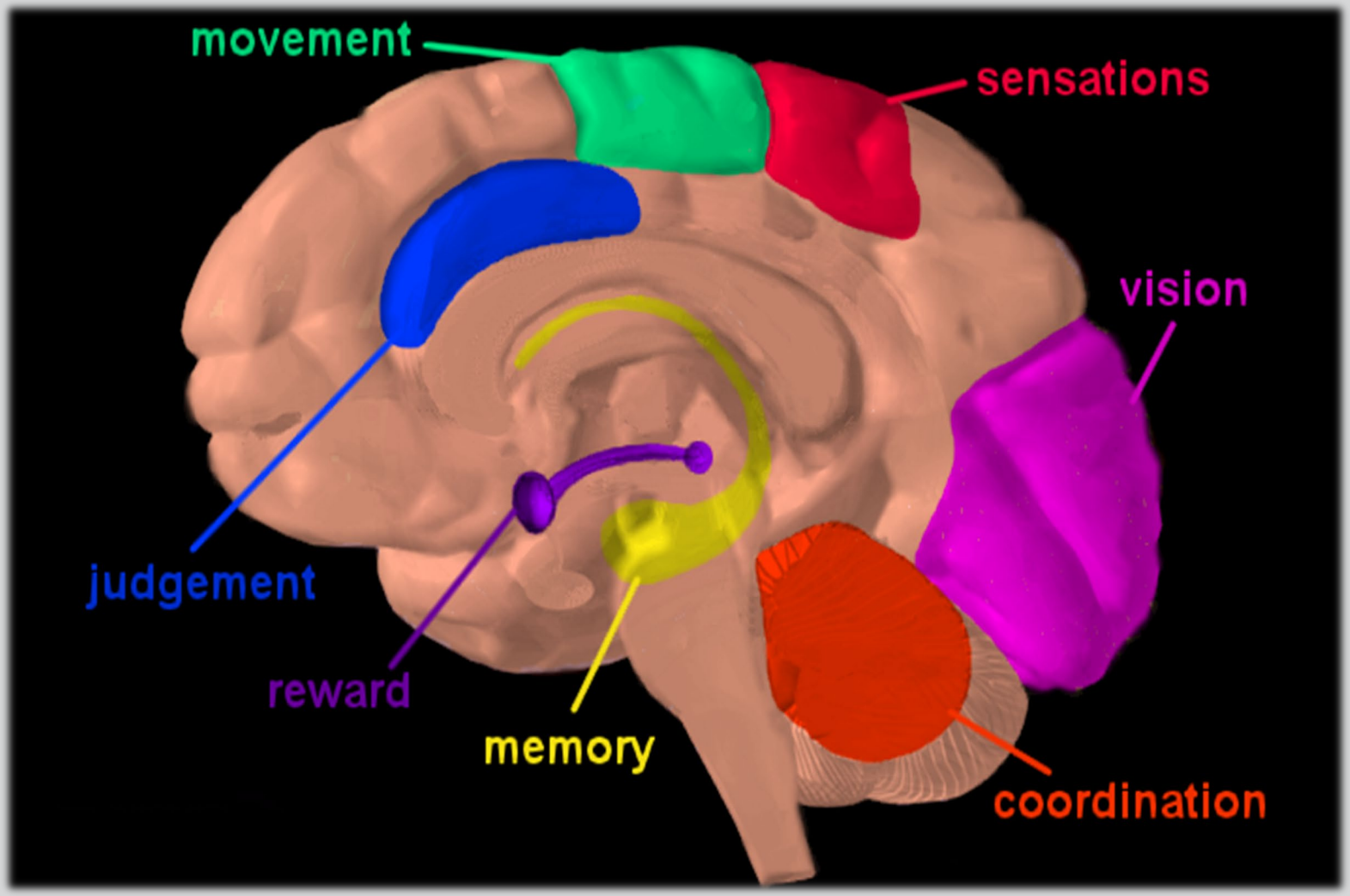
SOURCE: SAMHSA, OSG, 2016

Polling Question #1

What areas of the brain are impacted by psychoactive substance use?

- Movement
- Sensations
- Judgement
- Vision
- Memory
- Coordination
- Judgement, Coordination, and Sensations
- Movement, Vision, and Memory
- All of the Above

Brain Areas Affected by Psychoactive Substances



SOURCE: NIDA, 2019

Neurotransmitters

- Neurotransmitters can be categorized into two broad categories:
  - Excitatory
    - Move body toward state of arousal
  - Inhibitory
    - Move body toward state of relaxation

SOURCE: Lexico, 2020

Major Neurotransmitters Involved in SUD

- Serotonin
  - Plays role in mood function, sleep, and dreams - probably how LSD works; is increased slightly by the use of cocaine and amphetamines
- Dopamine
  - Affects motor movement; is central “pleasure-inducing” neurotransmitter; related to psychosis. Primary mechanism of action for stimulants
- Norepinephrine
  - Increases heart rate, blood pressure, and sweating; dilates pupils and constricts blood vessels

