

# How The Brain Forms New Habits: Why Willpower Is Not Enough

Presented by

**George F. Koob, Ph.D.**

## Disclosure

Neither Dr. George F. Koob, the presenting speaker, nor the activity planners of this program are aware of any actual, potential or perceived conflict of interest

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## COURSE OBJECTIVES

*Participants completing the program should be able to:*

- 1) Name several characteristics of reward-centered habits.*
- 2) Identify several evidence-based strategies for managing reward-centered habits.*
- 3) Describe how threat-based mental habits are connected to maladaptive emotions and actions.*
- 4) List one or more strategies for coping adaptively with threat-based mental habits.*
- 5) Identify several evidence-based principles for initiating and maintaining health-promoting habits.*

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1. Questions are encouraged. However, please try to ask questions related to the topic being discussed. You may ask your question by clicking on "chat." Your questions will be communicated to the presenter during the breaks. Dr. Koob will be providing registrants with information as to how to reach him by email for questions after the day of the live broadcast.

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[www.ibpceu.com/content/pdf/habits-s14-eval.pdf](http://www.ibpceu.com/content/pdf/habits-s14-eval.pdf)

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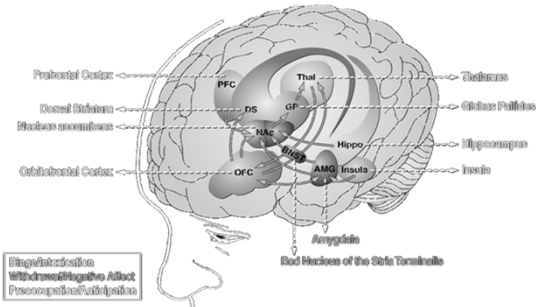
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## How the Brain Forms New Habits: Why Willpower is Not Enough

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## Definition —Will Power—

“...will-power is used to refer specifically to that function of the personality that allows an individual, after the selection of a goal and the choice of those actions that will help him realize his goal, to utilize his inherent activity, motility, and aggressivity to begin those chosen actions. Thus, will-power refers to a function of a process, which is preceded by thought and followed by action.”

From: Grinker RR Jr. Ego, insight, and will-power. Archives of General Psychiatry, 1961, 5:91-102.

## Overview of the Day

- 9:00 Habits and Reward Circuits
- 10:15 Break
- 10:30 Addiction and Reward Deficiency
- 11:30 Lunch
- 1:00 Threat-based Mental Habits
- 2:15 Break
- 2:30 Initiating and Maintaining Healthful Habits
- 4:00 End

## Overview of the Day

- (1) How do we learn habits?
  - A basic brain model

## Overview of the Day

### (2) What factors modify our tendency to do habits?

- A. Reward overvaluation or undervaluation
- B. Reward deficiency
- C. Stress
- D. Cortical/conscious control

## Overview of the Day

### (3) How can we prevent ourselves from doing bad habits?

- A. Correcting our reward expectations
- B. Recognizing associations
- C. Navigating social pressure
- D. Enriching our lives
- E. Developing a sense of control
- F. Removing triggers
- G. Train in competing or alternate good habits
- H. Improving cognitive flexibility and problem-solving ability
- I. Creating life balance

## Definition —Habit—

“ A habit, from the standpoint of psychology, is a more or less fixed way of thinking, willing, or feeling acquired through previous repetition of a mental experience”

From: Andrews BR. Habit. *J Psychol*, 1903, 14:121-149.

“*a*: a behavior pattern acquired by frequent repetition or physiologic exposure that shows itself in regularity or increased facility of performance, *b*: an acquired mode of behavior that has become nearly or completely involuntary.”

From: Merriam-Webster Dictionary.

## Understanding Habits What is a Habit?

- Automatic responses to improve well-being
- An autopilot system
  - Does not require conscious attention
  - Learned and maintained by reinforcement
  - But the behavior occurs autonomously or regardless of the goal and so is NOT goal-directed
- Can be a behavior, thought, or emotional response

### What Makes a Habit Bad?

- **Bad habits**
  - Cause immediate benefit but long-term harm with repetition
- **Good habits**
  - Cause immediate and long-term benefit

### Addiction-like Habits

- **Compulsive overconsumption**
  - Reward-based habit
  - Overeating, drinking, risky sex, smoking, gambling
- **Compulsive over-avoidance**
  - Threat-based habits
  - Chronic anxiety, depression, chronic pain, PTSD
- **Dependence cycles**
  - Cue or state (usually negative affect) leads to a response that leads back to cue or state

