Addiction and the Brain

Understanding Rather Than Personalizing Substance Use Disorders

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ATTITUDES

Throughout much of the last century, scientists studying drug abuse labored in the shadows of powerful myths and misconceptions about the nature of addiction.

When science began to study addictive behavior in the 1930s, people addicted to drugs were thought to be morally flawed and lacking in willpower.

Those views shaped society's responses to drug abuse, treating it as a moral failing rather than a health problem, which led to an emphasis on punitive rather than preventative and therapeutic actions.

Today, thanks to science, our views and our responses to drug abuse have changed dramatically. Groundbreaking discoveries about the brain have revolutionized our **understanding** of drug addiction, enabling us to respond effectively to the problem.

Dr. Nora Volkow

- Why Bad Habits are Hard to Break

National Institute of Drug Abuse

Drug addiction erodes a person's self-control and ability to make sound decisions, while sending intense impulses to take drugs.

The Numbers

- According to the National Survey on Drug Use and Health (NSDUH), 19.7 million American adults (aged 12 and older) battled a substance use disorder in 2017.

https://americanaddictioncenters.org/rehab-guide/addiction-statistics

THE CORRELATION BETWEEN NEUROSCIENCE AND THE BIOPHYSIOPSYCHOSOCIAL DISEASE OF ADDICTION

What does that mean?

Bio = Biological – Genes and Heredity (I.e. Alcoholism)
Physio = Physiological – chemical changes in brain & body
Psycho = Psychological – Feelings, Emotions & Beliefs
Social = Environment – Family – Friends – Bars - Hangouts

“Once you know why you are doing what you are doing, you will have more control over that.”

KNOWLEDGE = EMPOWERMENT

Understanding the disease

Drugs change your brain chemistry *and* behavior

Science of substance dependence

1. All addictive drugs produce a reward system in the brain.
2. Using addictive drugs produces a feeling of well-being and alleviates bad feelings.
3. The body develops a tolerance to limit the toxic effects of addictive drugs which requires user to take more, more often.

Science of substance dependence

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Science of substance dependence

Using

too much

too often

too soon

develops dependence

How Does This Happen

- Availability
- Opportunity
- Preoccupation

Preoccupation with next Opportunity and Availability to drink that increase as we age from weekends to weekdays to days to hours.

This is the progression of the disease when we drink too much, too often until brain and body become normal with the substance present.

HBO Video with Dr. Mark Willenbring

HANDOUTS

DSM V Diagnostic Criteria for

Substance Use Disorder Checklist

&

Other Behavioral Health Disorders

Medical Appointment

- Patients often do not report symptoms for Substance Use Disorders the same way they, or you or I would to our Doctor?

WHY?
Would you feel comfortable telling someone you are having an inability to regulate your behavior that is often in the face of catastrophic consequences?

Barriers to Accurate Reporting

- Money
- Stigmatization
- Legal Problems
- Fear of being Judged
- Don’t want to give up euphoric feeling
- Admission of a problem = Treatment
- Lack of understanding that Addiction is a Disease

To Understand Addiction as Disease

Stop the Stigma and Discrimination by Changing the Language

Addiction – Substance Use Disorder

Addict – Person in Recovery

Alcoholism – Alcohol Dependency

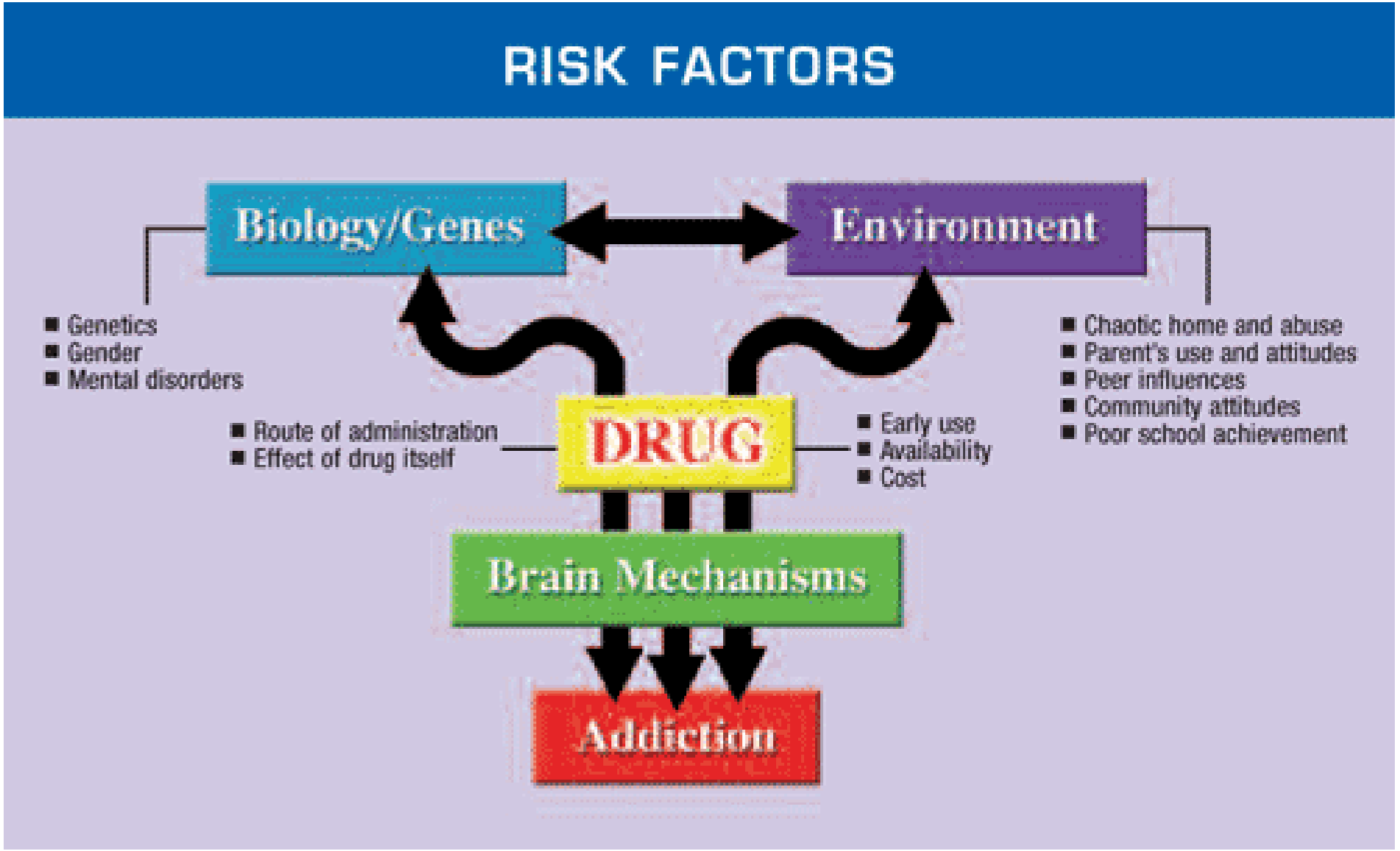
Heroin Addict – Opiate Dependent Person

Crack Addict – Person Dependent on Cocaine

Your brain on drugs

Drugs change your brain chemistry *and* behavior

No single factor determines whether a person will become addicted to drugs.

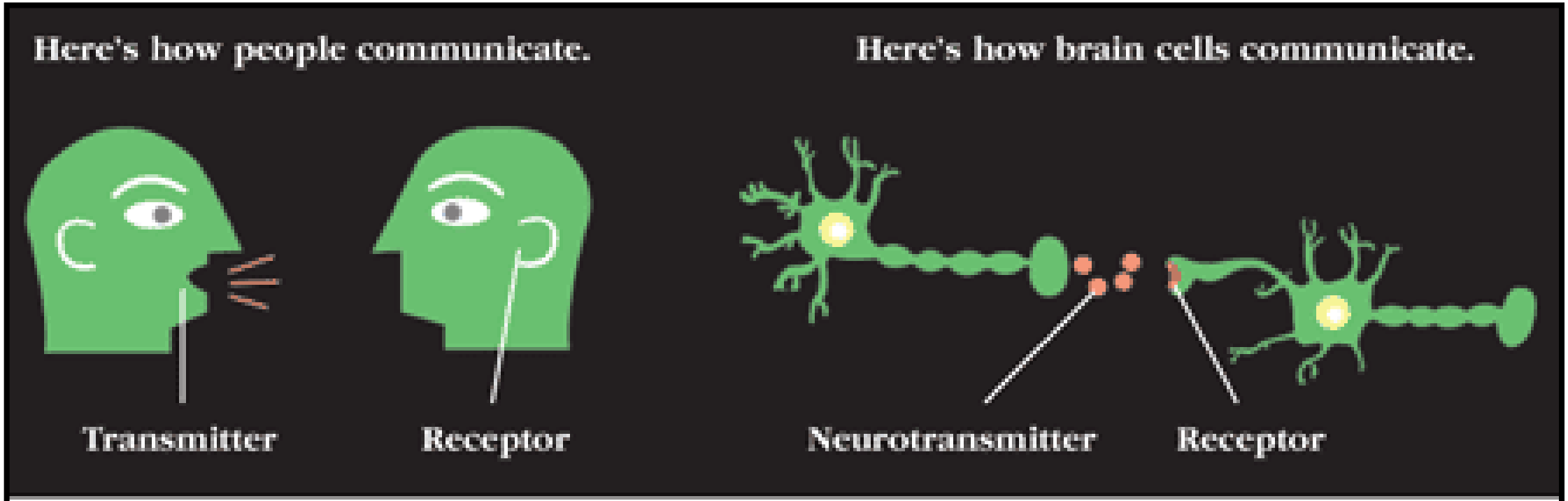


Why are drugs more addictive than natural rewards?

Answer: The more intense the reward, the more ingrained the memory, the more likely the action will be repeated (Wicklegreen, 1998).