SOURCE: NIDA, 2017

Major Neurotransmitters, continued

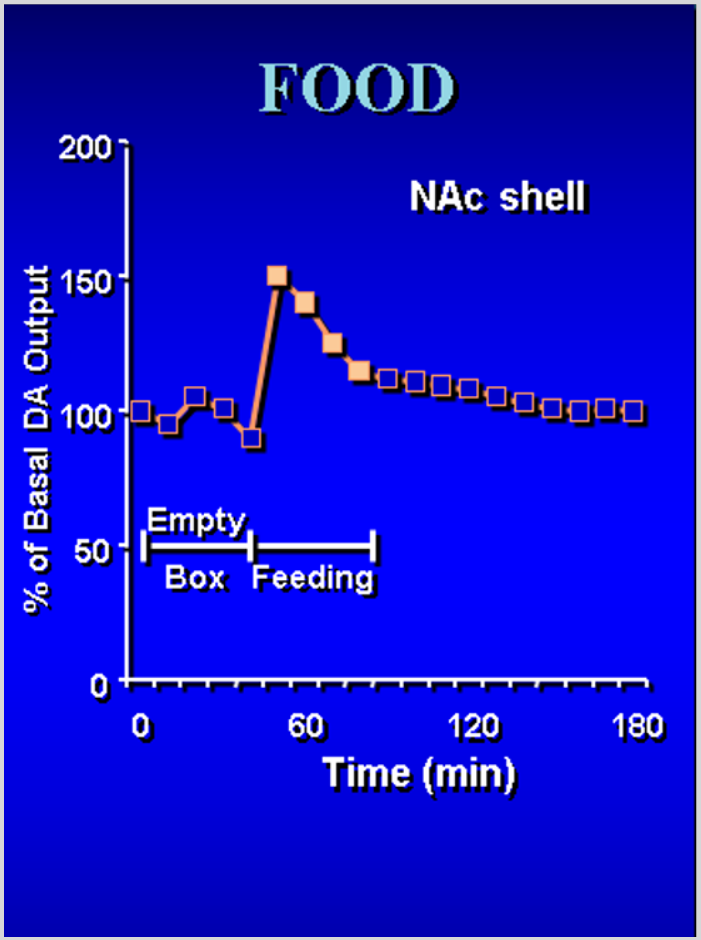
- GABA (gamma-aminobutyric acid)
  - Inhibits cells from firing; many of the following drugs produce their effects by agonizing release of this neurotransmitter - alcohol, barbiturates, and benzodiazepines
- Acetylcholine (ach)
  - Ubiquitous presence in nervous system – some in every neuron; nicotine seems to work through this neurotransmitter
- Endorphins
  - Body's natural pain killers, or endogenous opioids