### Features of Addiction Key Elements

- **Compulsive bad habits**
  - Repeated reward-seeking despite negative consequences
  - Craving for reward
  - Loss of control in limiting intake
- **Become normal with the substance on board**
  - Tolerance
- **Withdrawal when abstaining**
  - Can be drug-specific or global
  - Characterized by negative emotional states
- **Habits have triggers, learned contexts where rewards are available for seeking**

### Dependence Cycles

- The next planet was inhabited by a tippler. This was a very short visit, but it plunged the Little Prince into deep dejection.
- "What are you doing there?" he said to the tippler, whom he found settled down in silence before a collection of empty bottles and also a collection of full bottles.
- "I am drinking," replied the tippler, with a lugubrious air.
- "Why are you drinking?" demanded the little prince.
- "So that I may forget," replied the tippler.
- "Forget what?" inquired the Little Prince, who already was sorry for him.
- "Forget that I am ashamed," the tippler confessed, hanging his head.
- "Ashamed of what?" insisted the little prince, who wanted to help him.
- "Ashamed of drinking!"
- The tippler brought his speech to an end, and shut himself up in an impregnable silence. And the little prince went away, puzzled. "The grownups are certainly very, very odd," he said to himself, as he continued on his journey.

*The Little Prince by Antoine de Saint-Exupery*

### **Dependence Cycles**

- **Lead not only to compulsively repeated responses, but also increasingly negative emotional states, and dysregulation of affective and stress systems**
  - For example, decreases in dopamine function and increases in CRF function
- **Downward spiral**
  - Chasing relief with a response that maintains the distress

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### **Positive Reinforcement, Negative Reinforcement, Reward- Definitions**

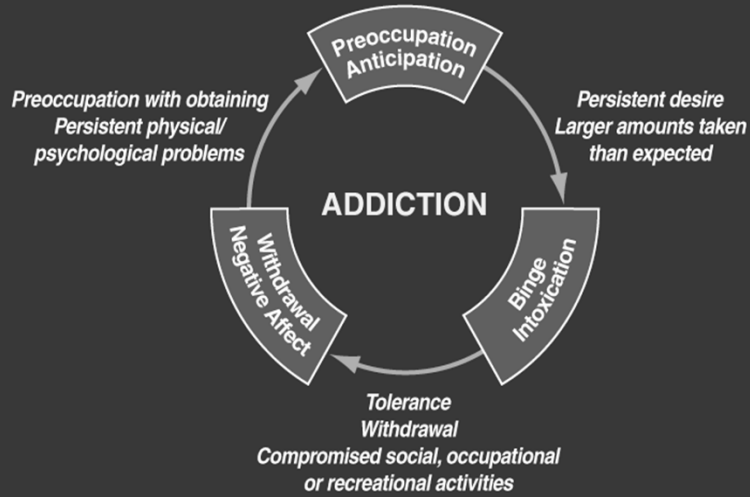
**Positive Reinforcement** — defined as the process by which presentation of a stimulus (drug) increases the probability of a response (non dependent drug taking paradigms).

**Negative Reinforcement** — defined as a process by which removal of an aversive stimulus (negative emotional state of drug withdrawal) increases the probability of a response (dependence-induced drug taking)

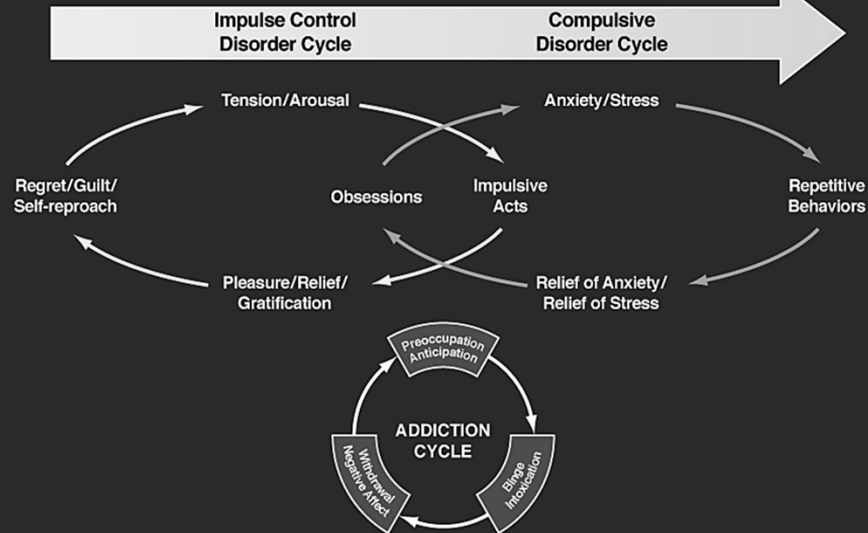
**Reward** — defined as a defined as a stimulus (drug) that increases the probability of a response, but usually includes a positive hedonic connotation

