

Overview of Addiction

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Disclosures

- No financial relationship with any manufacturers of products or suppliers of services related to the content of this presentation
- No current or recent associations with pharmaceutical industry--former member until 12/2006 of Speakers Bureau for Forest (Campral)
- If mentioned, any off-label uses of FDA-approved medications will be so identified at the time (none planned)

Outline

- Definitions
 - substance use disorder (SUD), addiction, substance misuse, physiologic dependence
- Neurobiology of Addiction
- Prevention
 - Addiction in the adolescent brain, co-morbidity of SUDs and mental illness, prevention of complications

DSM-5 Diagnostic Criteria for SUDs

- The *DSM-5* defines a *substance use disorder (SUD)* as the presence of at least 2 of 11 criteria, which are clustered in four groups:
- 1. *Impaired control*: (1) taking more or for longer than intended, (2) unsuccessful efforts to stop or cut down use, (3) spending a great deal of time obtaining, using, or recovering from use, (4) craving for substance.

DSM-5 Diagnostic Criteria for SUDs

- 2. *Social impairment*: (5) failure to fulfill major obligations due to use, (6) continued use despite problems caused or exacerbated by use, (7) important activities given up or reduced because of substance use.
- 3. *Risky use*: (8) recurrent use in hazardous situations, (9) continued use despite physical or psychological problems that are caused or exacerbated by substance use.

DSM-5 Diagnostic Criteria for SUDs

- 4. *Pharmacologic dependence*: (10) tolerance to effects of the substance, (11) withdrawal symptoms when not using or using less.*
- The number of criteria met defines severity from *mild* (2–3 criteria) to *moderate* (4–5 criteria) to *severe* (6 or more criteria).
- * Persons who are prescribed medications such as opioids may exhibit these two criteria, but would not necessarily be considered to have a substance use disorder.

Addiction vs. Substance Misuse

- Addiction: DSM-5 SUD at moderate or severe level
- Substance Misuse (not a formal term, varying definitions; here's mine): the continued use of drugs or alcohol despite negative consequences to the individual using, her/his friends, family and the community. All **substance** use has the potential to cause health, social and criminal consequences, but not all substance use is misuse.

Physiologic Dependence

- Physiologic dependence on a substance involves the physiologic changes in the nervous system that follow continued exposure to a substance; these changes manifest as withdrawal and are usually accompanied by tolerance.
- Physiologic tolerance usually occurs when an individual uses a substance regularly for a period of at least two weeks, though it may show earlier

Addiction: A chronic relapsing disease

- Compulsive drug seeking & use
- Loss of control of the drug use
 - Control is “eroded but not erased”
- Continued use in spite of consequences
 - Physical, psychological, social, & legal harms

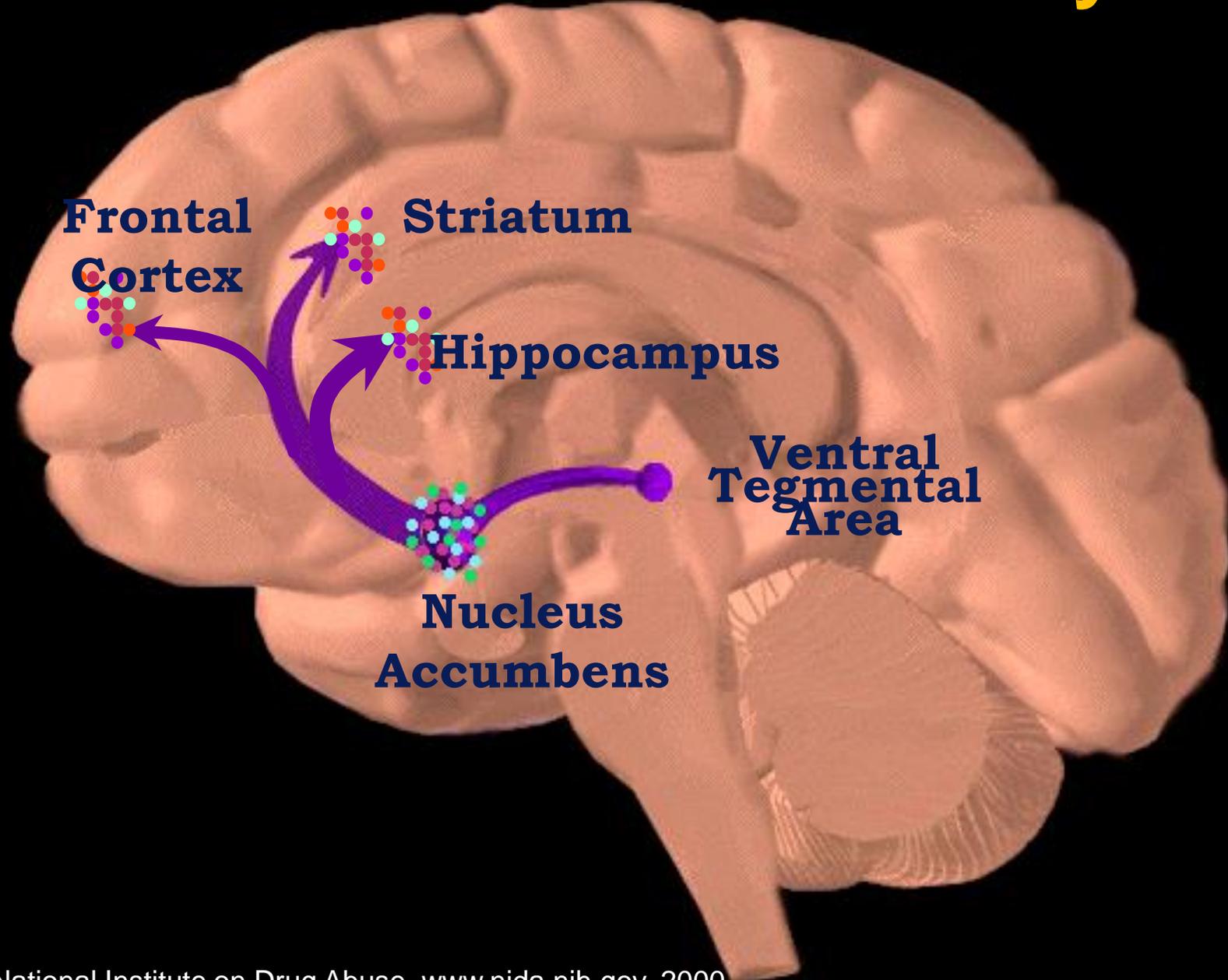
But what is addiction, really?