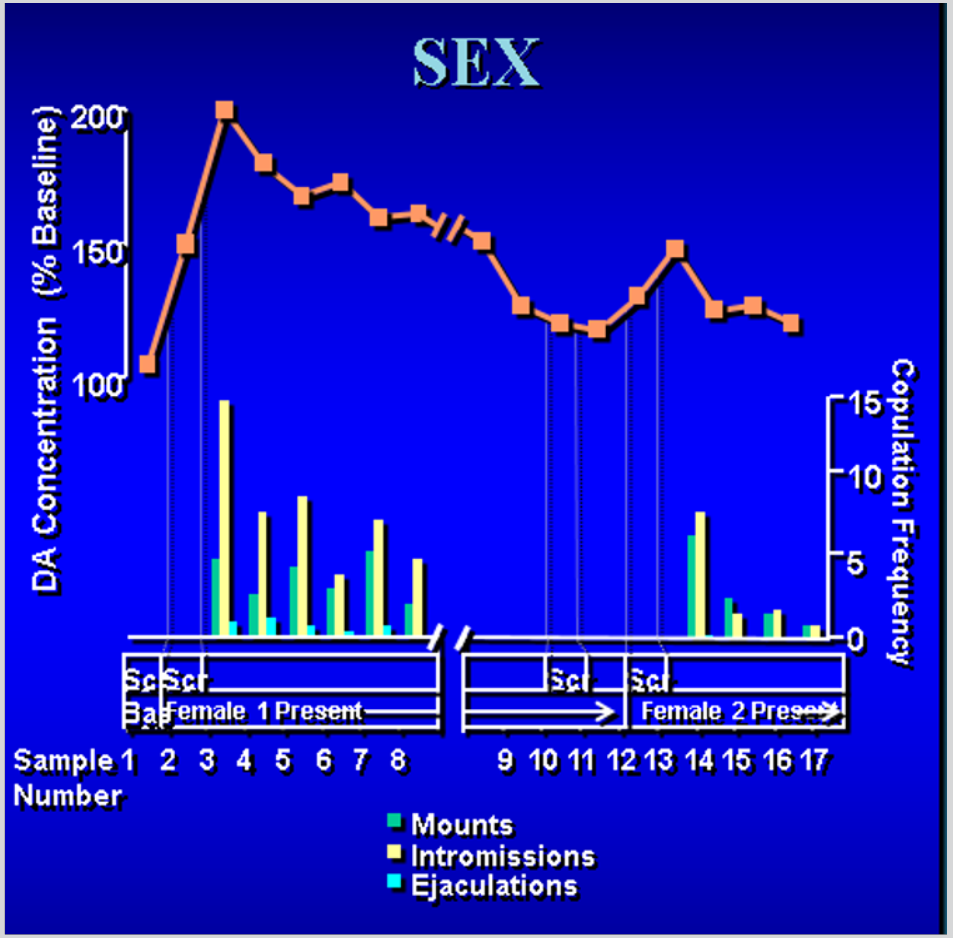
SOURCE: NIDA, 2017

Let's First Take a Look at Normal Dopamine Functioning

SOURCE: Meyers, 2008

Natural Rewards Elevate Dopamine Levels





SOURCES: Bassareo & DiChiara, 1999;
Fiorino & Phillips, 1997

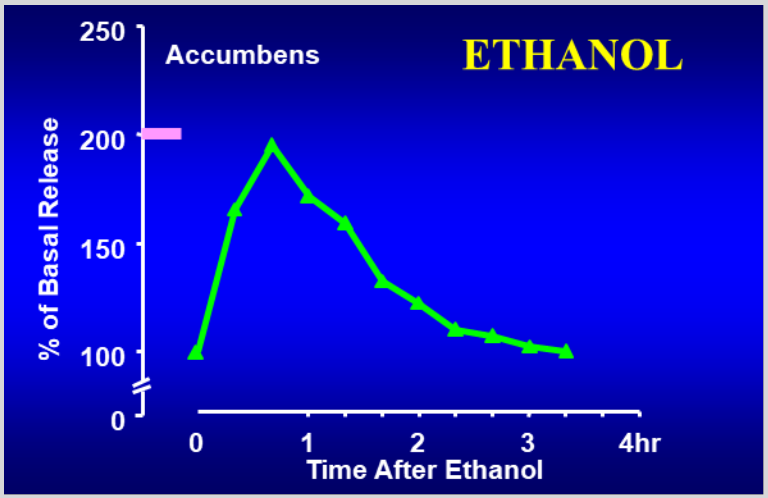
How the Brain Responds to Cocaine

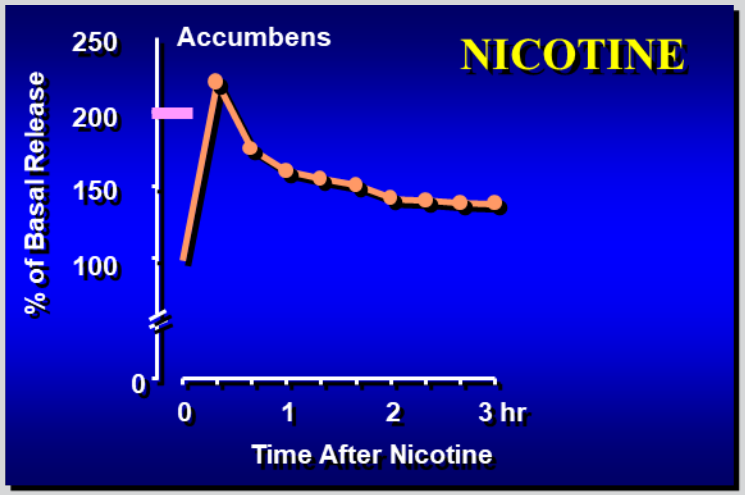
SOURCE: NIDA, 2016

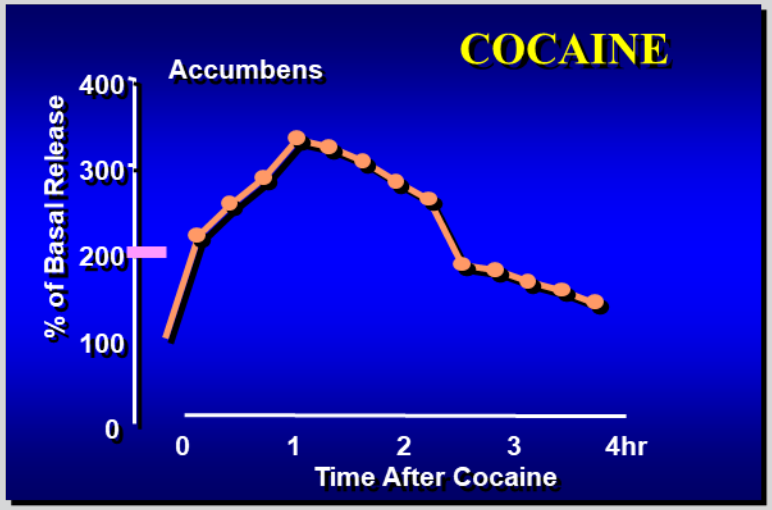
How the Brain Responds to Methamphetamine