When some drugs of abuse are taken, they can release 2 to 10 times the amount of dopamine than natural rewards do. In some cases, this occurs almost immediately (as when drugs are smoked or injected), and the effects can last much longer than those produced by natural rewards. The resulting effects on the brain's pleasure circuit dwarfs those produced by naturally rewarding behaviors such as eating and sex. The effect of such a powerful reward strongly motivates people to take drugs again and again. This is why scientists sometimes say that drug abuse is something we learn to do very, very well. **(Memory Bumps)**

The Neurochemistry Of Relapse And Recovery

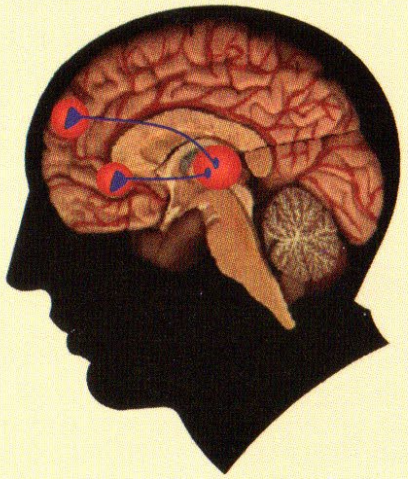


Drugs of abuse target the brain's reward system by flooding the circuit with dopamine.

Courtesy National Institute of Drug Addiction, National Institute of Health

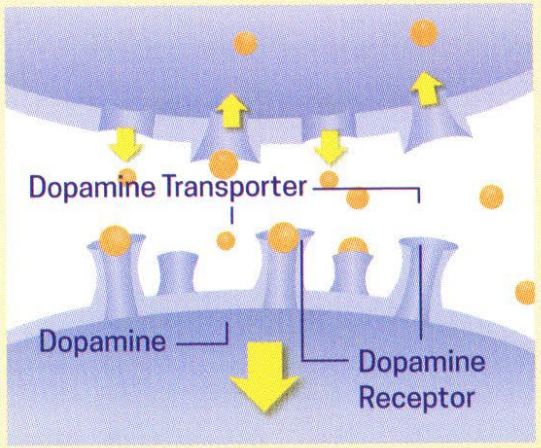
Some drugs target the brain's pleasure center

Brain reward (dopamine pathways)

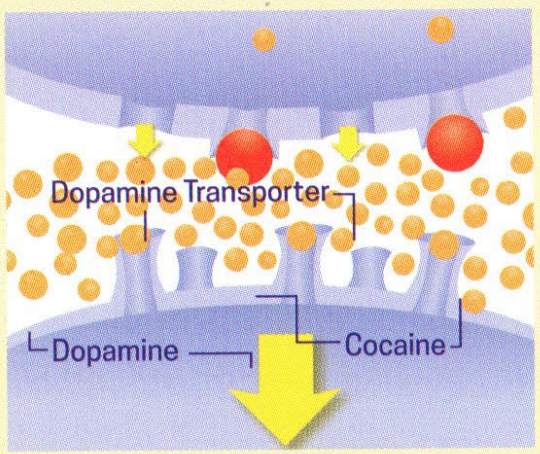


These brain circuits are important for natural rewards such as food, music, and sex.

How drugs can increase dopamine



While eating food



While using cocaine

Typically, dopamine increases in response to natural rewards such as food. When cocaine is taken, dopamine increases are exaggerated, and communication is denied.

Some drugs of abuse release 2 to 10 times the amount of dopamine than natural rewards

Courtesy National Institute of Drug Addiction, National Institute of Health

Drugs and the Brain

- Drugs are chemicals that work in the brain by interfering with how the brain sends, receives, and processes information.

- They do this by interacting with the brain's neurotransmitters— either by mimicking the natural chemicals in the brain, or by causing the brain to release abnormal amounts of a neurotransmitter.

- Increased firing of dopamine with drugs tricks the brain into thinking it got a reward. Effects are pharmacological and not reward-based.

- Brain devalues all other responses

- **How Drugs Hijack the Brain (video)**

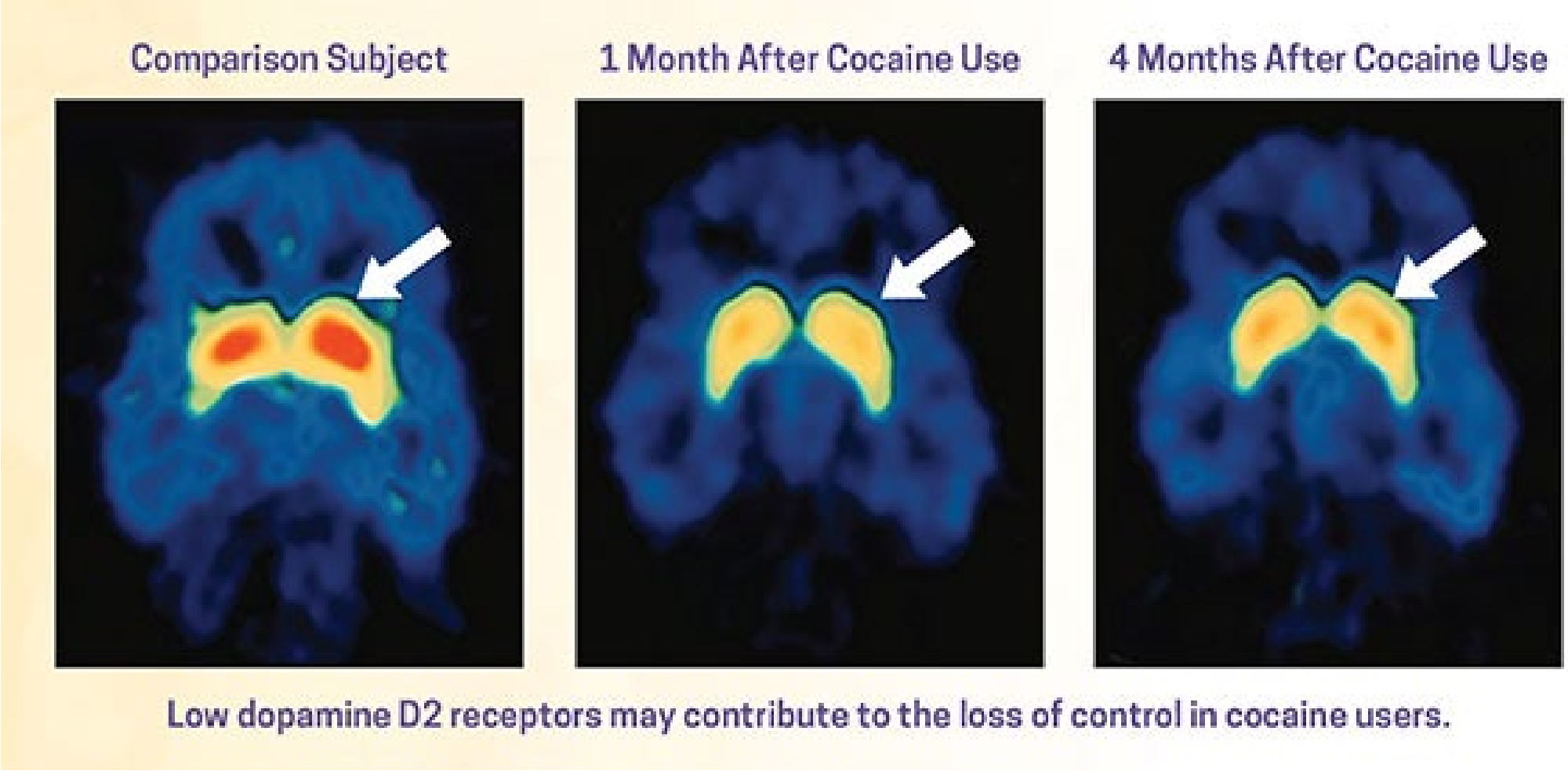
As a result, dopamine's impact on the reward circuit of a drug abuser's brain can become abnormally low, and the ability to experience any pleasure is reduced.

This is why the abuser eventually feels flat, lifeless, bored and depressed, and is unable to enjoy things that previously brought them pleasure.

This is known to be (**ANHEDONIA) and is thought to be the most significant factor leading to RELAPSE**.

Now, they need to take drugs just to bring their dopamine function back up to normal.