- Disease/illness? Dictionary.com defines disease:
 - a disordered or incorrectly functioning organ, part, structure, or system of the body resulting from the effect of genetic or developmental errors, infection, poisons, nutritional deficiency or imbalance, toxicity, or unfavorable environmental factors; illness; sickness; ailment.
- Lack of willpower?
- Poor moral fiber?
- Can't define it, but know it when you see it?
 - As Justice Potter Stewart originally characterized obscenity/pornography (but later changed his position)
- Sound-bite: Addiction is a chronic, typically relapsing and remitting and life-threatening illness (disease) that responds to treatment

Why Do People Take Drugs?

- Prescription by health care professional
- Performance enhancement
- To feel better (relieve)
 - To relieve withdrawal
 - Self-medication
- To feel good (positively altered)
 - Sensation seeking, to get high
- But it's more complex than this

Pleasure-Reward Pathways



Brain Reward Pathways

What are they good for?

- The reward system of vertebrate brains has been highly conserved through evolution—it is identical across all vertebrate species
- So what?
- Any structure that has remained unchanged throughout vertebrate evolution must be crucial to survival
- Brain reward pathways, as evolved and conserved, are critical to survival of species. But why?

Evolution and Brain Reward

- The brain reward system evolved to drive behavior
 - Eating
 - Mating
 - Other, sometimes species-specific, pro-social behaviors

Evolution and Brain Reward

- An animal that does not eat when food is available is less likely to survive to raise its offspring to reproductive success—and if that tendency is heritable, its offspring are less likely to survive to increase the reproductive success of their offspring—a genetic mutation that diminishes the reward value of eating will be selected against. Organisms that eat when food is available have a competitive advantage in terms of the success of their offspring.

Evolution and Brain Reward

- What about mating (sex)?
- Same argument as with eating. A genetic mutation that diminishes the reward value of sex would be selected against. If a mating opportunity is possible/available, the species survives by individuals “choosing” to copulate
- The reward system is entirely driven by immediate rewards

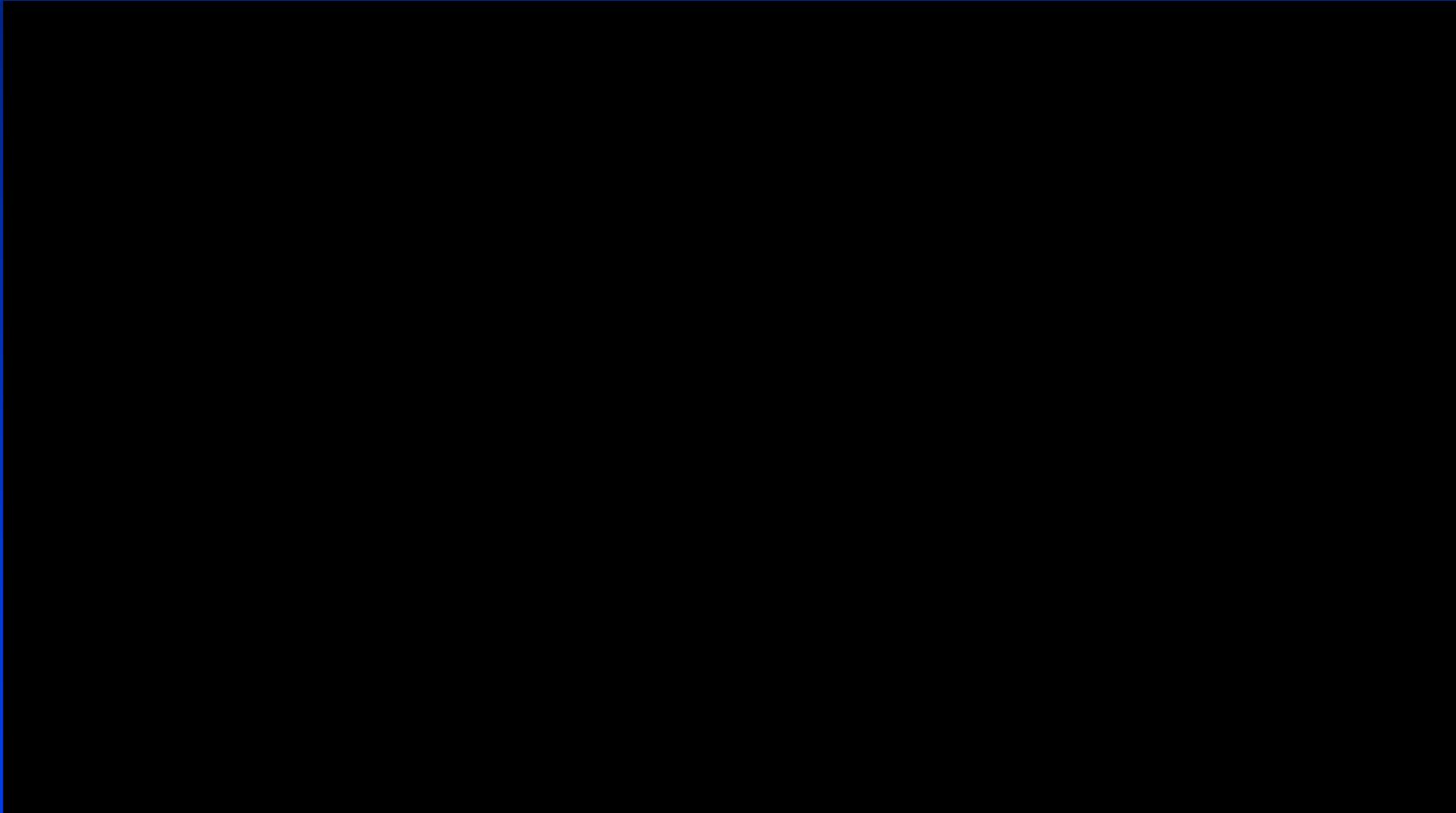
Brain Reward is Immediate

- The behaviors that the brain reward system drives are immediately gratifying (e.g., eating, mating)
- Although evolution makes the brain reward system effective in the long run for the species, it may do so at the expense of the individual organism
 - extreme examples in nature, e.g. of females eating the male after copulation. The individual male would be better off refraining, but the species would not be
- How does this apply in human beings? Are we different?