**Punishment** — defined as a process by which presentation of an aversive stimulus decreases the probability of a response

## Stages of the Addiction Cycle



## Theoretical Framework Relating Addiction Cycle to Motivation for Drug Seeking



From: Koob GF. Theoretical frameworks and mechanistic aspects of alcohol addiction: alcohol addiction as a reward deficit disorder. In: Spanagel R, Sommer W (eds) *Behavioral Neurobiology of Alcohol Addiction* (series title: *Current Topics in Behavioral Neuroscience*), Springer, New York, in press.

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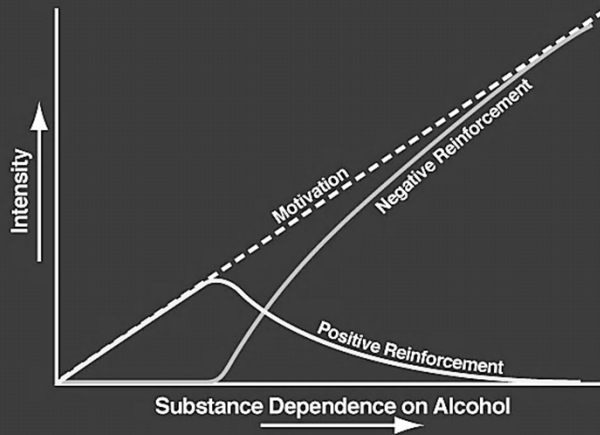
**Brain Challenge #1: Learning to Highly Value Behaviors that Promote Wellness and Devalue Behaviors that Lead to Poor Health**

**Reward-Centered Habits**

### **Challenge #1: Valuing Health**

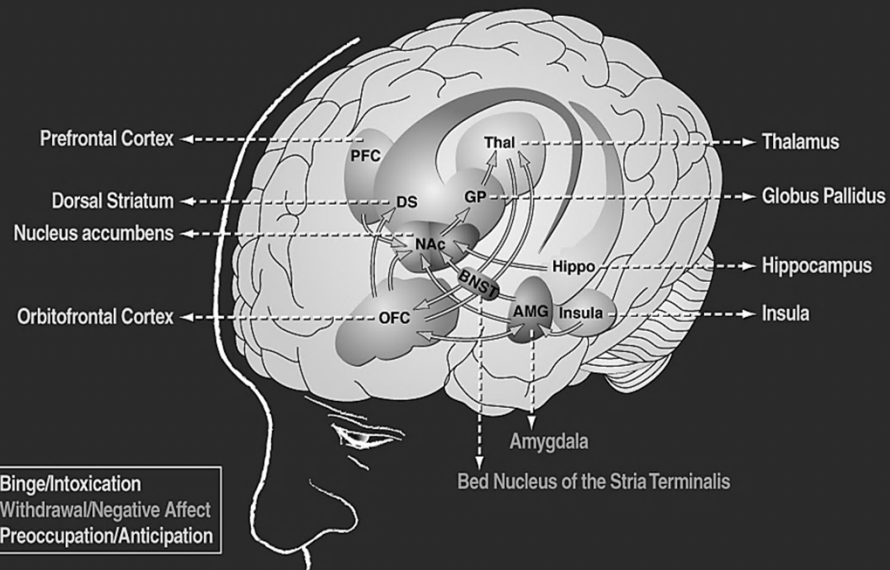
- Habits with high reward value estimates are more likely to be done
- Need to correct:
  - Overvaluation of rewards for bad habits
- Too much dopamine neuron firing for bad habit triggers
  - Undervaluation of rewards for good habits
- Not enough dopamine neuron firing for good habit triggers
- Much in our society is set up to overvalue bad habits, so it typically takes intentional reshaping of expectations, thoughts, and environment to align our reward value estimates with the actual impact of the response on health
- Many ways to do this....