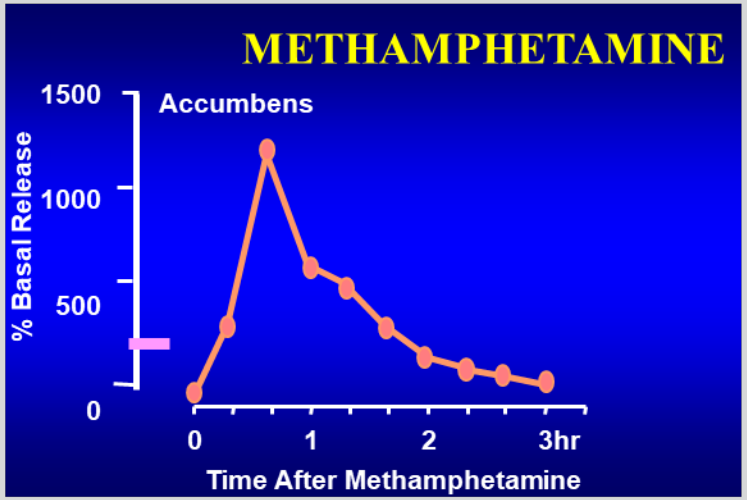
SOURCE: Meyers, 2008

Effects of Drugs on Dopamine Release



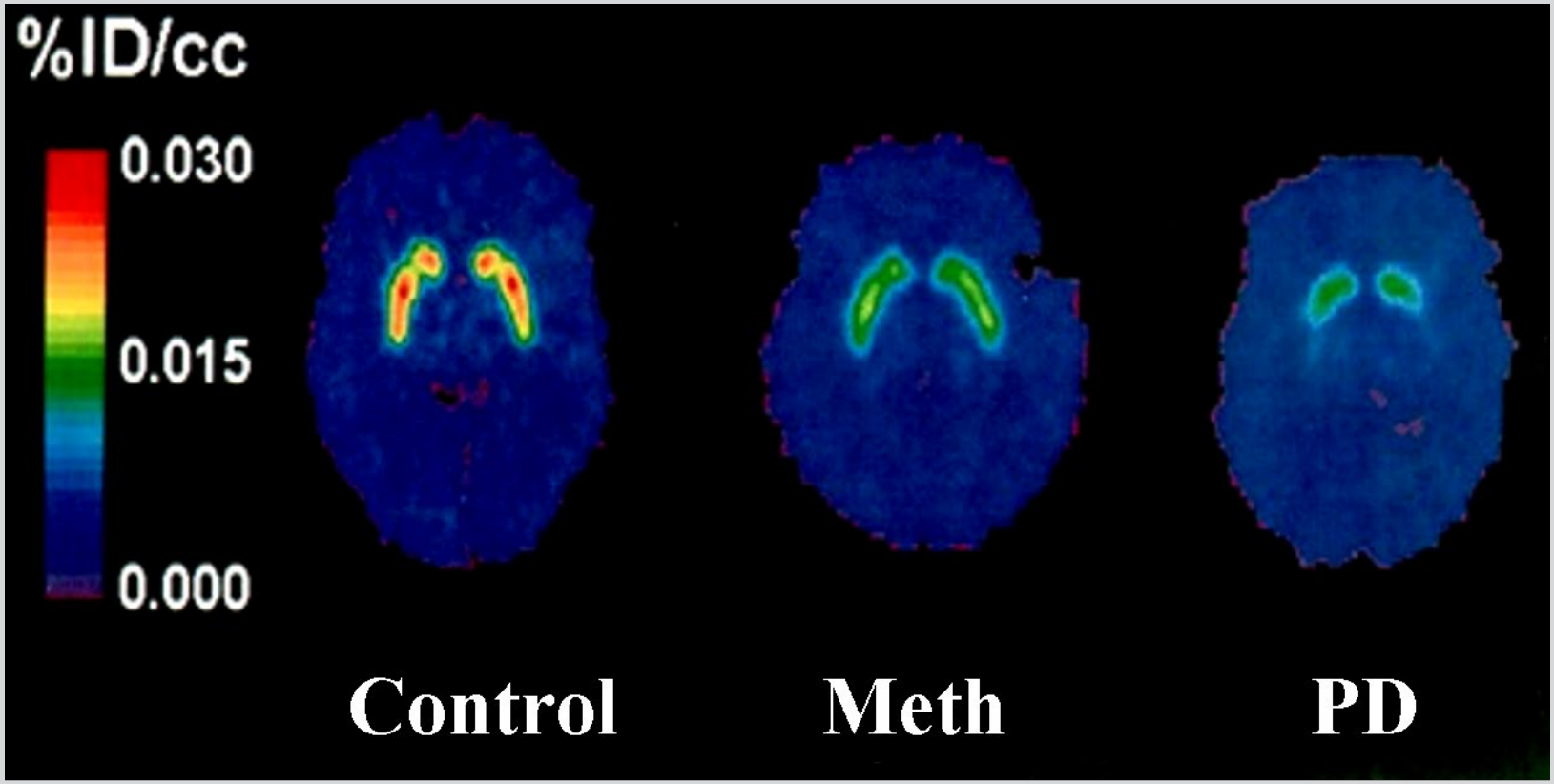






SOURCES: Shoblock et al., 2003;
DiChiara & Imperato, 1988

Decreased Dopamine Transporter Binding: Use of Meth and Parkinson's Disease



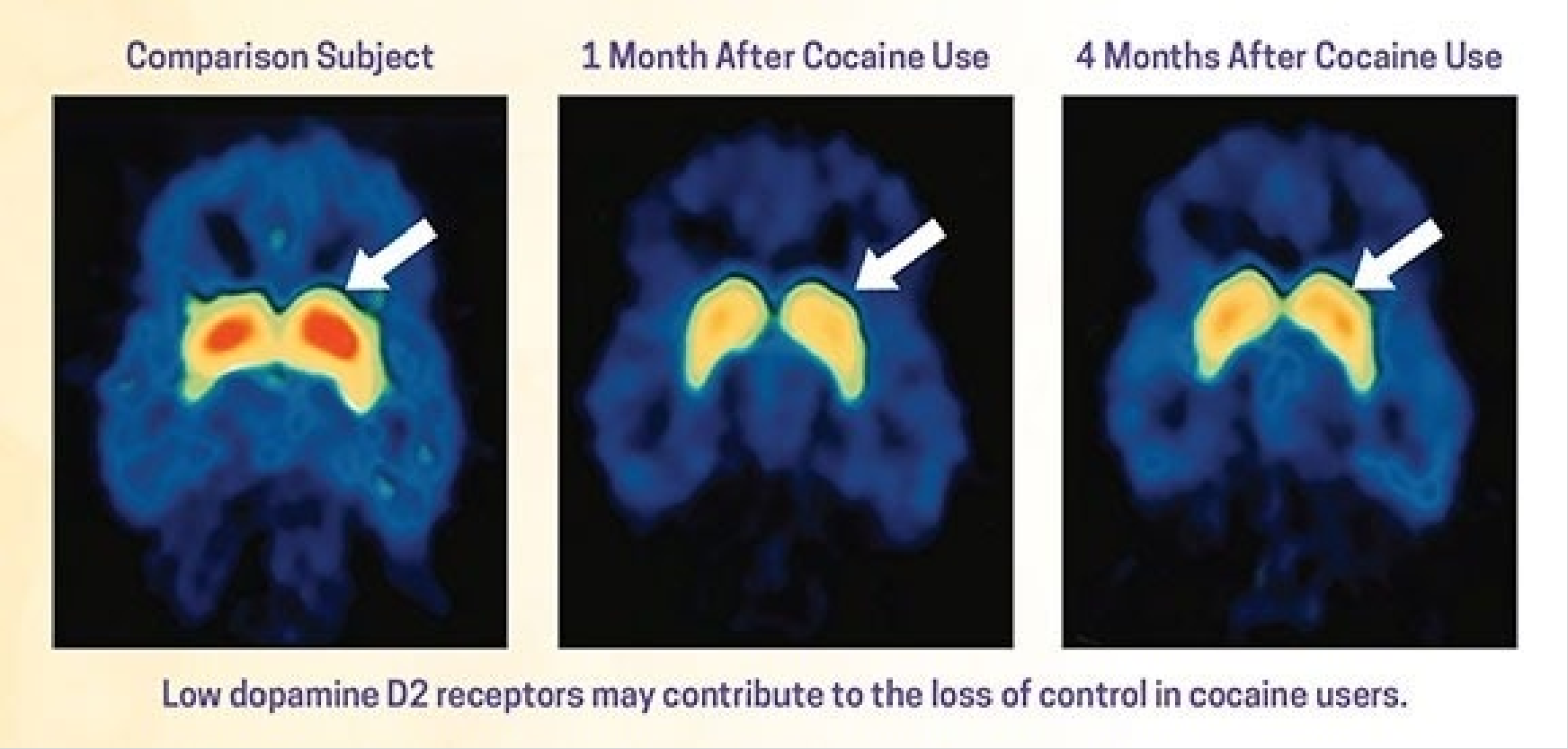
SOURCE: McCann et al., 1998

What Do Newer Research Studies Say?

- A 2011 study examined 300,000 hospital records spanning 16 years and found that patients with methamphetamine use disorders were **75% more likely** to develop Parkinson's disease.
- A 2015 study in Utah found that people who use methamphetamine were **300% more likely** to develop Parkinson's disease compared to those who did not use drugs or those who used cocaine.
  - Study also found that risk may be higher for females.
- A 2018 study concluded that methamphetamine use, along with other risk factors that a person may have, **may be an initiating event** in the development of Parkinson's Disease.

SOURCES: Lappin et al, 2018; Curtin et al., 2015; Callaghan et al., 2011

Dopamine (D2) Receptor Availability



SOURCE: NIDA, 2020

Acute and Chronic Effects of Stimulants

Chat Activity

What are some of the Acute and Chronic Effects of Stimulants?