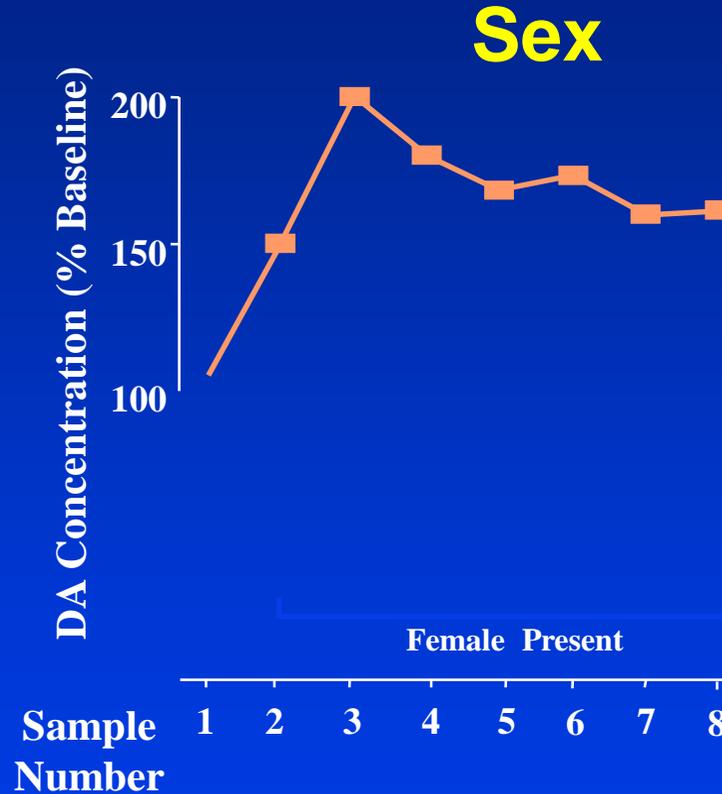
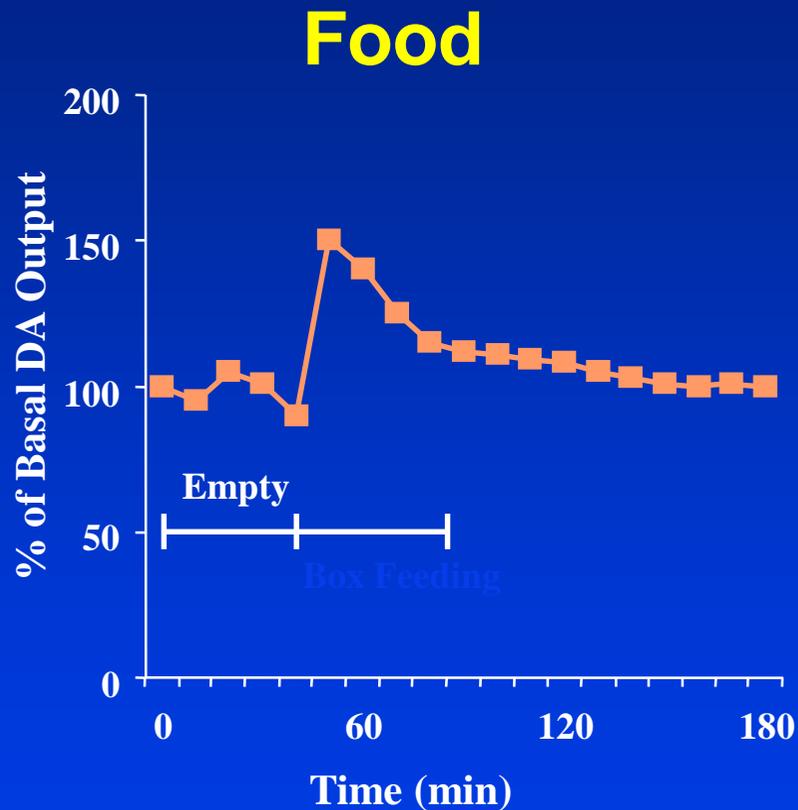
Free Will?

- Among vertebrates, human beings have, arguably, the greatest capacity to override urges driven by the brain reward system.
- But the available evidence suggests that majority do not readily do so.
- In essence, despite the evolution of a complex frontal cortex that can plan for the future, we are driven by a brain system that overvalues immediate reward (the brain reward system often wins = rationalization)
- Hyperbolic discounting
 - To which people with addiction are more susceptible, especially while using