## Theoretical Framework Relating Addiction Cycle to Motivation for Drug Seeking



Koob GF. Theoretical frameworks and mechanistic aspects of alcohol addiction: alcohol addiction as a reward deficit disorder. Spanagel R, Sommer W (eds) *Behavioral Neurobiology of Alcohol Addiction* (series title: *Current Topics in Behavioral Neurosciences*). Springer, New York, in press.

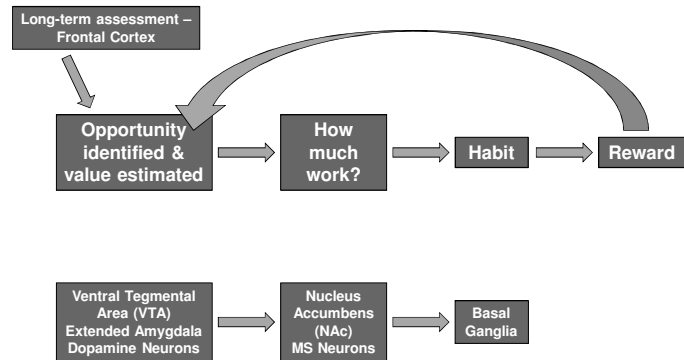
## Neurobiology of Addiction



From: Koob, G. F. and Volkow, N. D. Neurocircuitry of Addiction, *Neuropsychopharmacology Reviews* 35 (2010) 217-238

## Using your Brain to Form New Habits —Nucleus Accumbens to Basal Ganglia—

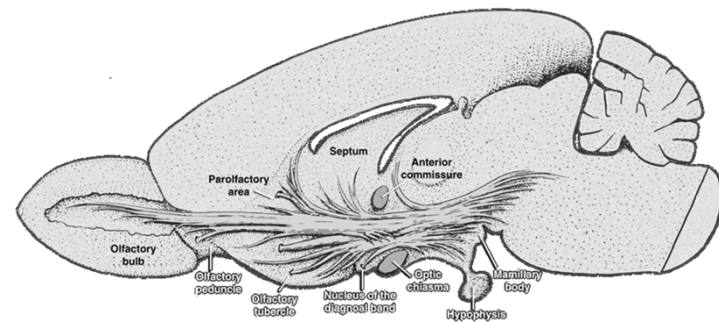
## Storehouse of Addictive Habits —A Brain Model—



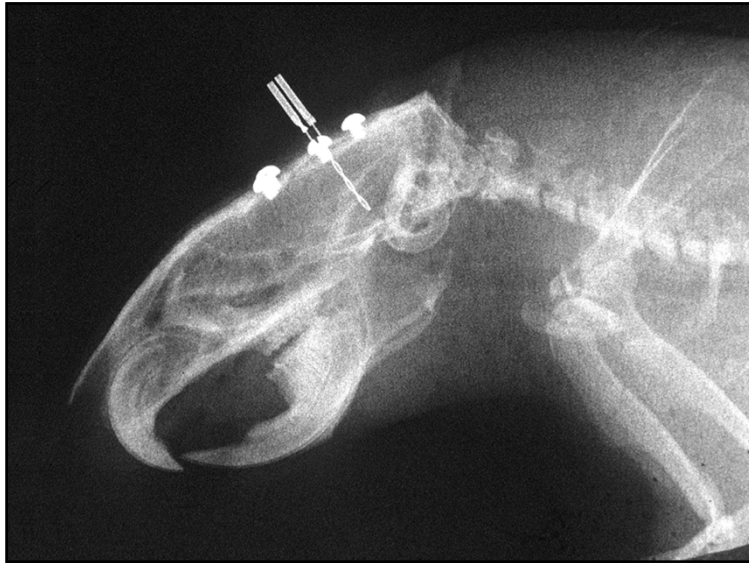
## Habits are Learned and Maintained by Reinforcement Circuits

- Reinforcement is not pleasure
  - Increases the likelihood of repetition
  - Not always associated with positive affect
- Reinforcement takes you from an immediate state of:
- OK to good = positive reinforcement
  - Reinforcement- focused habits
- Bad to OK (or less bad) = negative reinforcement
  - Threat-based habits
  - You can reinforce a response without ever having felt good or euphoric
- Example of partial relief of an ongoing pain stimulus

## Medial Forebrain Bundle in a Representative Rodent Brain



From: Le Gros Clark WE, Morphological aspects of the hypothalamus, In: Le Gros Clark WE, Beattie J, Riddoch G, Dott NM (eds) *The Hypothalamus: Morphological, Functional, Clinical and Surgical Aspects*, Oliver and Boyd, Edinburgh, 1938, pp. 1-68.