A Brain on Drugs



Courtesy National Institute of Drug Addiction, National Institute of Health

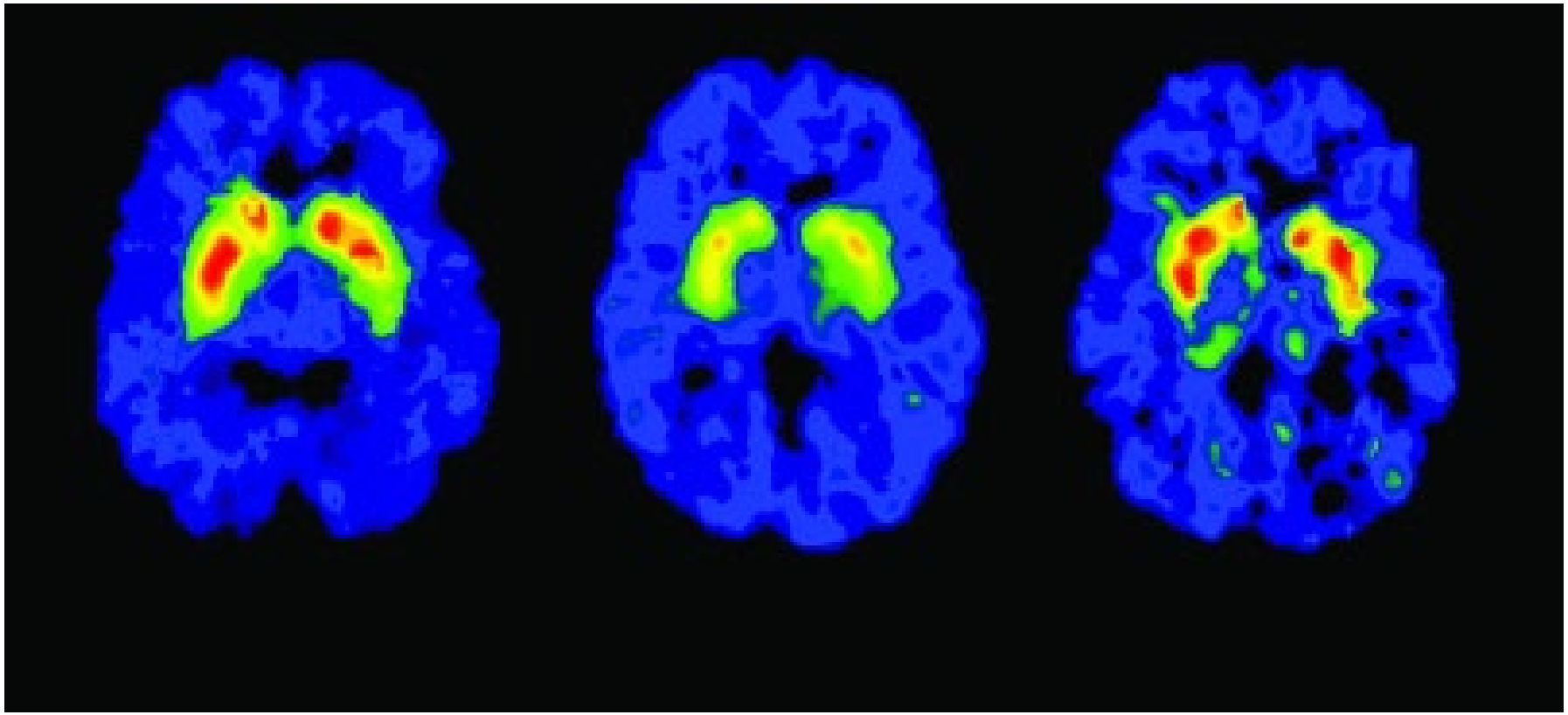
Withdrawal - When the individual stops using, the body shuts down the production of pleasure chemicals even faster and more erratically than it turned them on, which prevents the brain chemistry from returning to normal.

- At the same time, the brain turns back on the warning chemicals that increase very rapidly, often leading to feelings of anxiety or paranoia.
- This process can repeat itself over and over with the individual's feelings alternating between feeling invincible and courageous, to paranoid and hyper-vigilant.

BRAIN RECOVERY WITH PROLONGED ABSTINENCE

TREATMENT AND RECOVERY - Healthy Person –

Source: J Neurosci 21:9414–9418, 2001.



Healthy Person	Meth abuser 1 month abstinence	Meth Abuser 14 months of abstinence

These images of the dopamine transporter show the brain's remarkable potential to recover, at least partially, after a long abstinence from drugs

Why is it easier to learn than unlearn behaviors?

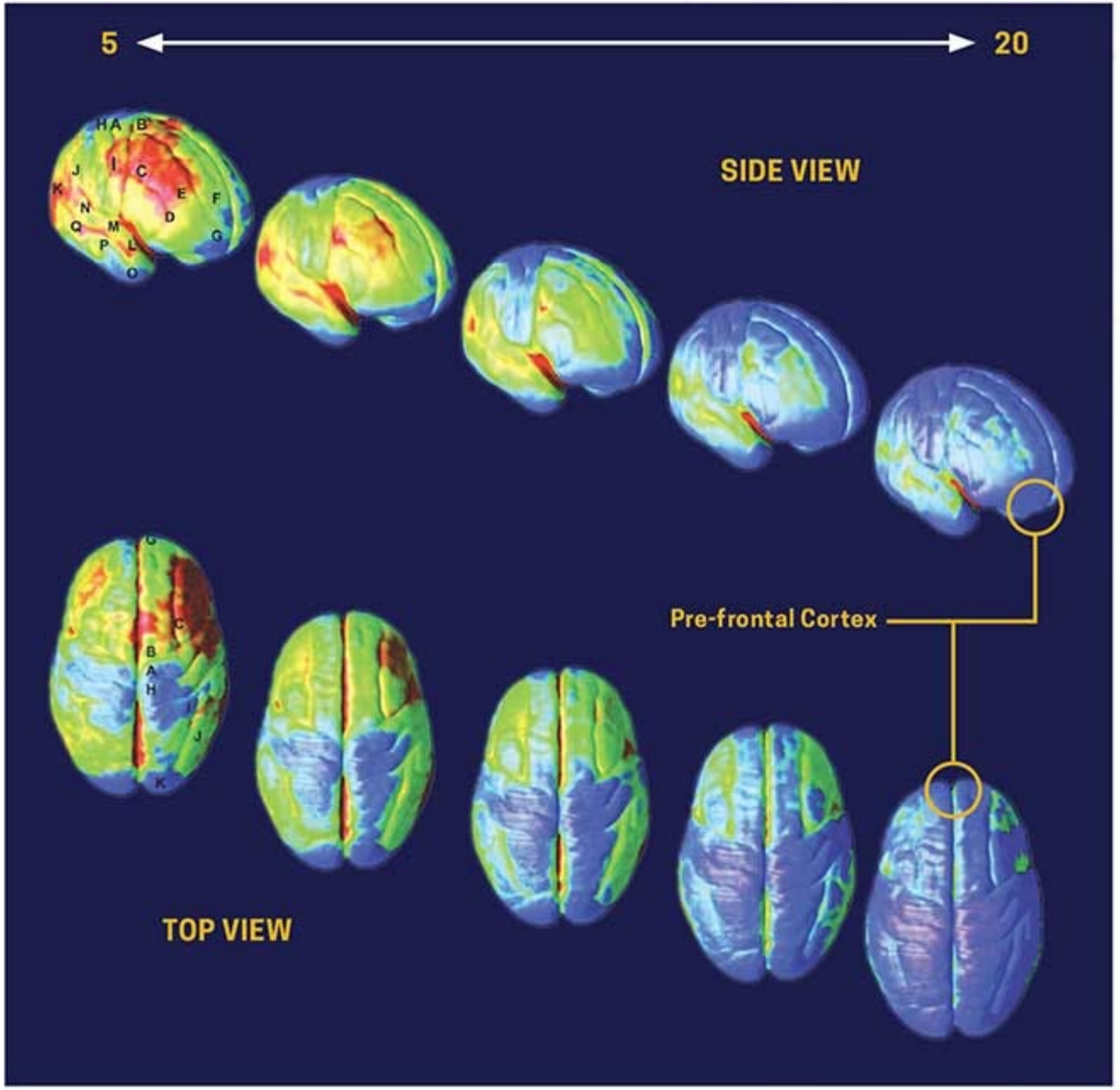
??????????

Addiction is a develop-mental disease - it typically begins in childhood or adolescence.

The brain continues to develop into adulthood and undergoes dramatic changes during adolescence

Images of Brain Development in healthy Children and Teens

(Ages 5-20)

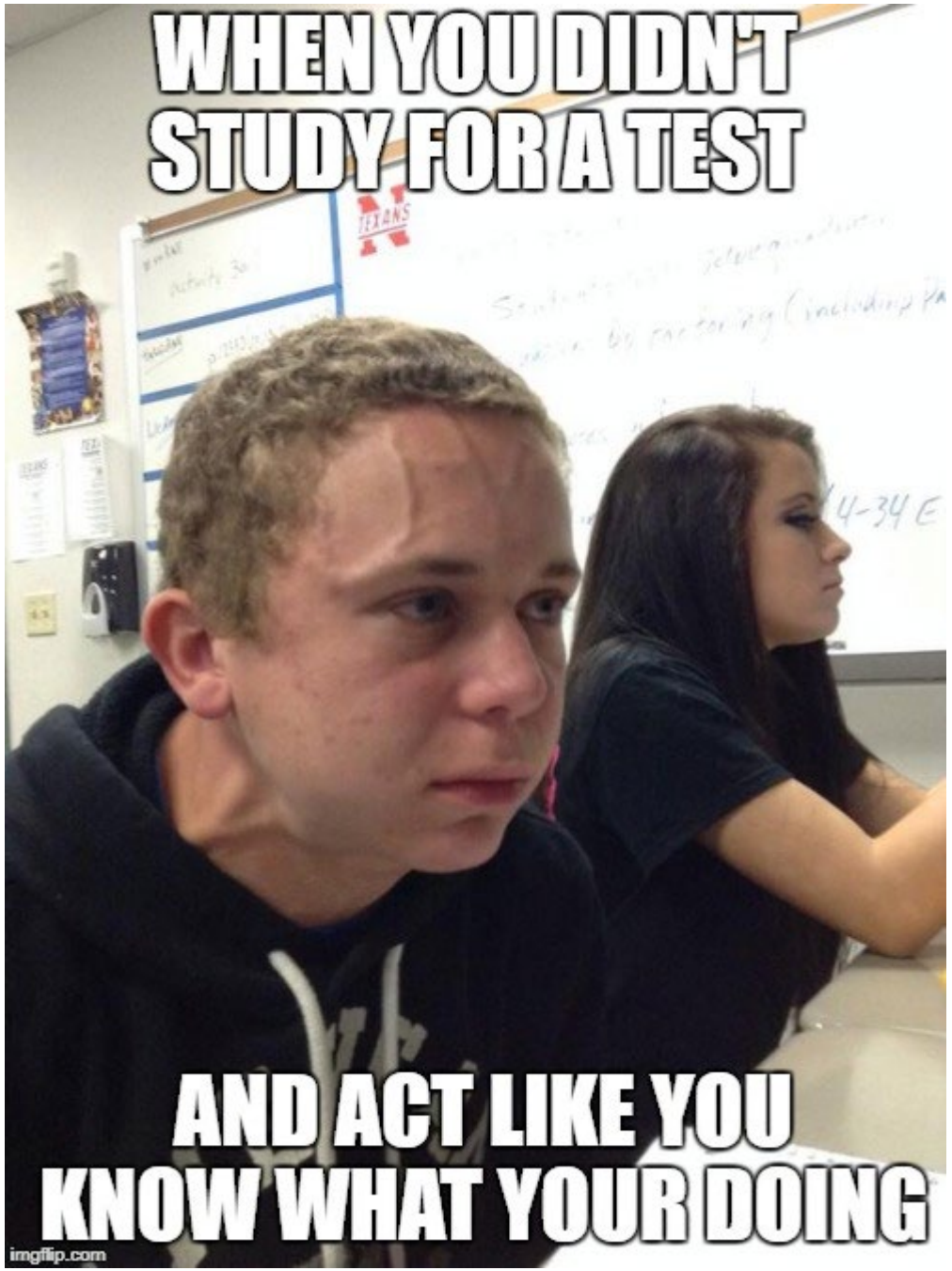


Source: PNAS 101:8174-8179, 2004.