Acute Physical Effects of Stimulants

Increases

- Heart rate
- Blood pressure
- Pupil size
- Respiration
- Sensory acuity
- Energy

Decreases

- Appetite
- Sleep
- Reaction Time

SOURCE: NIDA, 2019

Acute Psychological Effects of Stimulants

Increases

- Confidence
- Alertness
- Mood/Euphoria
- Sex drive
- Energy
- Talkativeness

Decreases

- Boredom
- Loneliness
- Timidity

SOURCE: NIDA, 2019

Chronic Physical Effects of Stimulants

- Tremor
- Weakness
- Dry mouth
- Weight loss
- Cough
- Sinus infection
- Dental Problems
- Sweating
- Burned lips; sore nose
- Oily skin/complexion
- Headaches
- Diarrhea
- Anorexia

SOURCE: NIDA, 2019

Chronic Psychological Effects of Stimulants

- Confusion
- Concentration
- Hallucinations
- Fatigue
- Memory loss
- Insomnia
- Irritability
- Paranoia
- Panic reactions
- Depression
- Anger
- Psychosis

SOURCE: NIDA, 2019

Acute Stimulant Overdose

- Severe hyperthermia
- Convulsions
- Severe dehydration
- Anxiety/panic
- Paranoia
- Delirium
- Rhabdomyolysis → acute renal failure
- Stroke
- Myocardial infarction

SOURCE: NIDA, 2019

Chronic Stimulant Use

Organ system damage

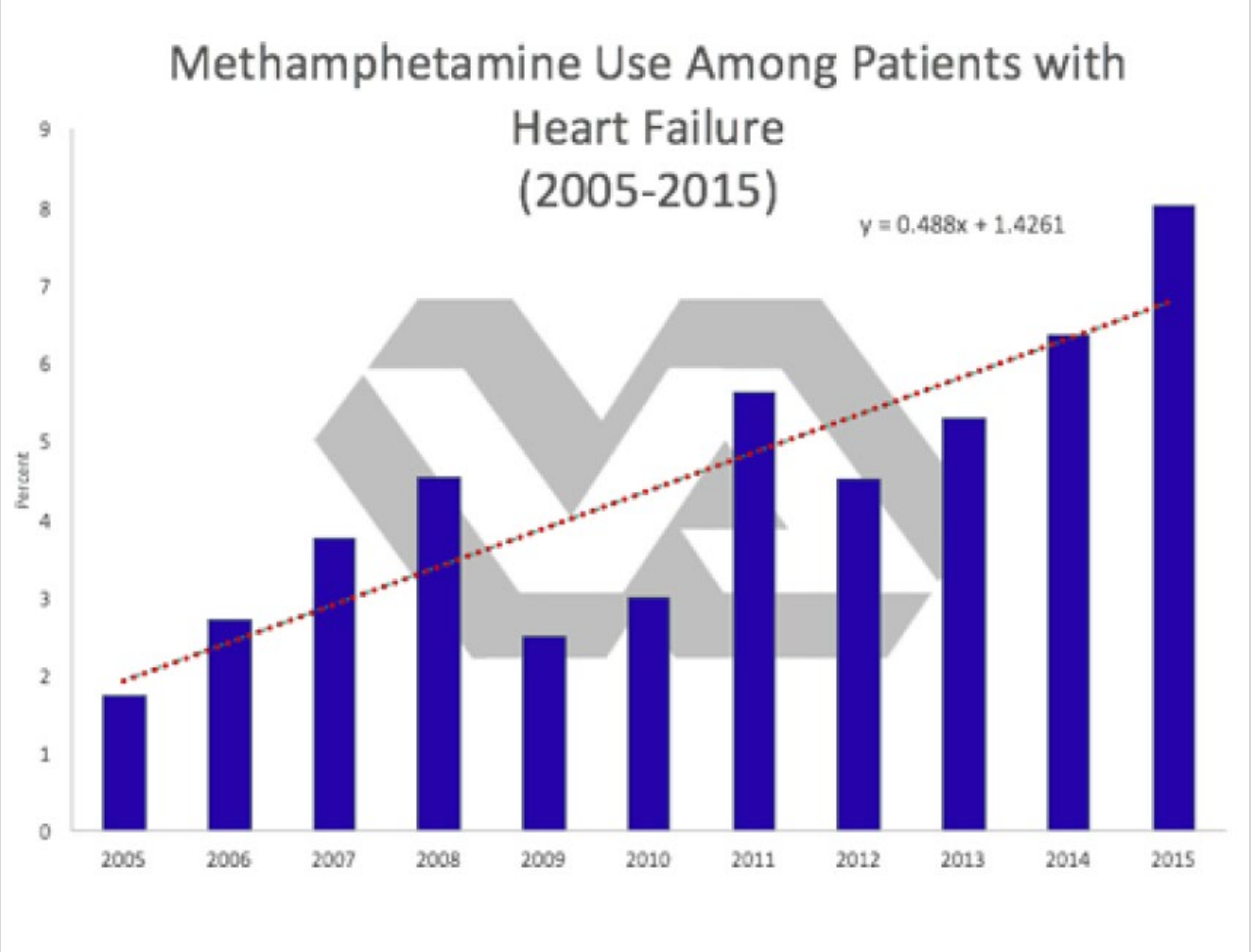
- Respiratory (pulmonary hypertension, difficulty breathing, pleuritic chest pain, decreased capacity)
- Neurological (stroke, seizure, hemorrhage, cerebral vasculitis)
- Renal failure (resulting from rhabdomyolysis)
- Hepatic failure (resulting from rhabdomyolysis)
- Cardiac (tachycardia, arrhythmia, reduced heart rate variability, myocardial infarction, heart failure)

Psychological Effects

- Psychosis (hallucinations, delusions)
- Affective (depression, suicidal ideation, mania)

SOURCE: NIDA, 2019

Methamphetamine-Associated Heart Failure



SOURCE: Nishimura et al., 2017

Other Chronic Methamphetamine Problems

- Eye ulcers
- Over-heating
- Obstetric complications
- Anorexia / weight loss
- Tooth wear, cavities
- “Speed bumps”

SOURCE: NIDA, 2019

Did I Mention Skin Problems?