**Neurotransmitters:  
Dopamine and Opioid Peptides in Reward Circuits**

- Dopamine circuits are associated with reward (drive, push to respond, orienting to salient stimuli)
- Opioid peptides and other circuits are more associated with affective states (am I OK?, comfort, relief)

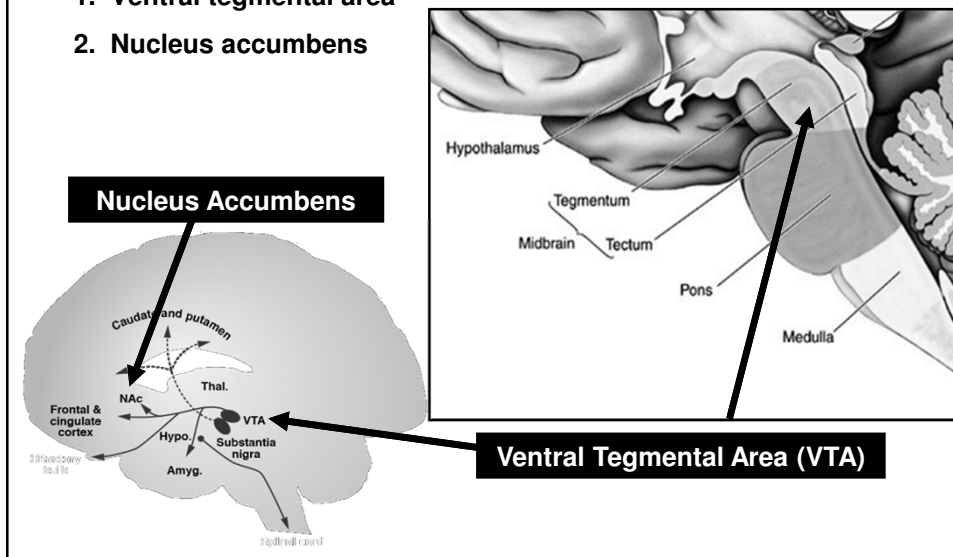
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## Mesolimbic Dopamine System

### Mesolimbic dopamine system

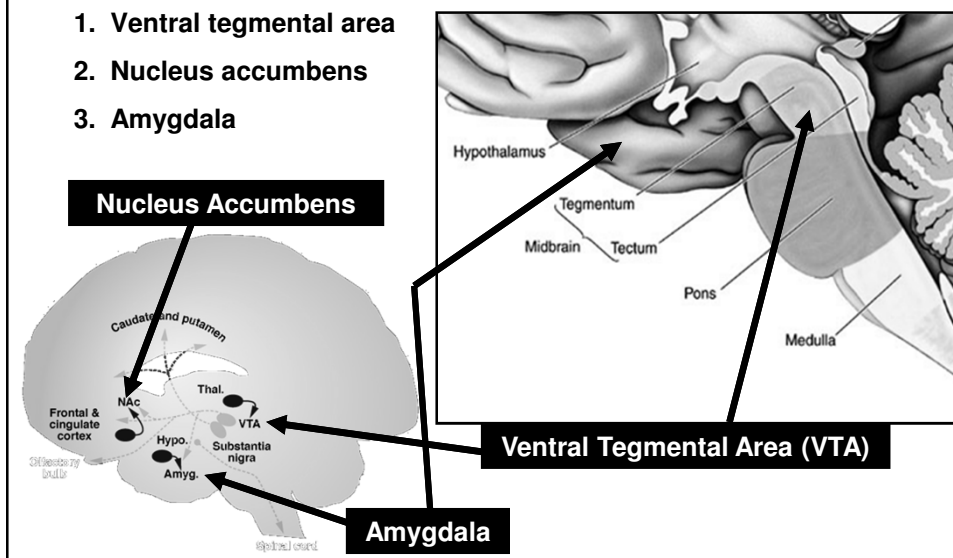
1. Ventral tegmental area
2. Nucleus accumbens



## Opioid Peptide Reward System

### Enkephalin and endorphin reward system

1. Ventral tegmental area
2. Nucleus accumbens
3. Amygdala



## Dopamine Neurons

- Fire to indicate the presence of an opportunity and the expected immediate benefit of performing a habit to take advantage of the opportunity
  - Firing rate = reward value estimate
- Like a Geiger counter or metal detector for immediate gratification opportunities
  - Find chances for reward/relief