The Super Bowl Commercial

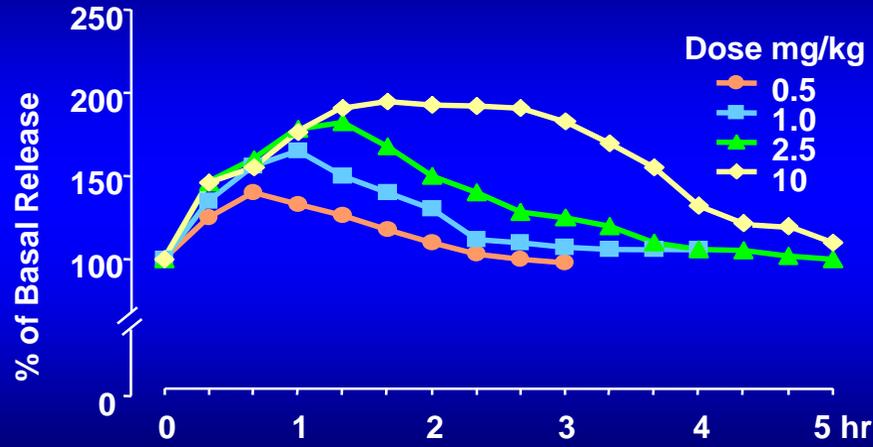


Natural Rewards and Dopamine Levels

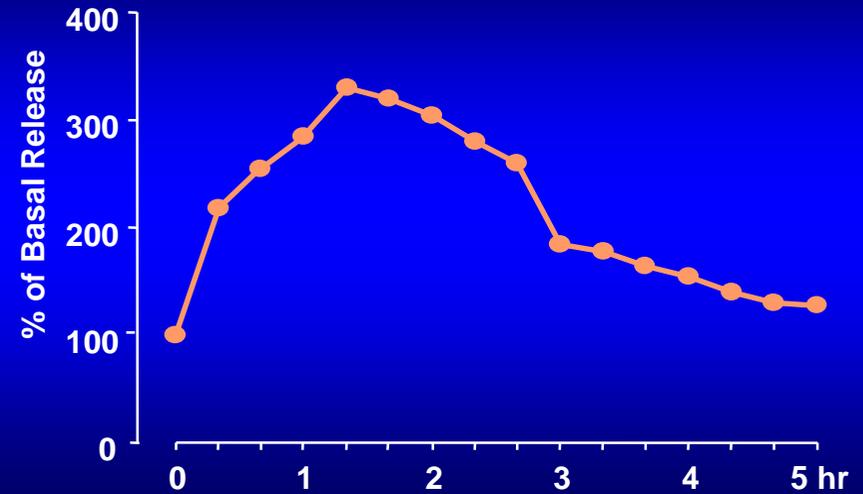


Effects of Drugs on Dopamine Levels

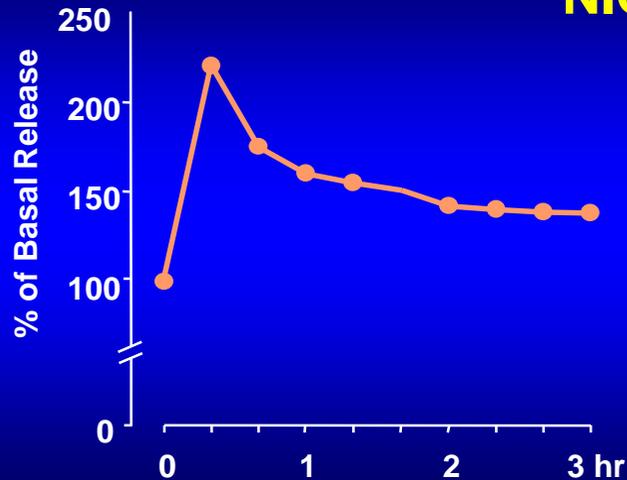
MORPHINE



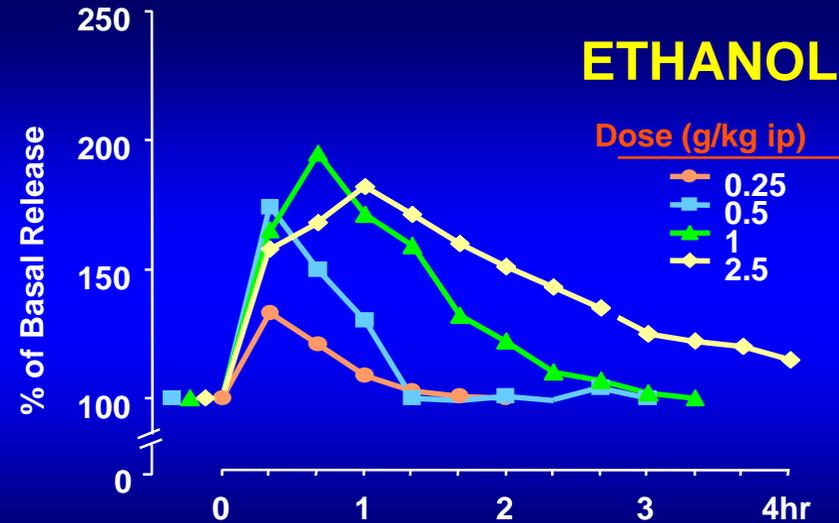
COCAINE



NICOTINE



ETHANOL



Risk of Addiction Differs by Substance

- If a person tries a drug, what is the likelihood that she or he will develop addiction?
 - Cocaine: 17% to 22% risk--intranasal vs. IV or smoked
 - With cocaine, 1 in 20 become addicted within 1st year of use
 - Nicotine 32%
 - Heroin 23%
 - Alcohol 11%
 - Marijuana 9%

Prevention of Addiction and/or Its Negative Consequences

- Addiction and the adolescent/young adult brain
 - For most individuals, substance use and misuse begin in adolescence or young adulthood
- Co-morbidity of substance use disorders and other mental illnesses
- Preventing/mitigating negative consequences of use

Addiction and the Adolescent Brain

- Adolescence an important period of brain development, particularly in the cerebral cortex
- Critical periods of development when cortex is sensitive to environment-induced changes in strength of connections between neurons
- Between ages 10 and 25, major changes in synaptic receptors and density, as well as myelination