Courtesy National Institute of Drug Addiction

“The combination of heightened responsiveness to rewards and immaturity in behavior control areas may bias adolescents to seek immediate rather than long-term gains.”

(Simpkin, 2006)



Growing up is a long and painful process.

Stress is everywhere

Adolescence appears to be a time of increased sensitivity to stress, which worsens each time substances are used to relieve stress. (Simpkin)

Stress increases the value of immediate rewards

- *Under stress the brain favors immediate solutions –*
- *Prioritizes quick fixes*
- *Not longer-term goals*
- *Stress amplifies dopamine neuron firing*
- *Stress = fear = prevention of changing bad habits*
- *Conditioned learned response is comfortable and gratifying*

Some Adolescent Risk and Protective Factors

Risk Factors	Domain	Protective Factors
Poor Social Skills	Individual	Positive Relationships
Substance Abuse	Peer	Academic Competence
Drug Availability	School	Anti-Drug Use Policies

Sense of Belonging

- No accident that all of your friends use drugs
- Easiest way to make….
- Friends and seek approval
- Way to release pressure
- Good Feeling!

A predictor of progression to alcohol-related harm is age at first use.

Age of	Probability of	
First Drink	Abuse	Dependence
11 – 12	=	15.9%
13 – 14	=	9.0%
19 – 20	=	1%

Early use is a factor

Age of Onset Crucial to Long, Chronic and Lasting Effects of Substance Abuse (Age of first drink, simpkin, schukit, 2006/08)

Substance Abuser who had

- First drink age 13,
- First drunk at age 16
- First problem age 18

Was likely to develop first Dependence ages 25 – 40, with Death likely at age 60.

Rapid progression of disease occurred with early onset, frequency and amount, not duration.

Addiction and Dependency

- In addition to the behavior displayed in the abuse stage, individuals using substances also may develop physical and emotional dependence on drugs and can begin to show withdrawal symptoms when they attempt to stop taking a specific drug.

- Use at this stage is compulsive and the individual is unable to stop on her/his own despite the mounting problematic consequences associated with her/his drug use.

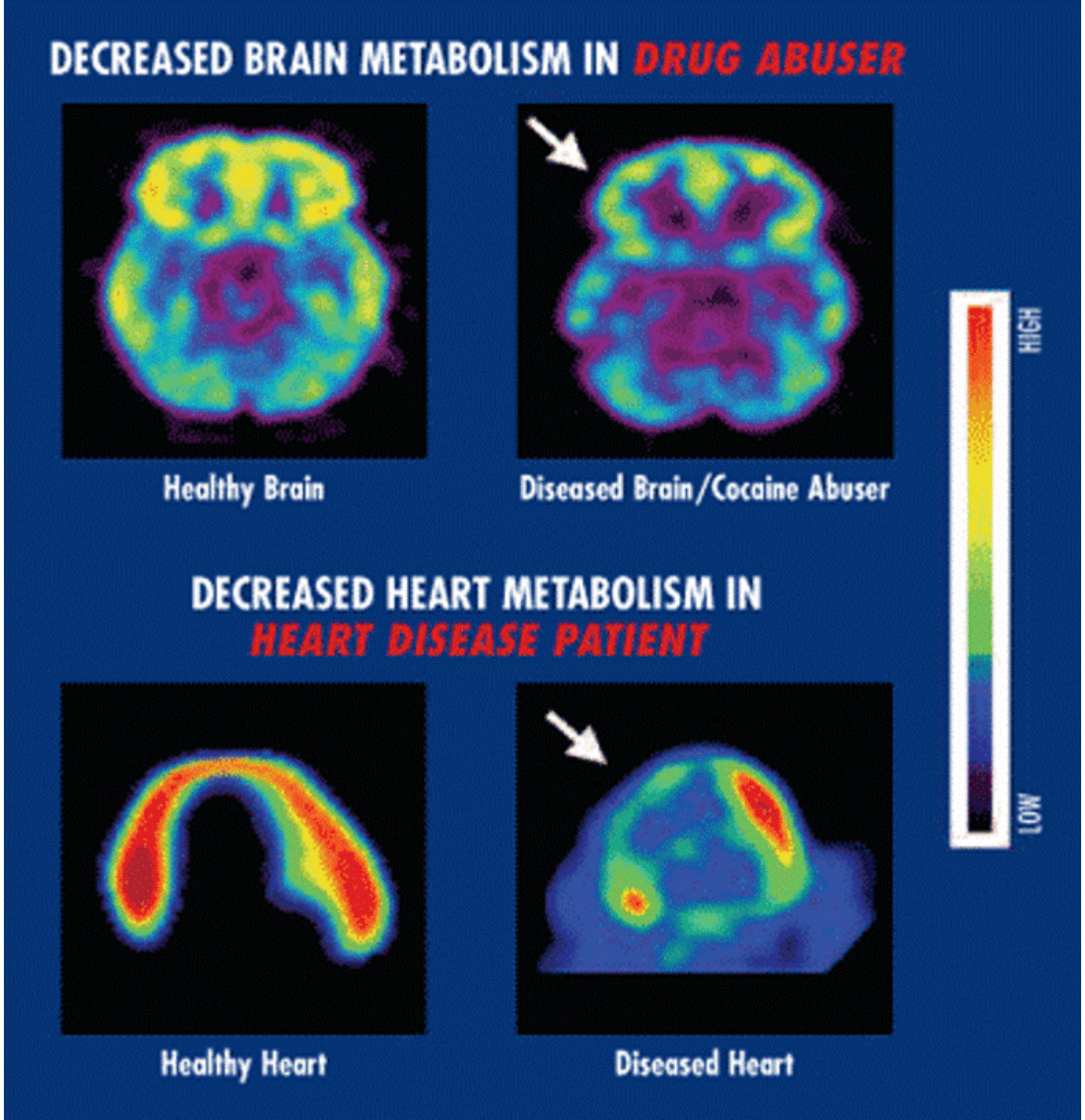
  (Maggie Trapp, 2009)

Drug addiction as a Disease

Drugs change your brain chemistry *and* behavior

Drug Addiction is a disease like heart disease.

Courtesy of National Institute of Drug Abuse



Both disrupt the normal, healthy functioning of the underlying organ

- have serious harmful consequences
- are preventable
- treatable
- and if left untreated,
- can last a lifetime.

is long-term

Symptoms of Diabetes

- Tiredness
- Poor Circulation
- High Blood Sugar

Symptoms of Addiction

- Inability to control intake
- Susceptible to triggers
- High tolerance/deep withdrawals

- Use despite harmful consequences
- Genetic predisposition
- Threshold equals onset of disease
- *You don't un-get it*

- Use despite harmful consequences
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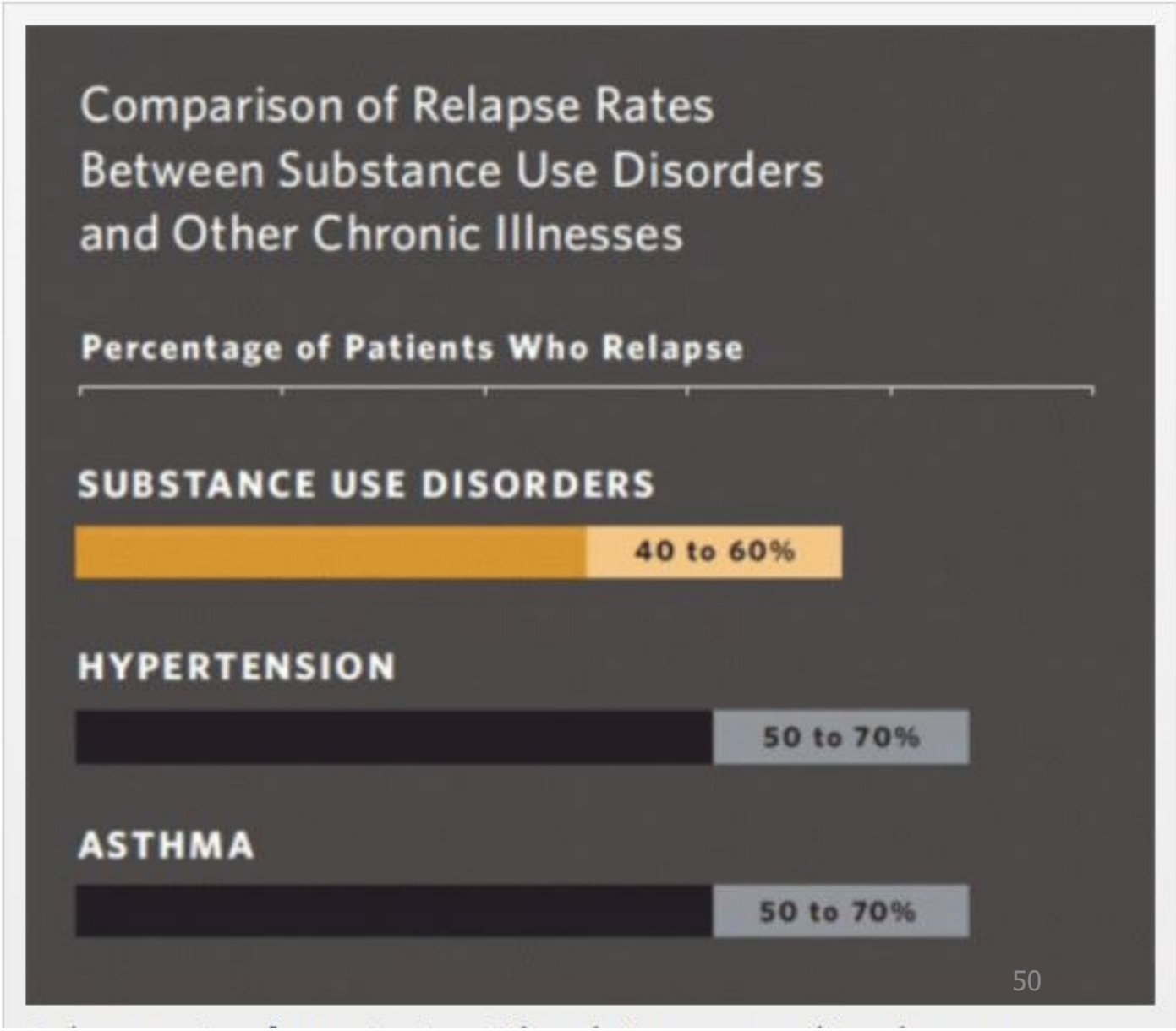
Patients who have a Chronic Illness; often relapse.