## Dopamine Neurons

- Alert the habit system (nucleus accumbens) and the executive system (prefrontal cortex) about opportunities
- The habit system uses this to make a quick decision about whether it is worthwhile to perform the habit
- The executive system considers and can modify the estimates based on long-term benefits/goals, current social context, and other factors
- The executive system can also stall performance of the habit while considering other responses
- But the executive system is relatively SLOW

A) First experience of a reward:



B) After repeated exposure to same cue and reward:



C) When a better reward is received:



D) When expected reward isn't received:



Cue

Reward

## Dopamine Neurons

- Tell you how much benefit you can expect from doing a habit
- Anticipates benefits
  - Dopamine response from seeing pictures of food or smells of food, not from eating food
- Volkow imaging experiments

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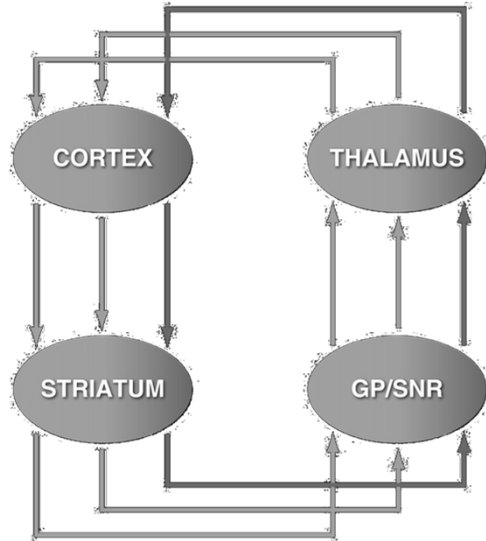
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**How can this habit learning process  
lead to maladaptive habits?**

### **Cognitive Overvaluation**

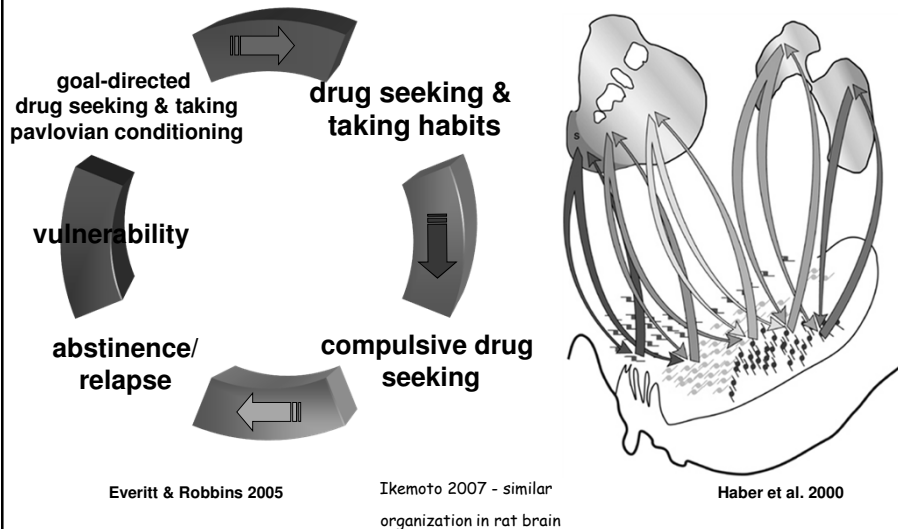
- Our conscious beliefs and expectations change our dopamine neuron function
  - Example: Placebo effects
  - Being given a placebo “painkiller” increased release of dopamine in persons who were anticipating a painful stimulus (Scott *et al.*, 2007) in proportion to the anticipated analgesic effects
  - A placebo “analgesic cream” decreased self-reported pain and activation of brain circuits that detect pain in response to a heat stimulus (Wager *et al.*, 2004)

## Functional Topography of Cortico-Basal Ganglia-Thalamocortical Circuits



From: Haber S, McFarland NR. *Neuroscientist*, 2001, 7:315-324.