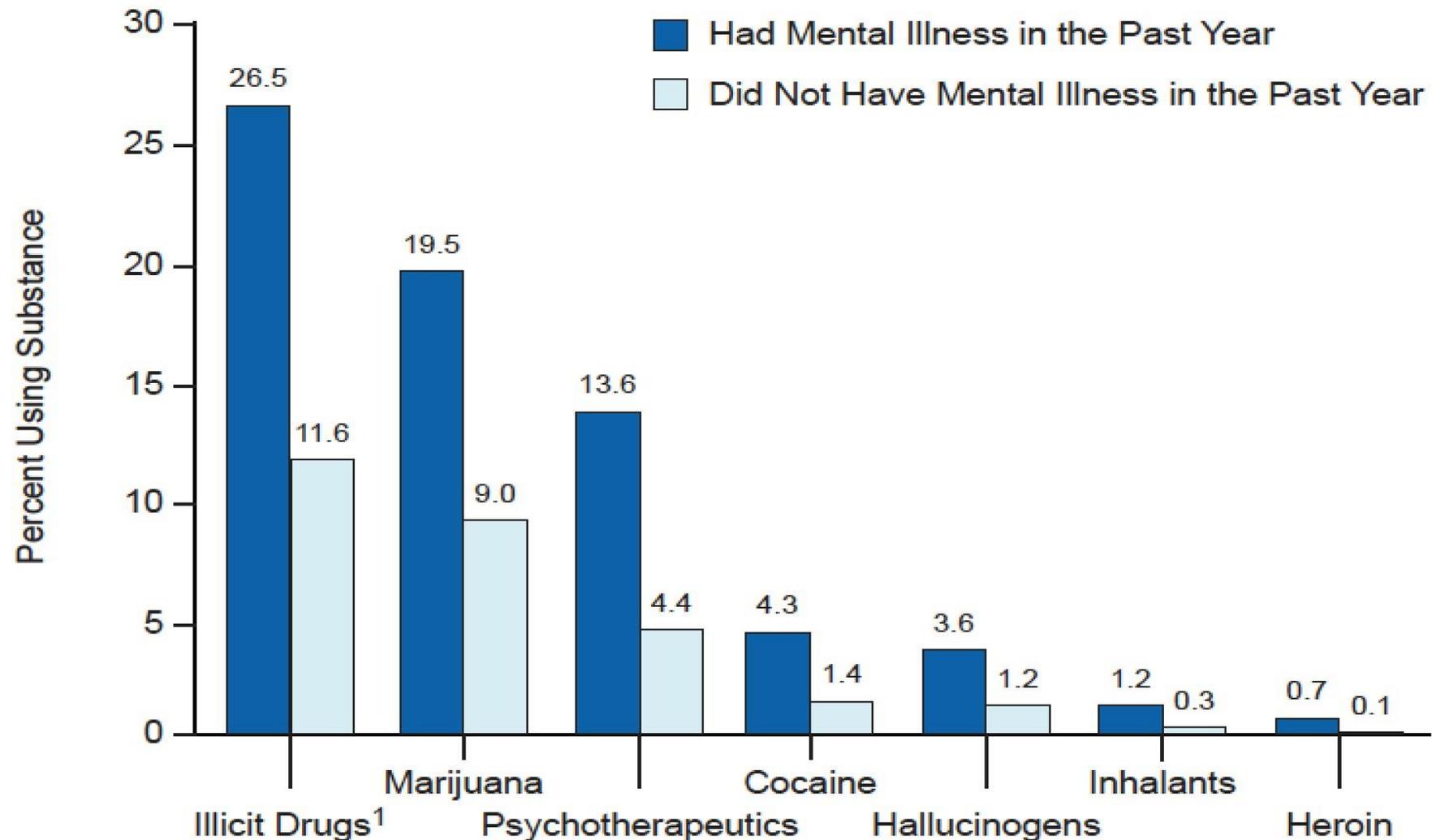
Addiction and the Adolescent Brain

- The changes in the brain during adolescence are important for development of impulse control, goal setting, motivation, interpersonal interactions, reasoning, assessment of rewards and punishments
- Studies support the likelihood that alterations in adolescent brain development may affect the cortical networks that underlie adult behaviors
- For example, heavy alcohol consumption during adolescence can disrupt cortical development, altering higher executive functions and promoting continued impulsive behavior, alcohol abuse, and risk of alcohol dependence

Comorbid SUDs and Mental Disorders

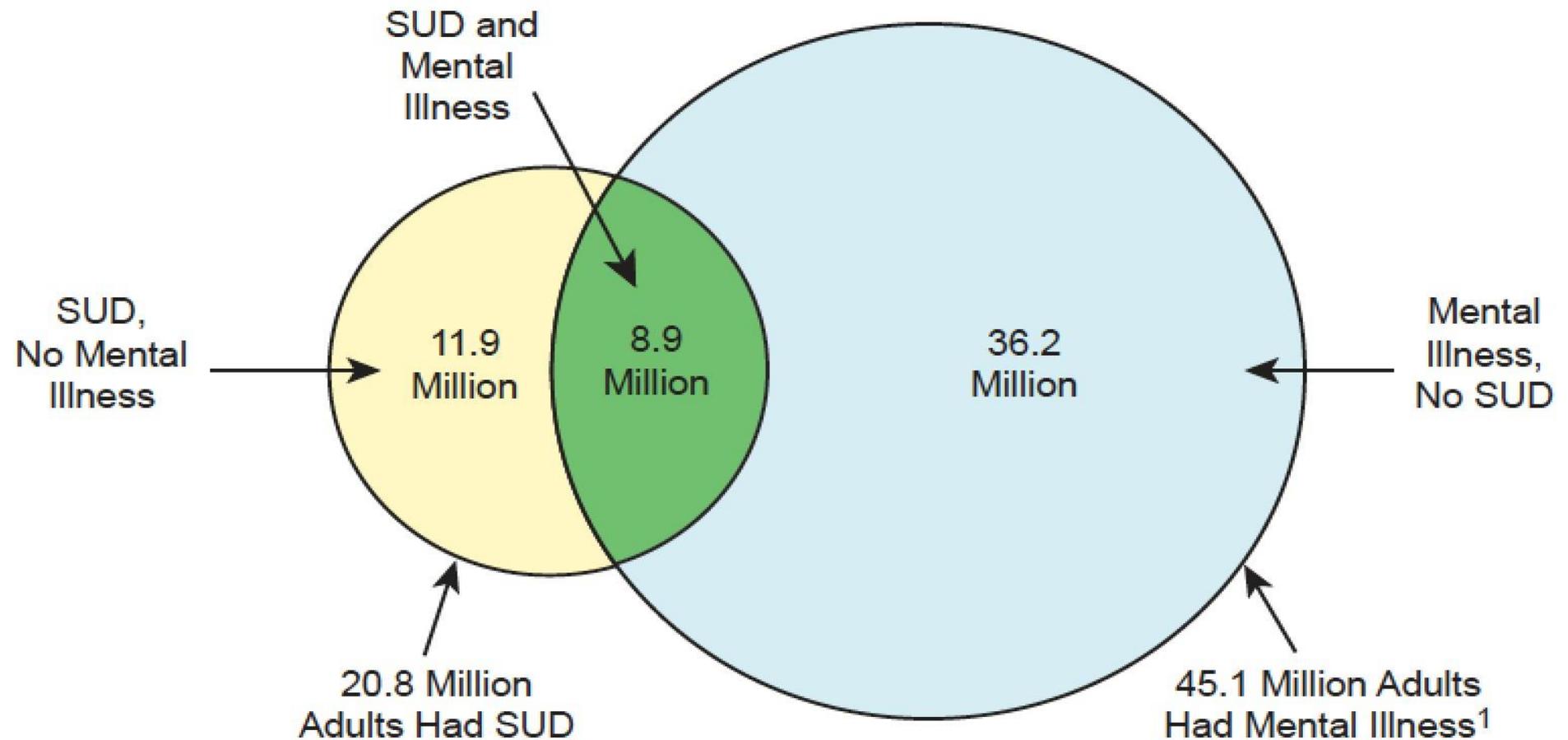
- As the next several slides show, SUDs and other mental illnesses co-occur at much higher rates than would be expected by chance.
- And each type of disorder worsens the course of the other
 - Self-medication of underlying symptoms may perpetuate drug use
 - Substance use clearly interferes with treatment of mental illnesses