Courtesy National Institute of Drug Addiction, National Institute of Health



Psychological Impact

- As the disease progresses, patients have difficulty managing their feelings, thinking, and controlling their behavior.
- They also may drink or do drugs to cope with feelings of depression, anxiety, or low self-esteem.

- **Chasing relief with a response that leads to distress**

- Over time, individuals lose control, and their behavior becomes increasingly impulsive and unpredictable.

- A chemical reaction to the substance occurs, resulting in impaired judgment and problems with impulse control.
- (**What is Addiction? HBO Video**)

Simple Facts

- 1 of 2 bipolar patients have SUD problems
- 1 in 3 patients with Anxiety or Depression will have SUD
- 2 out of 3 of these MH problems disappear with long-term sobriety, including clinical depression

Simple Facts

- All co-occurring conditions are highly treatable, but require integrated treatment
- Individual conditions worsen if treated separately
- Brain chemistry shifts back to relatively normal states longer-term with combination of medication and/or therapy

Wrap up

Drugs change your brain chemistry *and* behavior

The disorder

Using

too much

too often

too soon

develops dependence

The reality

1. All addictive drugs produce a reward system in the brain.
2. Using addictive drugs gives us a feeling of well-being and alleviates bad feelings.
3. Addictive drugs disrupt critical brain functions that control judgement, decision-making, and behavior.

Can SUD's be treated successfully?

YES! Addiction is a treatable disease. Discoveries in the science of addiction have led to advances in drug abuse treatment that help people stop abusing drugs and resume their productive lives.

Can addiction be cured?

Addiction need not be a life sentence.

Like other chronic diseases,

addiction can be managed successfully.

Treatment enables people to counteract

addiction's powerful disruptive effects on

brain and behavior

and regain control of their lives.

REVIEW

Why are drugs more addictive than natural rewards?

Answer:

The more intense the reward, the more ingrained the memory, the more likely the action will be repeated (Wicklegreen, 1998). Drugs of Abuse are 2 to 10 time more rewarding than natural rewards.

Results of the biophysiopsychosocial

- Biological – Genes/Inheritance
- Physiological – Chemical changes caused by drugs and alcohol
- Psychological – Feelings and Emotions
- Social – Friends, People, Places, Events, Bars……
- Leads to addictive beliefs, defensiveness, guilt, shame, and hopelessness manifested in patients suffering from the disease of addiction.

Like any other disease, it is the responsibility of the patient to treat the disease by the most effective means possible.

Those who suffer from this disease must gain an understanding of what happened to them and develop new beliefs about themselves that effectively engage ongoing healthy support leading to a meaningful and productive life that sustains their recovery.

What You Can Do

1. Change the language by using Substance Use Disorders instead of Addiction.
2. Explain SUD symptoms like you would other behavioral health disorders that impact daily functioning.
3. Refer to all of the people you see as “Patients” and never use the word “Addict” or other demeaning terms to describe those who have SUD’s.

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Services Available

Substance Abuse and Mental Health

Individual and Group Outpatient Treatment

Assessment and Referral Services

Resources available at
The National Institute of Drug Abuse
Drugs Brain and Behavior: The Science of Addiction
Ph: (877)643-2644; E-mail: drugpubs@nida.nih.gov
&
SAMHSA)Substance Abuse and Mental Health Services Administration
SAMHSA - https://www.samhsa.gov/

The brain on marijuana

Drugs change your brain chemistry *and* behavior

Marijuana Myths

- Not harmful
- Not addictive
- No withdrawal

Cannabis Use Disorder Prevalence

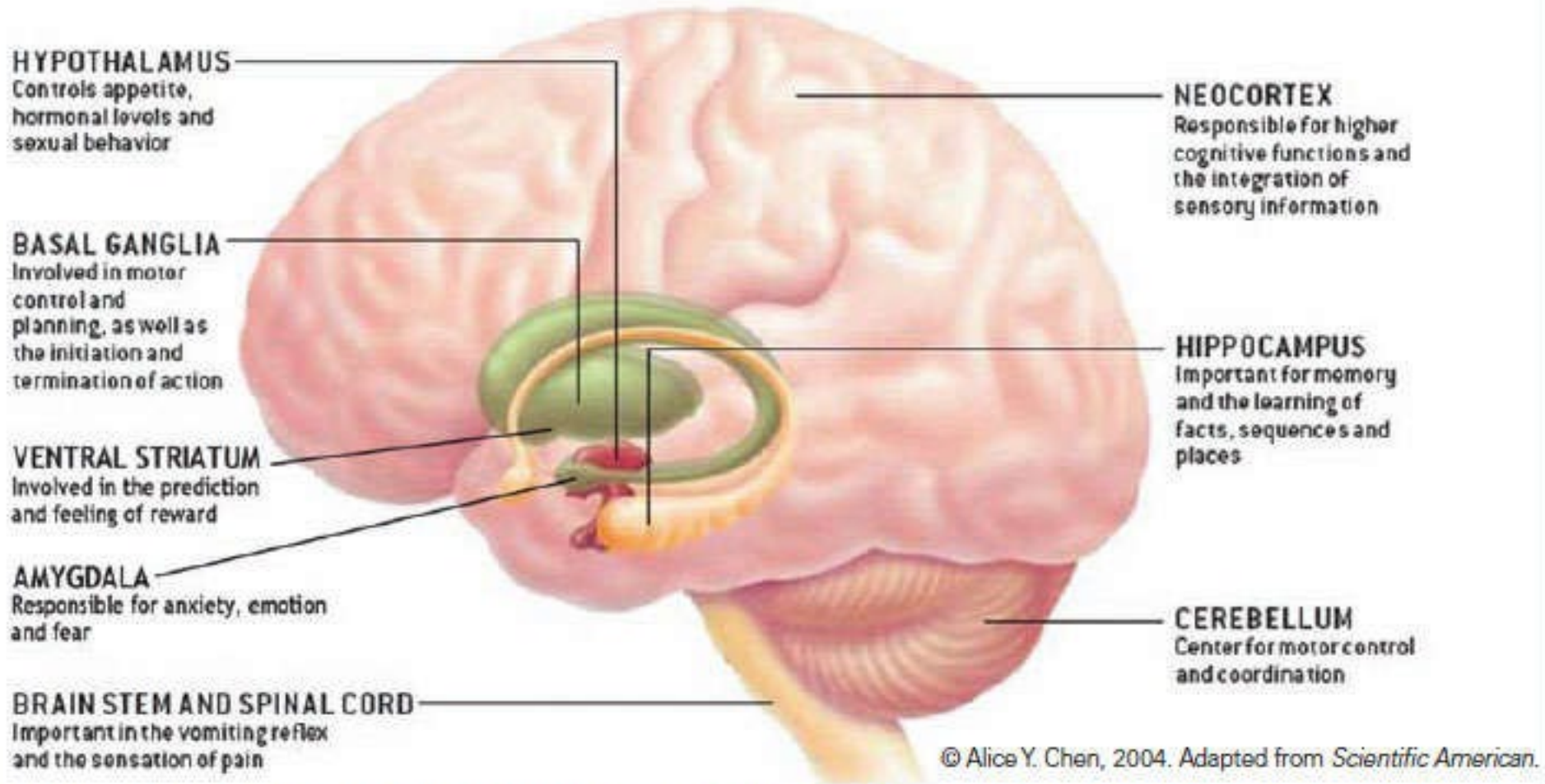
Users	Ratio	Percent
All Users	1:10	10%
Mid-Teen	1:6	17%
Daily Use	1:2-3	30-50%

Courtesy Harvard Medical School

Cannabis withdrawal symptoms

1. Irritability, anger, or aggression
2. Nervousness or anxiety
3. Sleep difficulty
4. Restlessness
5. Depressed mood

Marijuana's Effects on the Brain



When marijuana is smoked, its active ingredient, THC, travels throughout the body, including the brain, to produce its many effects. THC attaches to sites called cannabinoid receptors on nerve cells in the brain, affecting the way those cells work. Cannabinoid receptors are abundant in parts of the brain that regulate movement, coordination, learning and memory, higher cognitive functions such as judgment, and pleasure.