## The Ventral to Dorsal Striatal Shift: Ascending Spirals from Shell to Core to Dorsal Striatum Via Striato-VTA/Nigrostriatal pathways



### **Cognitive Overvaluation**

- **Example: Alcohol expectancies**
  - Bar lab experiments
  - Social lore says that drinking alcohol will make you more social, fun, confident, and sexually disinhibited
  - Thinking you are drinking will make you more social and confident talking to people you are attracted to, even if there is no alcohol in the drink
  - The main effect of alcohol, minus expectations, is impairment of motor coordination
  - Preteens who believe the social lore are more likely to start drinking and develop alcohol problems
- Your beliefs and expectations about the effects of a habit will change your likelihood of doing the habit and the perceived effects of the behavior

### **Secondary Gain**

- Doting, rescuing, or attending primarily to negative responses can reinforce bad habits in others
- Providing attention, relief, or rescuing people when they respond inappropriately can reward bad responses and make them habitual
- These rewards can turn a maladaptive response into a habit
- If we are rewarded for doing things that make us feel bad, then we will tend to feel bad

### **Secondary Gain**

- Social acceptance/conformity
  - Fitting in by eating junk food
- Getting out of doing something we fear
  - Being sick to avoid the math test
- Getting attention for bad behaviors
  - Joking around in class
- Escaping boredom/tedium
  - Smoke breaks
- Must remove the secondary gain to get rid of the bad habit

### **Associational Overvaluation**

- Rewards that are linked in time to behaviors can amplify reward estimates
  - Example: Pictures of attractive faces activate dopaminergic reward circuits and arbitrary pictures that had been shown at the same time as the attractive faces were preferred following the viewing session (Bray & O'Doherty, 2007)
  - Advertising uses this principal
- We will overvalue habits that have been linked to other rewards, like pretty faces, symbols of power, successes, or relief
- Experience by observation will train these circuits
  - Seeing someone else benefit can change our estimates

### How can we improve reward valuation?

- Reframing - cognitive restructuring
  - A core component of cognitive behavioral therapy
  - Focus on changing perspective to reassess the emotional or motivational components of thoughts and expectations
  - Take another perspective
  - Corrects cognitive distortions, such as overgeneralization, jumping to conclusions, catastrophizing
- For example, you might become angry if you think random inconveniences were purposely imposed on you - leads to overvaluation of revenge opportunities and potentially anger control problems; reframing eliminates motivation for revenge
- Changing beliefs
  - Challenge habitual thoughts for accuracy
  - Learn new information about the consequences of habits

### How can we improve reward valuation?

- Identifying maladaptive associations
  - Identify harmful habits
  - Track when you do them and the context (environmental cues, emotional states, and thoughts) that trigger or precede the habit
  - Avoid triggers when this is adaptive
- Don't go to bars if you are an alcoholic
  - Create competing good habits off the same trigger

### Linking Habits to Values and Goals

- Does your habit align with your core values and lead you toward your goals?
- Motivational interviewing helps clients connect habits to values/goals to motivate change
- Values/goals assessment can help reprioritize healthful behaviors
  - Do I really need to watch this TV show or should I use this time to go for a walk?

### Clarifying Your Values

- What is important to you? What do you admire and value?
  - Thought experiments: What would your dream job look like? What do you want to be remembered for?
  - Explicitly identify and prioritize values
- Consider your habits in the context of these values. Do your habits support or conflict with your values? If you make living by your values your goal, then does that change the value you place on doing your habit? When values and habits conflict, reminders about values and developing plans to help live by one's values can help change habits.

### **Normative Feedback**

- Reassessing beliefs about what behaviors are normal can help to revalue habits
- People tend to associate with people who act like them, which makes it seem like everyone acts like you
- Providing feedback on what is statistically normal can motivate change by making a behavior seem less important for social acceptance
- Used successfully to modify alcohol use and sexual behavior in high-risk teens
- Can be used for anything with information on population norms (e.g. smoking in California)

### **Guided Exposure**

- Exposing people to fears or distressing emotions or experiences in a safe and supportive setting can help to challenge beliefs about the negative consequences of an action or non-action
- This can help to reduce expectations about the value of escape or relief-seeking behaviors
- Effective treatment for chronic pain and phobias

### **Alter Secondary Gain**

- Identify and remove secondary gain for bad responses
  - Usually need help from the person providing the secondary gain
- Therapies that include family or significant others may address this (e.g. behavioral couples therapy)
- Examine interactions to find interpersonal triggers for habits (e.g. revenge for criticism)
  - Look out for extinction bursts!!!
- Add secondary gain for healthful responses
  - Contingency management

### **Take-Home Advice**

- Challenge beliefs and expectations about bad habits
  - Use evidence-based techniques such as cognitive behavioral therapy, motivational interviewing, reframing, assessment and normative feedback, aligning values and goals to devalue bad habits and make them less appealing
- Challenge fears and concerns about good habits
  - Use evidence-based techniques such as guided exposure, and address social pressures and learned associations
- Create new associations to encourage good habits
  - e.g. spinach makes you strong, doing yoga will impress women