Figure 4.1 Past Year Substance Use among Adults Aged 18 or Older, by Any Mental Illness: 2009



¹ Illicit Drugs include marijuana/hashish, cocaine (including crack), heroin, hallucinogens, inhalants, or prescription-type psychotherapeutics used nonmedically.

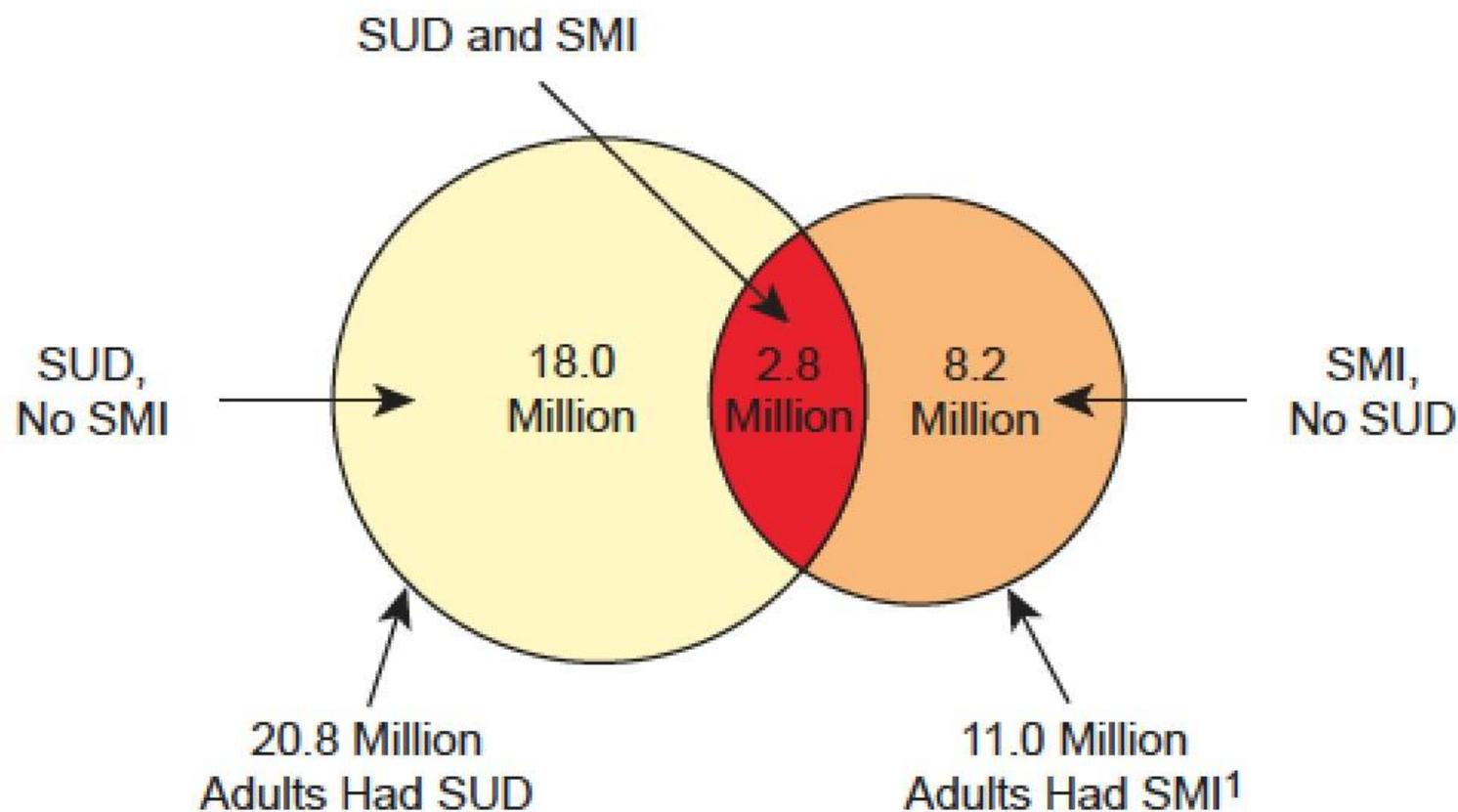
Figure 4.2 Past Year Substance Dependence or Abuse and Mental Illness among Adults Aged 18 or Older: 2009



SUD = substance use disorder.

¹ Statistics on mental illness are located in Chapter 2 of this report.