Marijuana impairs higher brain function

Reduces

- Learning
- Memory
- Concentration
- Problem solving
- Decision making

Reduces

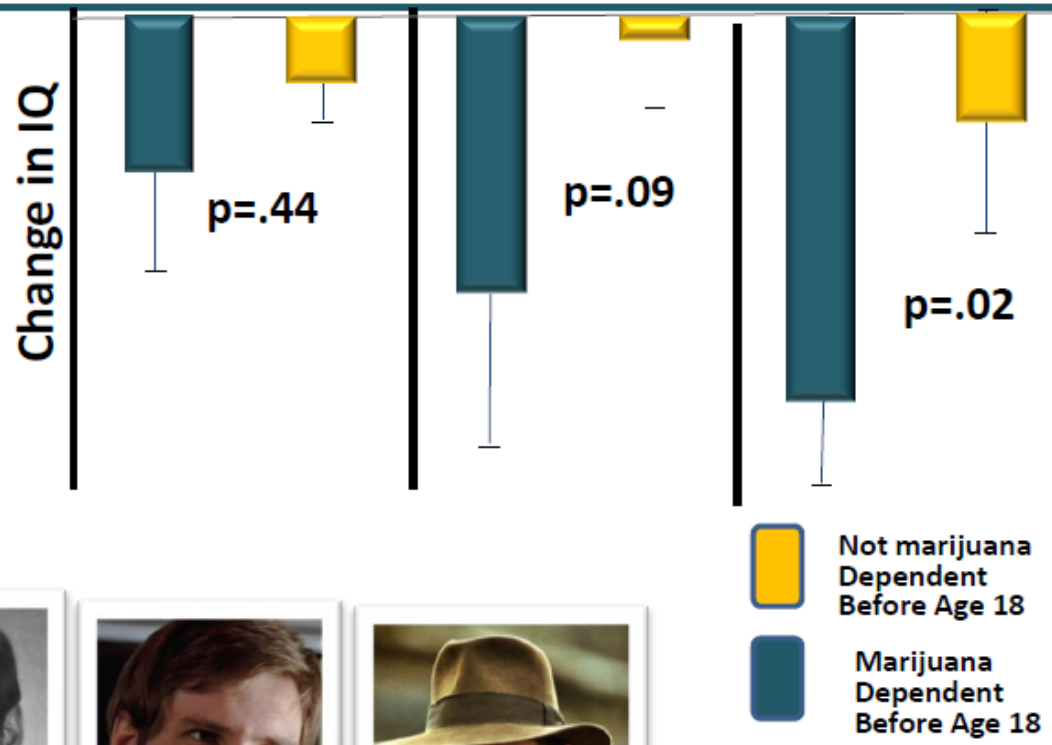
- Emotional control
- Behavior control

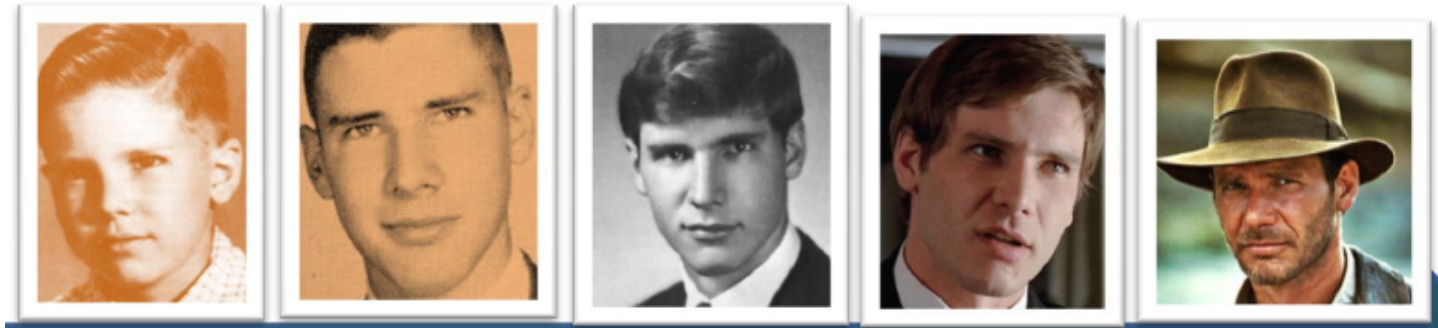
Increases

- Impulsivity
- Hunger

Early, Persistent Marijuana Use Associated with Reduced I.Q.

IQ drop most
if use before age 18, addicted at 38
IQ drop associated
with length of time addicted
IQ still reduced
if use before 18 and then quit
IQ reduced
if did not quit use at age 38