- Grayish leathery texture to skin
- Increased sweating (hyperhidrosis)
- Repetitive or compulsive skin picking
  - "Speed bumps" / Formication

SOURCE: Richards & Laurin, 2019

Use of Methamphetamine Leads to Severe Tooth Decay

- Methamphetamine-related dental issues are characterized by severe tooth decay and gum disease
- Teeth often break or fall out

SOURCE: American Dental Association, 2017

Effects of Stimulant Use During Pregnancy

- Maternal migraines and seizures
- Premature membrane rupture
- Separation of placental lining from uterus prior to delivery
- High blood pressure
- Edema and seizures
- Spontaneous miscarriage
- Preterm labor
- Difficult delivery

SOURCES: Smid et al., 2019; NIDA, 2016; Cain et al., 2013; Volkow, 2005

Additional Effects of Methamphetamine

- Cardiac and brain abnormalities
- Neurological problems
  - Decreased arousal
  - Increased stress
  - Attention impairments

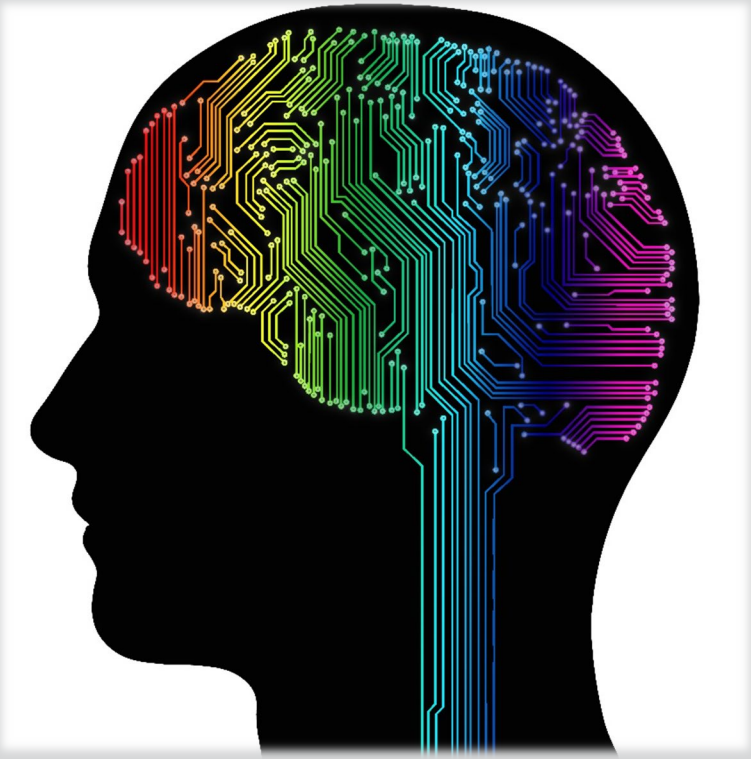
SOURCES: Smid et al., 2019; American Congress of Obstetricians and Gynecologists, 2017

IDEAL Follow-up Study School-Aged Outcomes

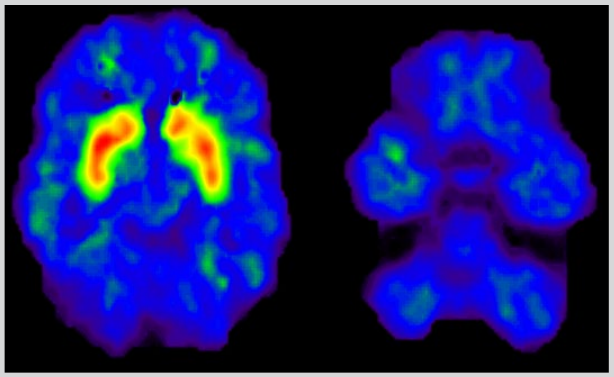
- 7.5-year follow-up study involved 290 children originally enrolled in IDEAL
- Key finding – a supportive home environment may reduce behavioral and emotional issues among methamphetamine-exposed children
- Poverty and continued drug use by parent contributes to issues
- Strong relationship seen between pre-natal methamphetamine exposure and rule-breaking and aggressive behavior
- Other early adverse conditions associated with behavioral problems included changes in primary care giver, sexual abuse of the caregiver, and maternal depression

SOURCE: Eze et al., 2016

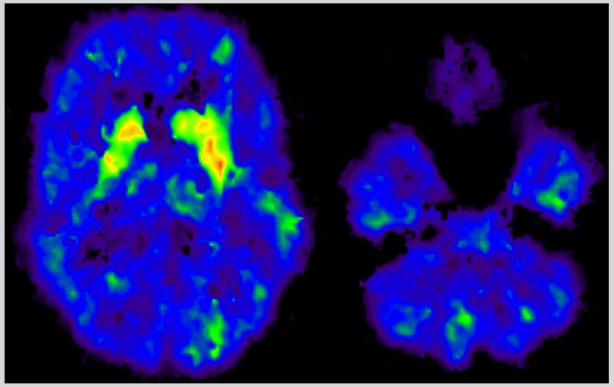
Cognitive and Memory Effects of Stimulant Use