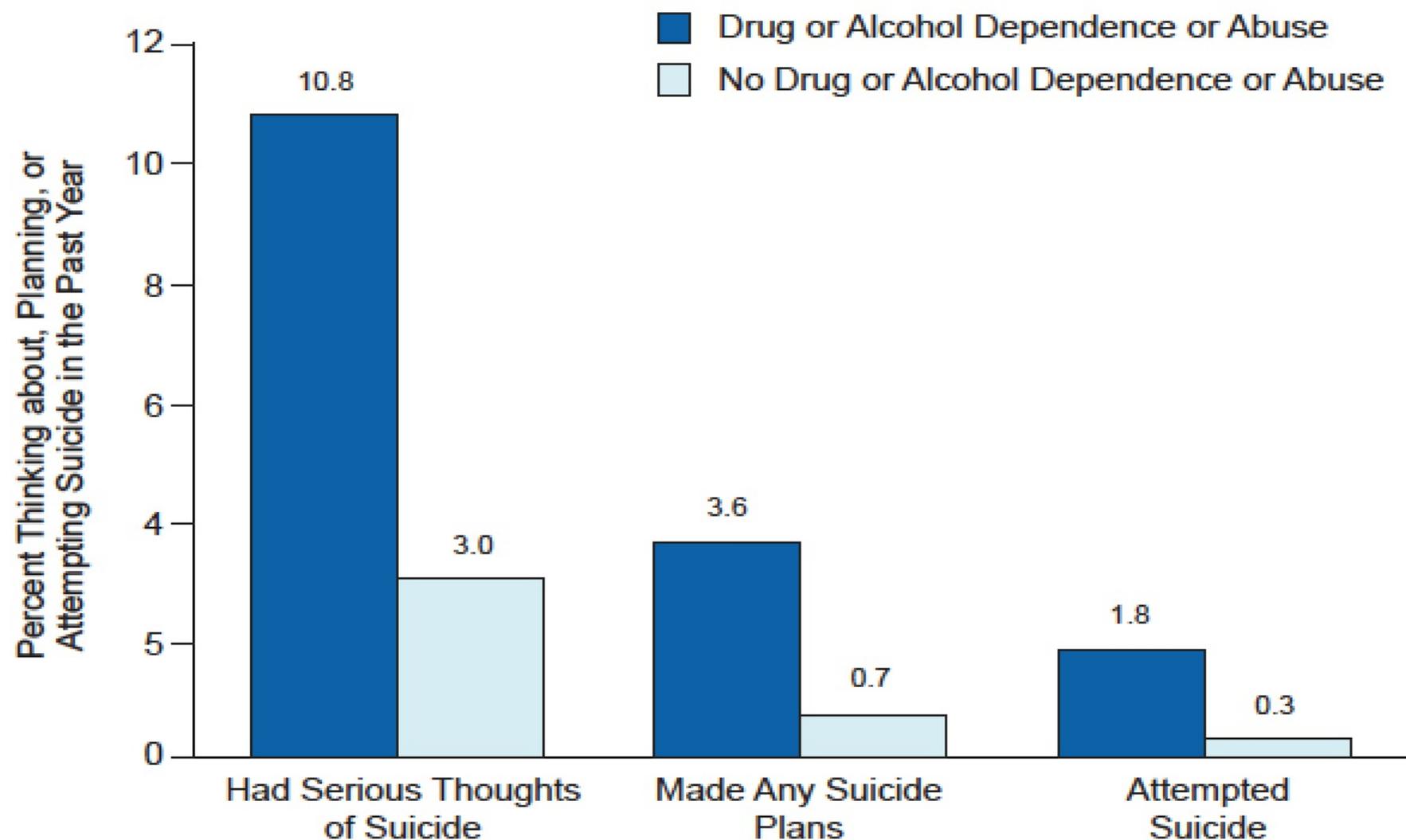
Figure 4.3 Past Year Substance Dependence or Abuse and Serious Mental Illness among Adults Aged 18 or Older: 2009



SMI = serious mental illness; SUD = substance use disorder.

¹ Statistics on mental illness are located in Chapter 2 of this report.

Figure 4.7 Suicide Thoughts, Plans, and Attempts in the Past Year among Adults Aged 18 or Older, by Substance Dependence or Abuse: 2009