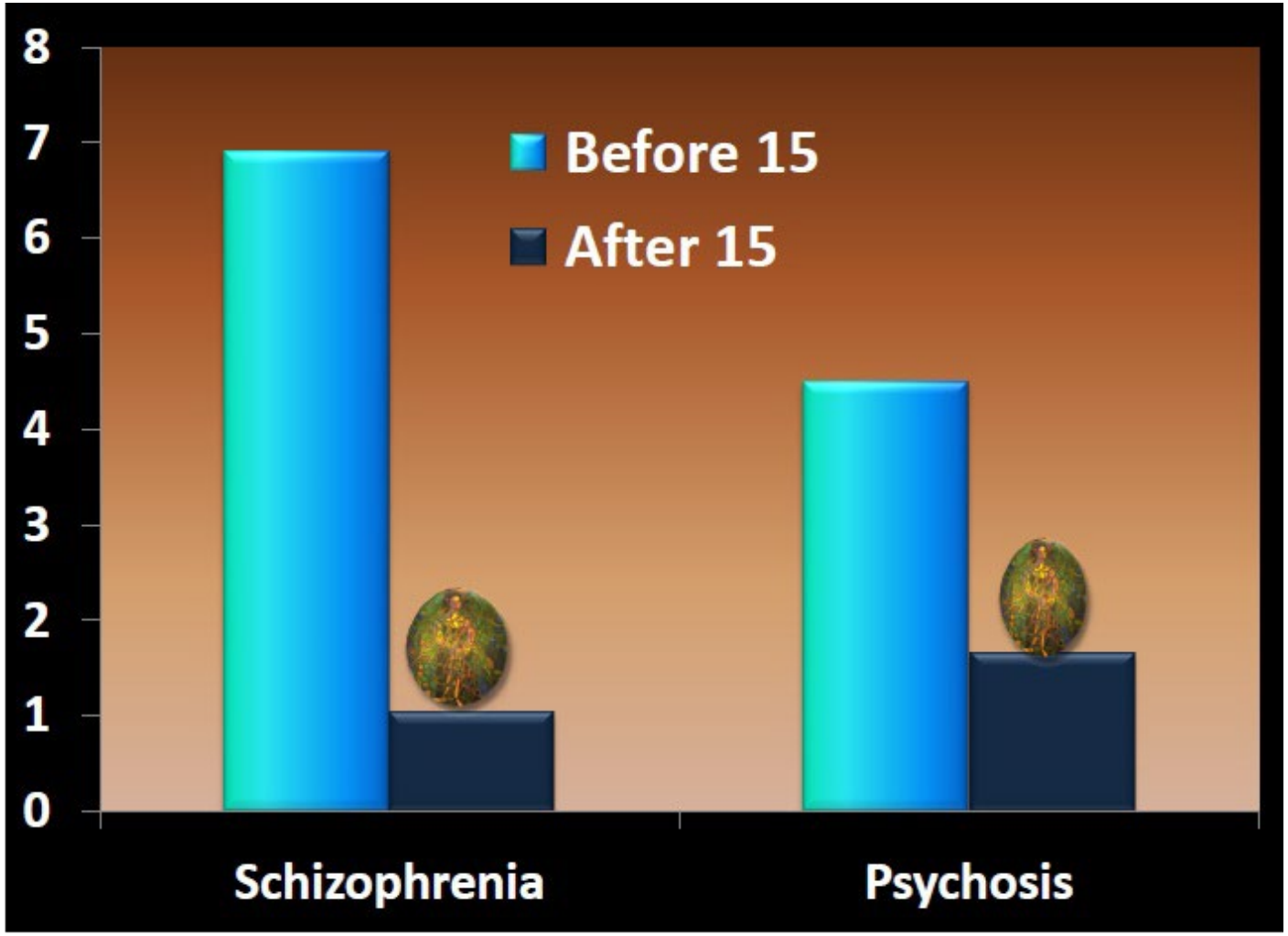




est. 13 yr | 18 yr | 21 yr | 32 yr | 38 yr

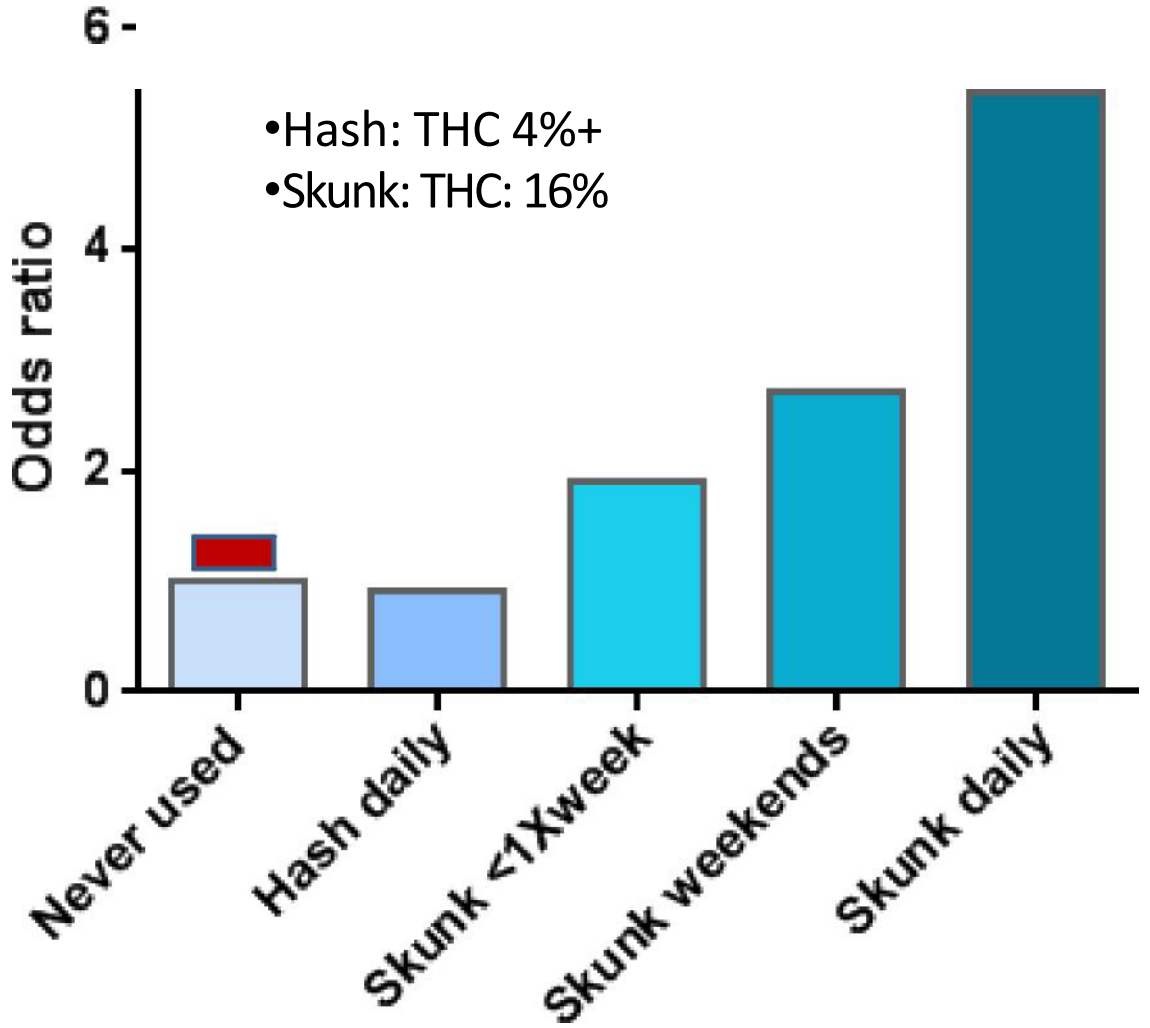
Meier et al, Persistent cannabis users show neuropsychological decline from childhood to midlife. Proc. Natl. Acad. Sci *USA*, 2012 Oct 2;109(40):E2657-64.

Early marijuana use associated with psychosis in young adults



Courtesy Harvard Medical School

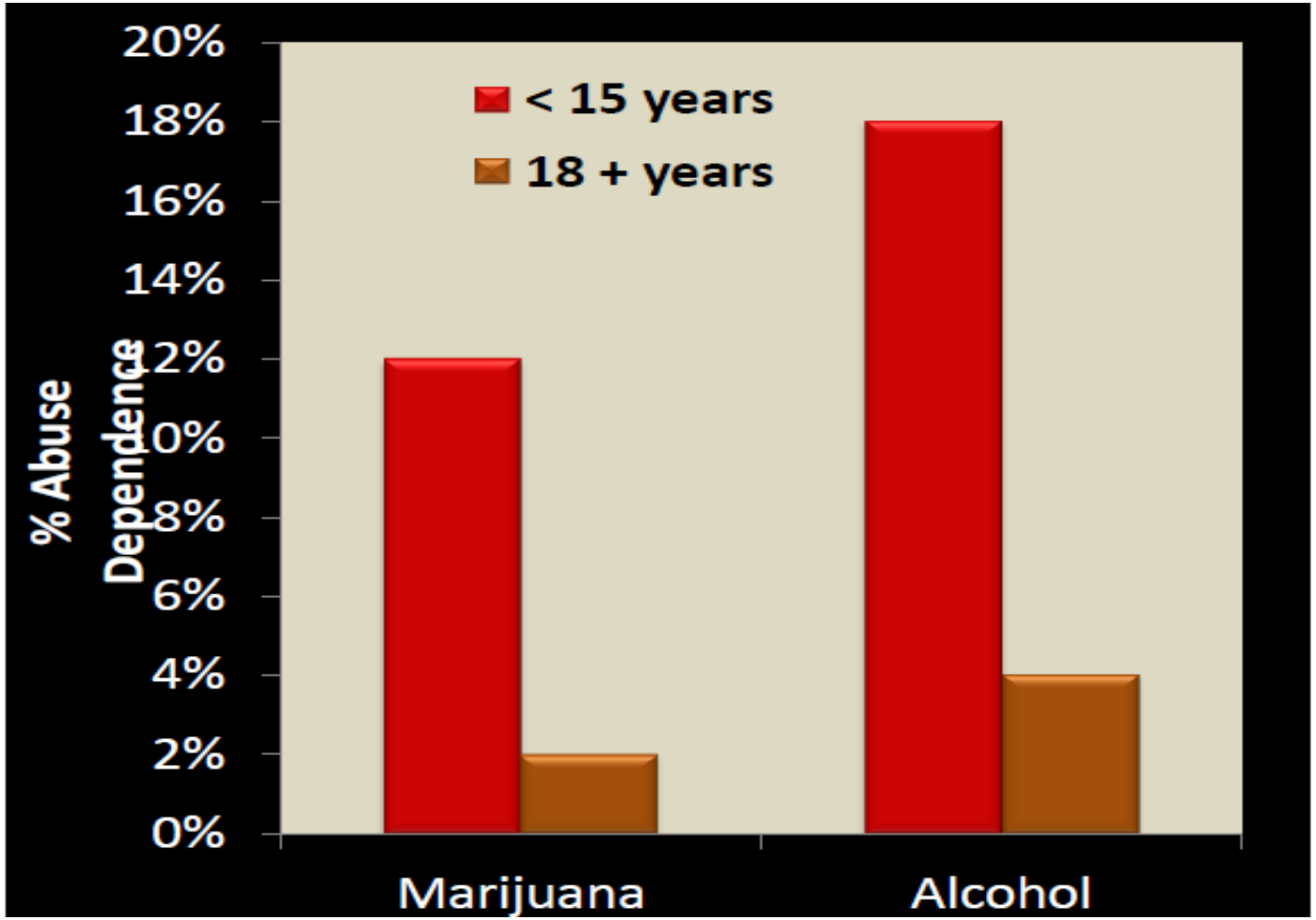
Strength and Frequency of Marijuana Use Increases Risk of Psychosis



•Di Forti et al Proportion of patients in south London with first-episode psychosis attributable to use of high potency cannabis: a case-control study. The Lancet Psychiatry 2:233-238, 2015

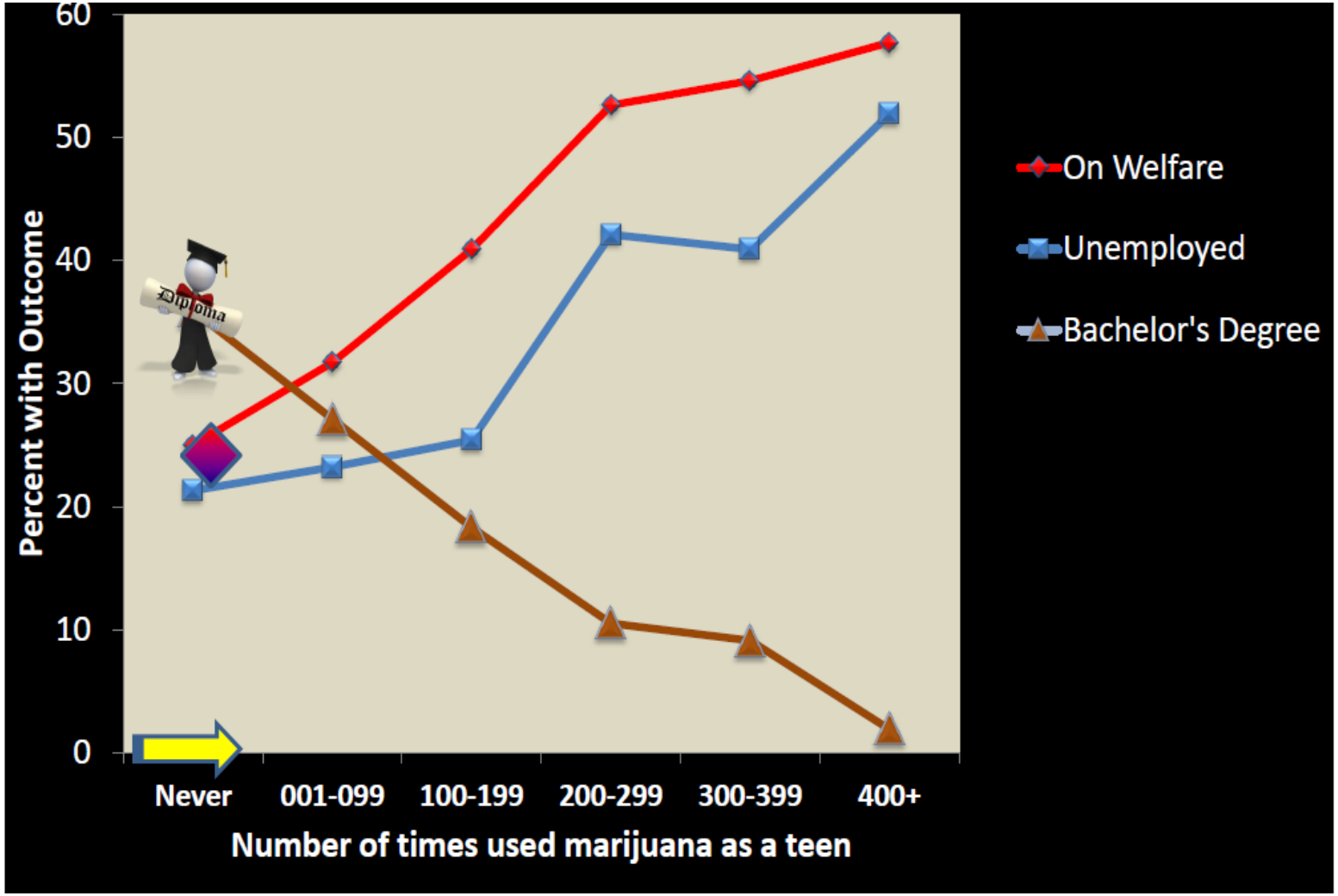
Risk of Initiation

- Nicotine
- Alcohol
- Marijuana
- Inhalants
- Simulants
- Cocaine
- Opioids
- Hallucinogens
- Anxiolytics