Dopamine Transporters in People who Use Methamphetamine

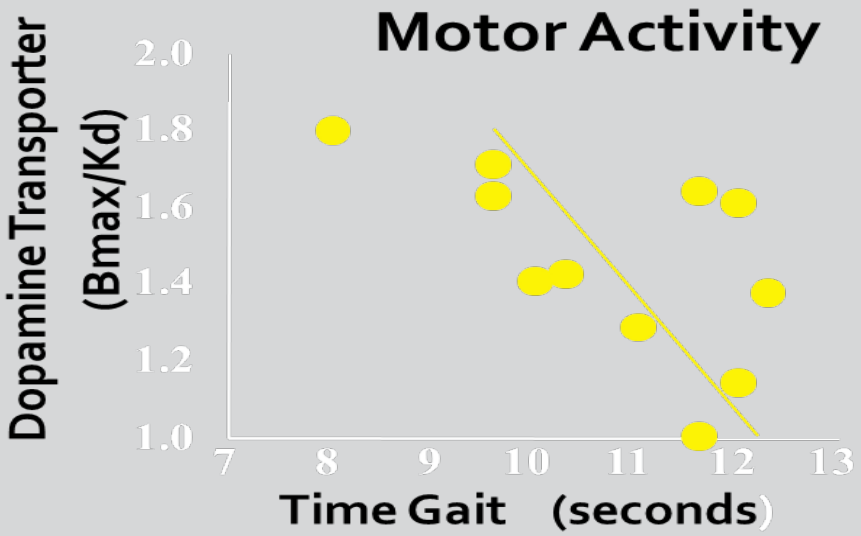


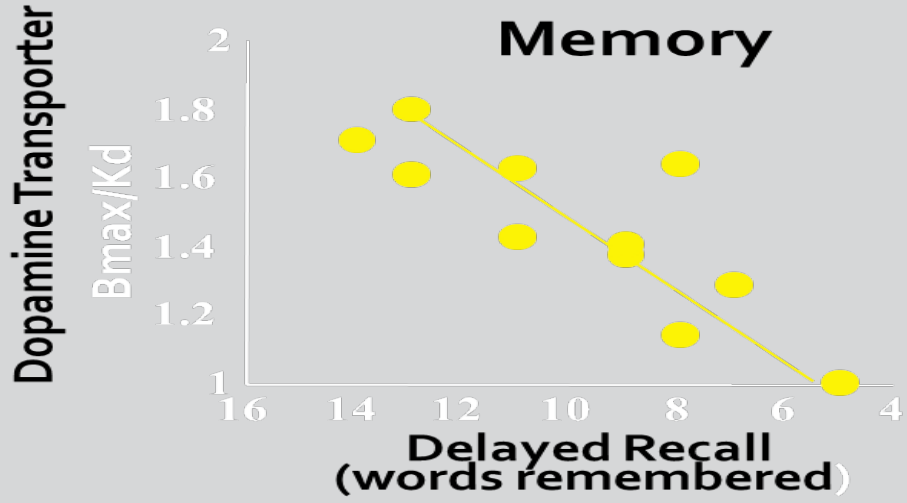
Normal Control



Methamphetamine Abuser

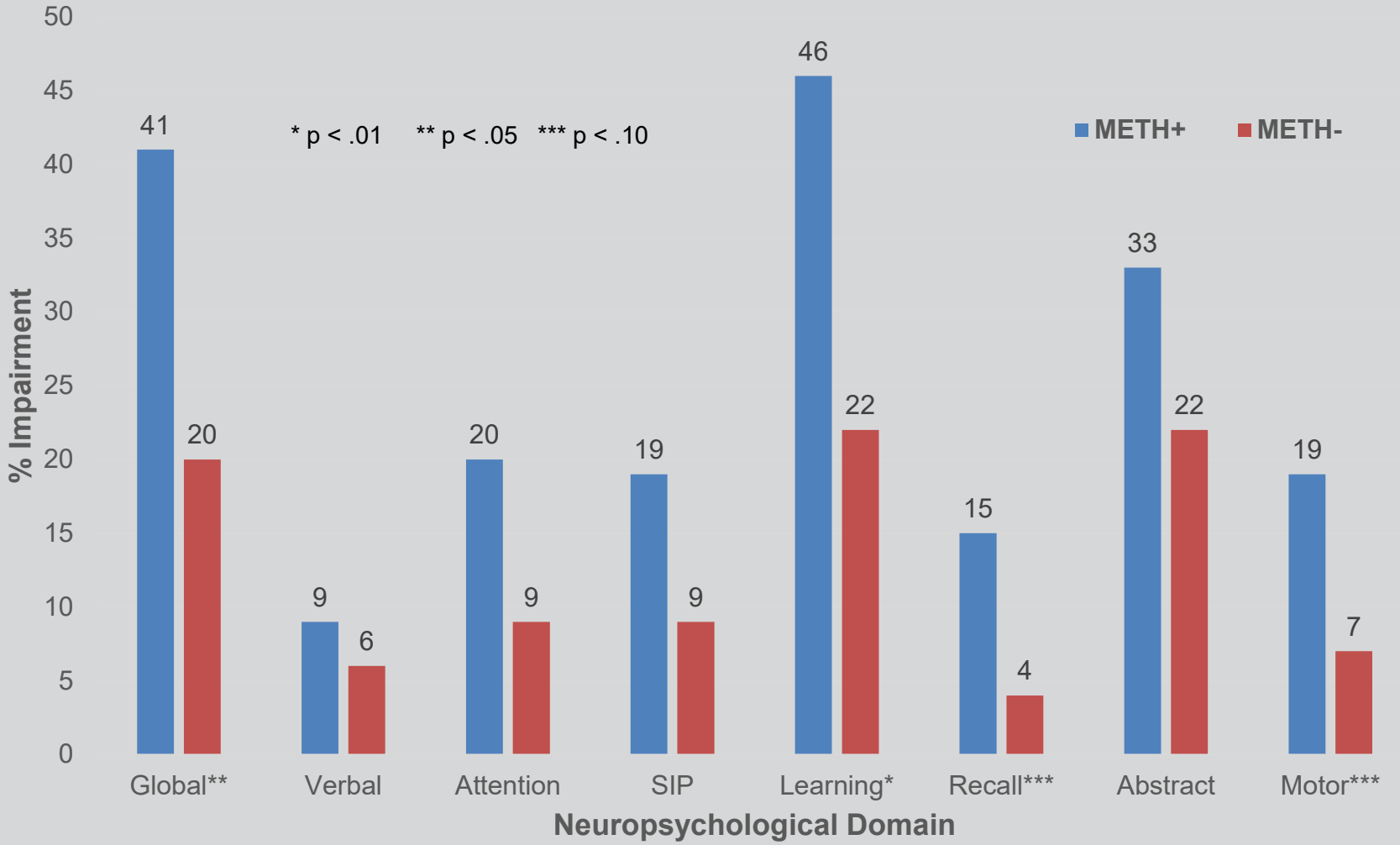
$p < 0.0002$





SOURCE: Volkow et al., 2001

Neuropsychological Functioning and Methamphetamine Use



SOURCE: Cherner et al., 2010

Motor and Cognitive Impairment Associated with Methamphetamine Use

- Those METH+ participants with motor impairments were found to have higher rates of meth use.
- For METH+ with cognitive impairment (vs those without) showed no difference in meth exposure.
- A meta analysis also found significant difference across studies, but poor controls for confounding variables.
- Investigators also noted that while difference existed between those who had used meth and controls, the meth group was still within normal ranges. Perhaps the differences are of little clinical significance.
- There is a great need to study individual differences in vulnerability to methamphetamine-associated neurotoxicity, and meth use alone does not explain it.