High Prevalence of SUDs Among Individuals with Mood and Anxiety Disorders

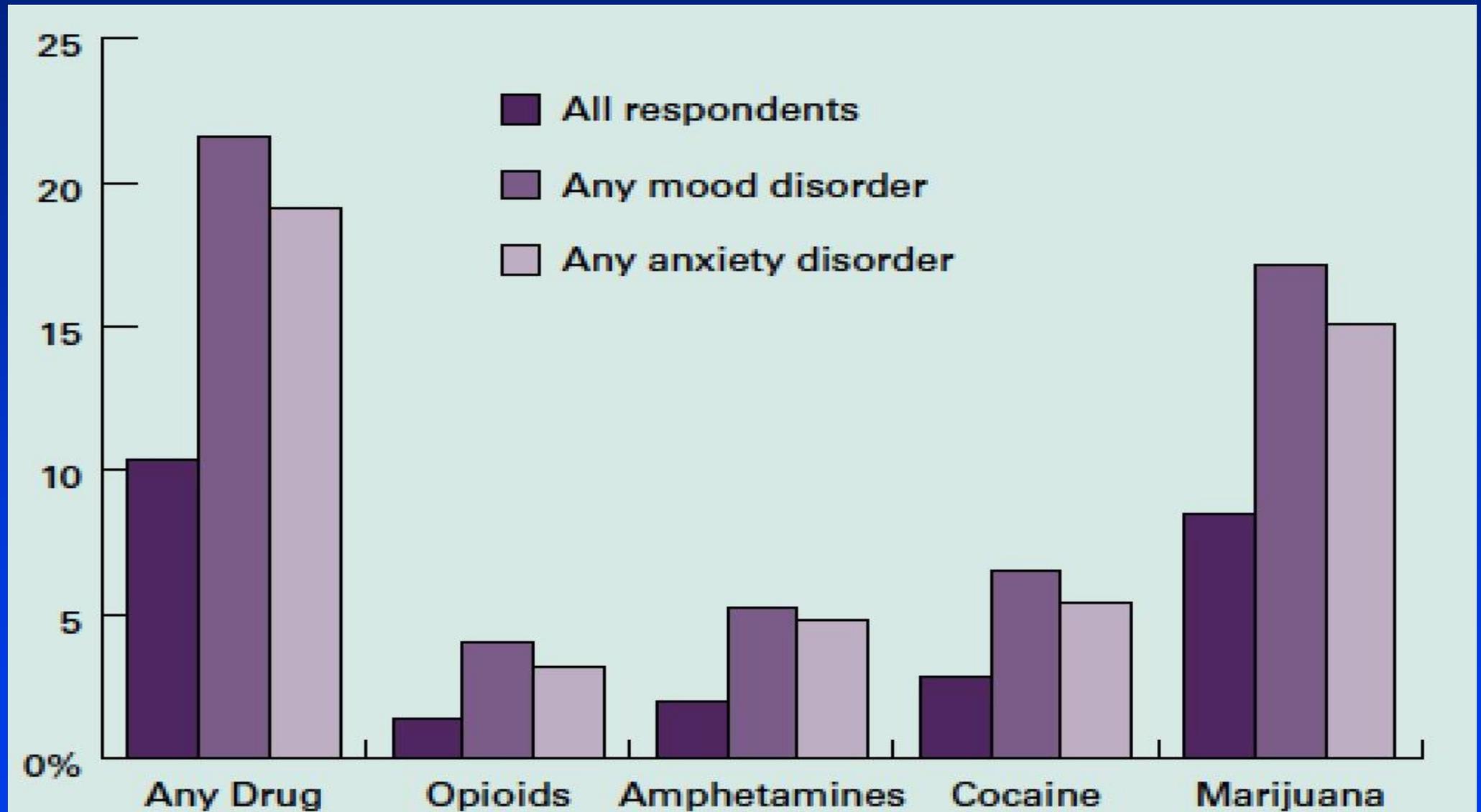
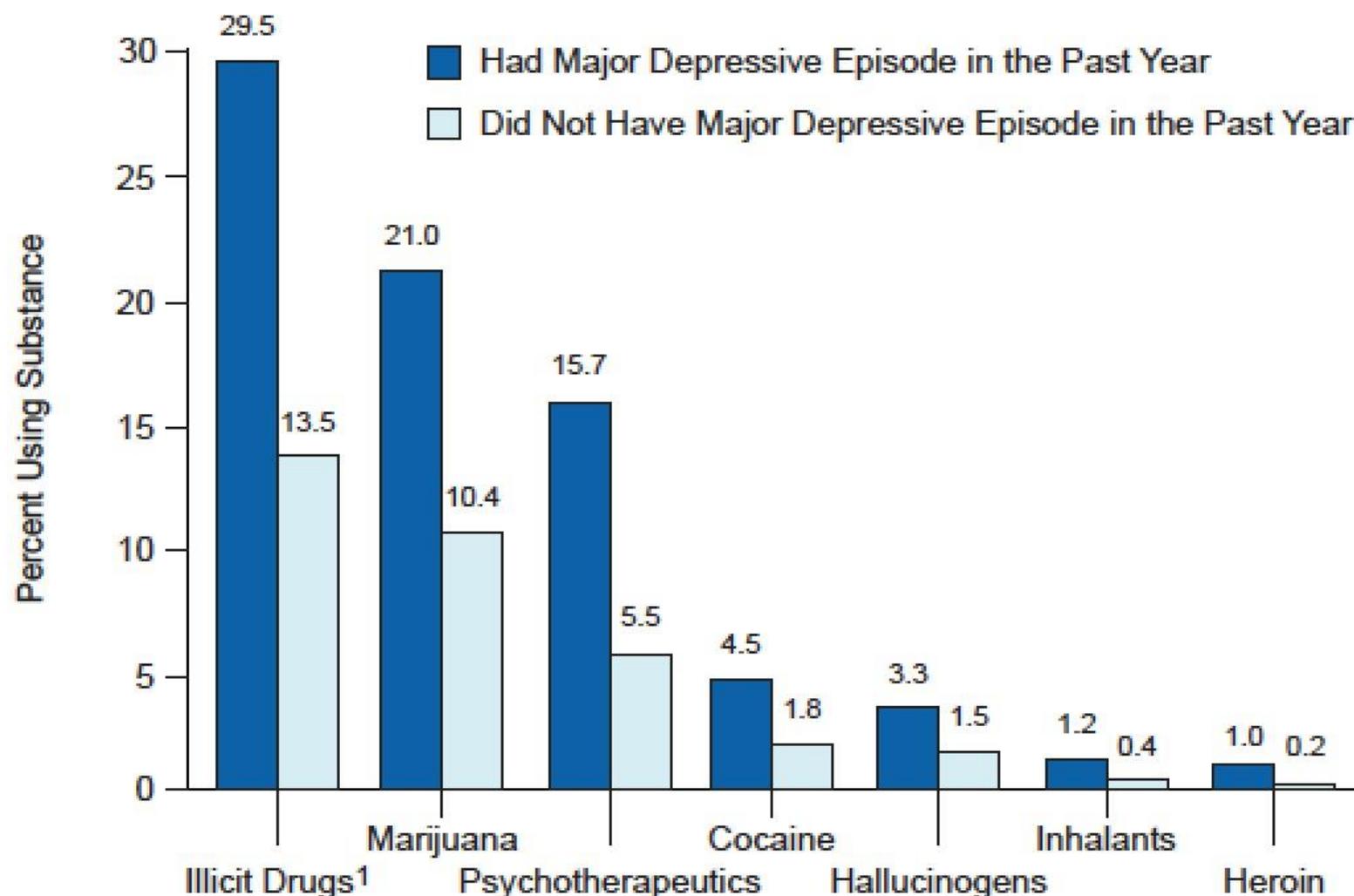


Figure 4.8 Past Year Substance Use among Adults Aged 18 or Older, by Major Depressive Episode in the Past Year: 2009



¹ Illicit Drugs include marijuana/hashish, cocaine (including crack), heroin, hallucinogens, inhalants, or prescription-type psychotherapeutics used nonmedically.

Prevention of Negative Consequences of Addiction

- Primary prevention
 - Activities aimed at preventing a disease from occurring—e.g., reducing exposure of adolescents to addicting substances; drug take-back days
 - Should be considered in debates about legalization of drugs
 - Medicalization of marijuana will have an anti-primary prevention effect, particularly for exposure of adolescents to marijuana
 - Educational efforts likely have a role—use vs. perceived harm

Prevention of Negative Consequences of Addiction

- Secondary Prevention

- Aims at reducing the negative consequences of illness by identifying early or asymptomatic cases before they progress to full-blown, late stage disease requiring extensive treatment
- Screening for diseases before they present clinically are examples of this
 - Screening tests for SUDs—screening questionnaires and urine drug tests

Prevention of Negative Consequences of Addiction

- Tertiary Prevention
 - Efforts to care for established disease, minimize its consequences, restore function, prevent complications
 - Harm reduction activities are examples of tertiary prevention
 - Provision of naloxone to prevent opioid overdoses
 - Needle exchanges/education about cleaning of needles
 - Moderation management