Courtesy SAMHSA 2013 National Drug Study

Teen marijuana use affects adult motivation



Courtesy Harvard Medical School

- **Marijuana - Opioids:**
- **Children at Risk**

- **Adolescent**

- **Developing Fetus**

- **THC Exposure Before Conception**

Marijuana Exposure in Developing Fetus: Association with Developmental Problems

•Fetus Birth Early childhood Adolescence, Young adulthood

•Infertility

•Placental •problems

•Low birth •weight

•< week- 1 month

•Increased tremor, startle

•9 months impaired mental development

•3 – 6 years

•inattention, impulsivity hyperactivity, impaired memory, behavioral problems

•14-21 years

•increased risk of smoking, marijuana

•19-21 years

•altered brain function during memory task

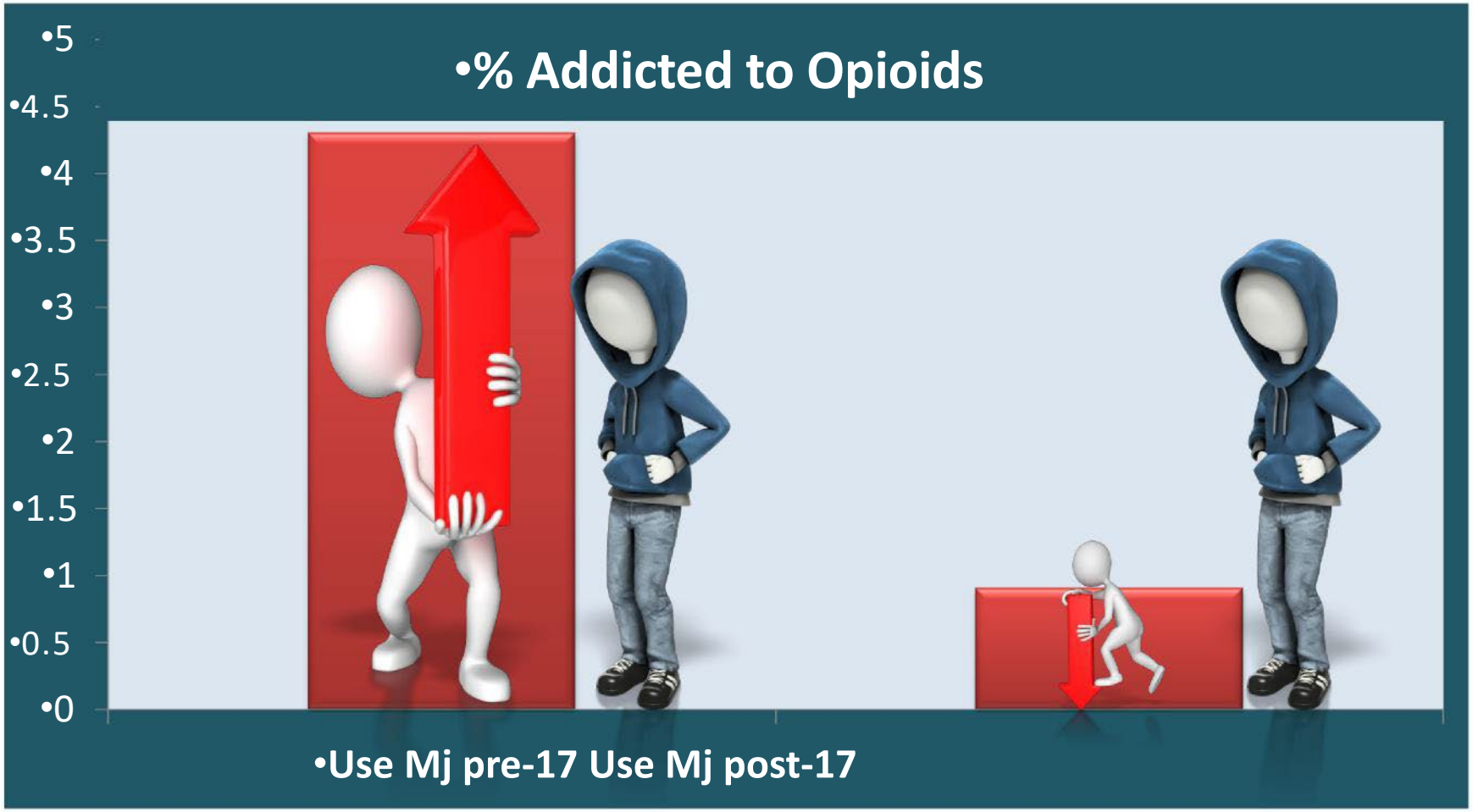
•increased incidence of •schizophrenia, addiction

•Morris CV, DiNieri JA, Szutorisz H, Hurd YL. Molecular mechanisms of maternal cannabis and cigarette use on human neurodevelopment. Eur J Neurosci. 2011 Nov;34(10):1574-83.

Adolescent Marijuana Use and Opioid Addiction: Twin

Twin A started marijuana before age 17; Twin B after age 17

Twin A is 4x more likely than Twin B to develop opioid addiction

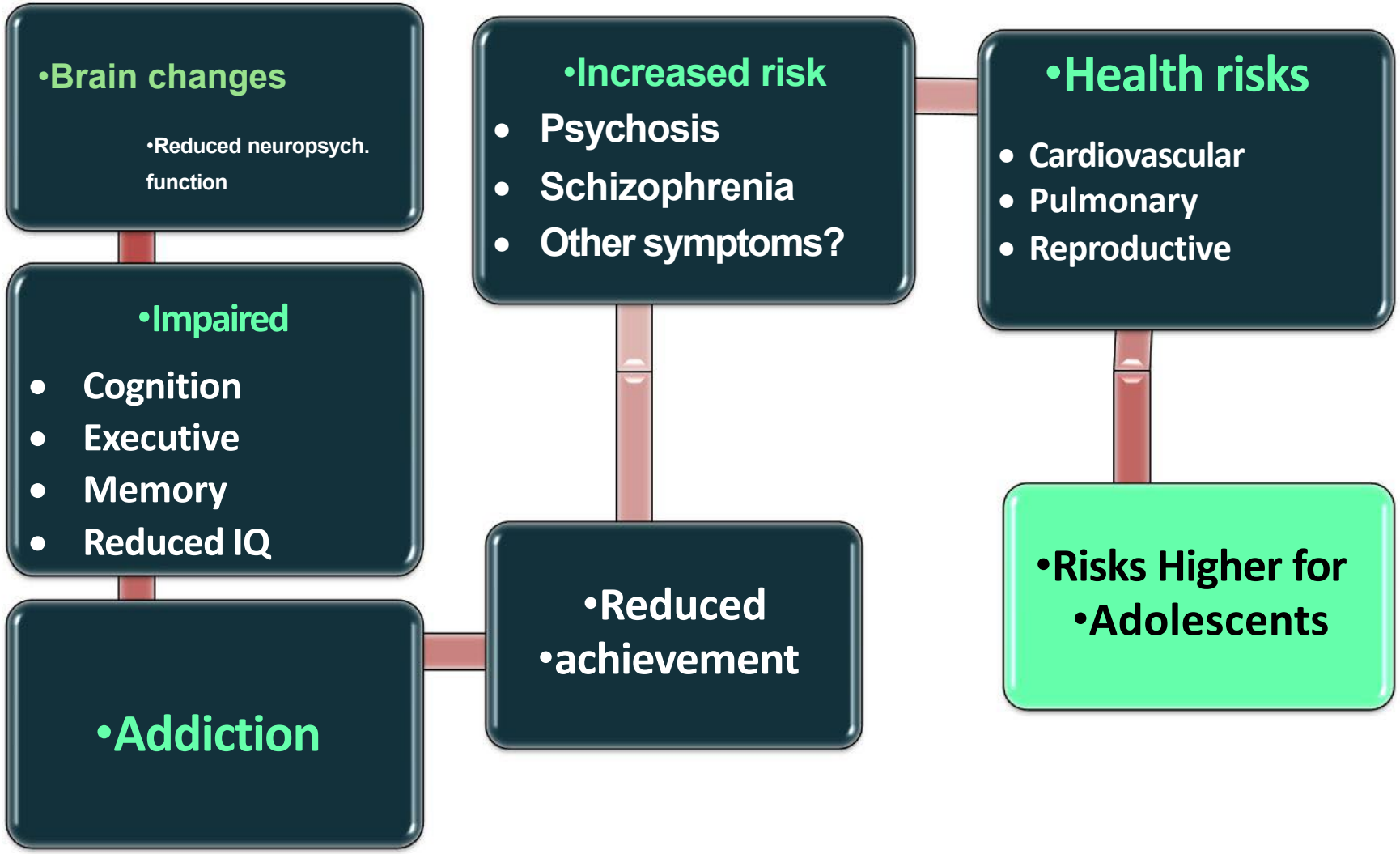


•Michael T. Lynskey; Andrew C. Heath; Kathleen K. Bucholz JAMA, January 22/29, 2003—Vol 289, 427-433

Summary: Marijuana and Heroin

•*Human* young •adolescent marijuana •users	•Adults use, abuse heroin, other drugs •more
•*Rodent adolescents* •exposed to THC	•Adults seek heroin more avidly
•Exposed to THC in utero	•Adult offspring seek heroin more avidly •Behavioral, brain impairment
•Future parents exposed to •THC long before pregnancy	•Adult offspring seek heroin more compulsively •More heroin withdrawal •Brain, behavioral changes

Long term Marijuana Use Associated With Adverse Effects on Brain And Body



HBO 14-Part Series on Addiction

- DR. NORA VOLKOW

- WHAT IS ADDICTION?