SOURCES: Hall et al., 2012; Cherner et al., 2010

Cognitive Deficits in Methamphetamine Use Disorder

- Compared 108 methamphetamine treatment seekers and 50 matched controls.
- Methamphetamine use was associated with impulsive decision making and disinhibition.
- Greater disinhibition associated with longer durations of methamphetamine use.

SOURCE: Fitzpatrick et al., 2020

Methamphetamine and Psychosis

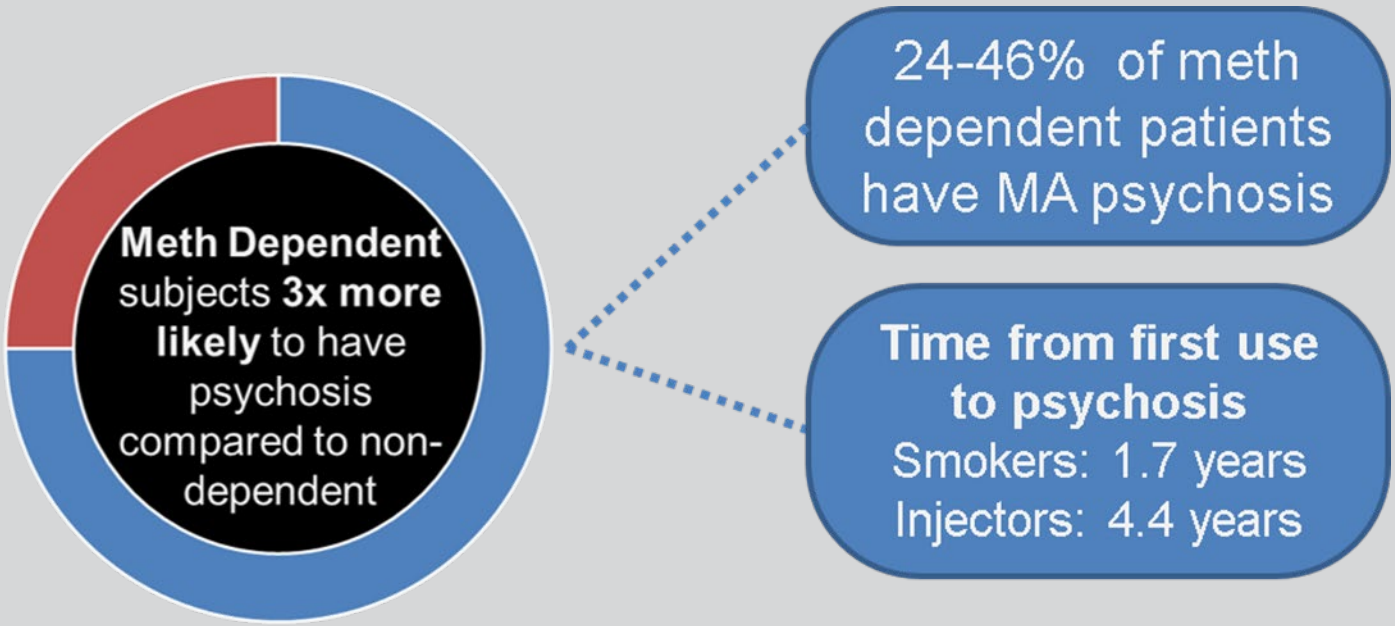
Polling Question #2

What percentage of meth dependent patients have MA psychosis?

- 32-52%
- 24-46%
- 16-24%
- 8-20%

Methamphetamine and Psychosis

- A strong association exists between methamphetamine and psychosis, even after controlling for history of schizophrenia and other psychotic disorders



SOURCE: Glasner-Edwards & Mooney, 2014

Symptoms of Amphetamine-Induced Psychosis

- Persecutory delusions
- Ideas of reference
- Hallucinations (visual, auditory, olfactory, tactile)
- Stereotypical and compulsive acts
- Blunt affect, poverty of speech
- Prone to excited delirium and violence

SOURCE: Bramness et al., 2012

Methamphetamine Use and Violence

- Compared to no use, amphetamines use was associated with a 2-fold increase in the odds of hostility or violence
- Frequent use increases the risk of violent behavior

- Other risk factors included: psychotic symptoms, alcohol or other drug use, psychosocial problems, and impulsivity
- People who use methamphetamine are also more likely to be victims of abuse or violent acts
- Women who used methamphetamine are significantly more likely to experience partner abuse/violence

SOURCES: Foulds et al., 2020; Cohen et al., 2003

Summary

- Psychostimulants cause an increase of dopamine in the brain, resulting in feelings of euphoria
- The repeated use of stimulants results in changes to brain function and structure
- Stimulant use can results in overdose and death, and it causes damage to organ systems, and is dangerous during pregnancy
- Methamphetamine may cause difficulties in cognitive functioning, psychotic symptoms, and increases in violence
- **In part 3, we will examine evidence-based treatments for simulant use disorders**

Resources for Continued Learning

- ATTC Network's Focus on Stimulant Misuse Web Page: https://attcnetwork.org/centers/global-attc/focus-stimulant-misuse
- Evidence-Based Resource Guide Series: Treatment of Stimulant Use Disorders: https://store.samhsa.gov/product/Treatment-of-Stimulant-Use-Disorder/PEP20-06-01-001
- Northwest ATTC's Contingency Management for Healthcare Settings Self-Paced Online Course: https://healtheknowledge.org/course/search.php?search=Contingency+Management

Thank You For Your Time

- For questions, please email Beth (brutkowski@mednet.ucla.edu) or Thomas (tfreese@mednet.ucla.edu)

- You will be notified as components of this curriculum are finalize and posted to the ATTC website at: https://attcnetwork.org/centers/global-attc/focus-stimulant-misuse

- For additional information regarding SUD-related Training/TA, please visit: http://www.attcnetwork.org

- For additional information regarding HIV/AIDS-related Training/TA, please visit: https://aidsetc.org/