### Addictive Drugs

- Addictive drugs ALL pharmacologically increase dopamine neuron firing
- This tricks the brain into thinking it just got a large reward
- Leads to massive overvaluation of drug seeking
- Trains in lots of drug cues which trigger craving

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### Habit Learning with Addictive Substances

A) First exposure to drug reward:



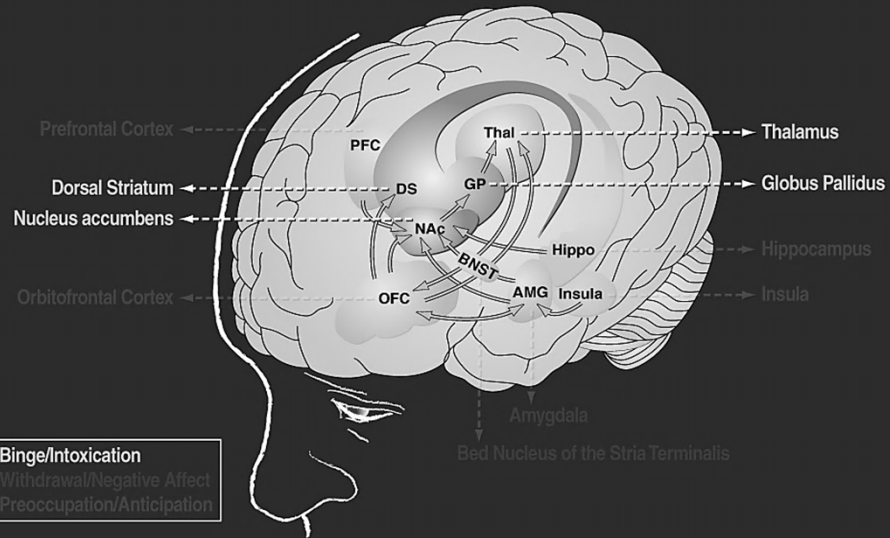
B) Next exposure to drug and predictor:



C) After repeated exposure to drug:

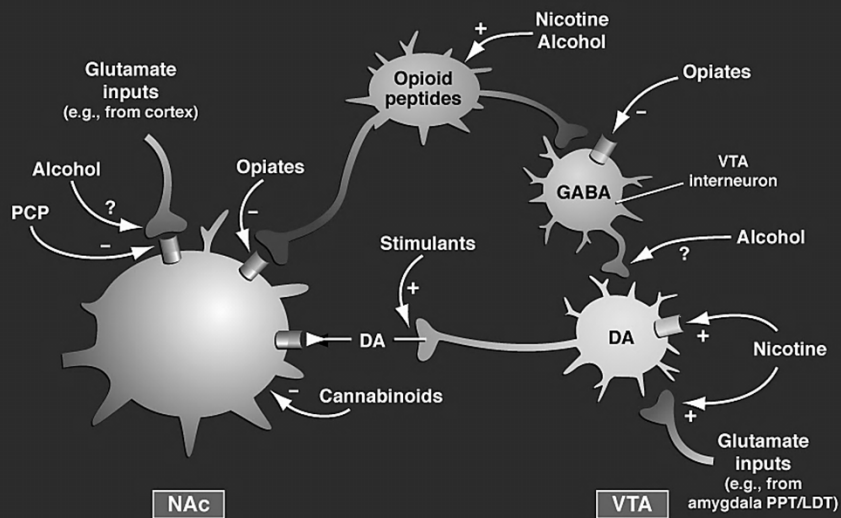


## Binge-Intoxication Stage



From: Koob, G. F. and Volkow, N. D. Neurocircuitry of Addiction, *Neuropsychopharmacology Reviews* 35 (2010) 217-238

## Converging Acute Actions of Drugs of Abuse on the Ventral Tegmental Area and Nucleus Accumbens



From: Nestler EJ, *Nat Neurosci*, 2005, 8:1445-1449.

## **Addictive Substances**

- This hijacked habit learning process applies to:
  - Alcohol
  - Tobacco
  - Cannabis/Marijuana
  - Opioids (e.g. heroin and prescription painkillers such as hydrocodone, oxycodone, fentanyl, morphine)
  - Stimulants (e.g. cocaine, amphetamine, Ritalin, Adderall)
  - Sedatives (e.g. benzodiazepines?, barbiturates)
  - Caffeine?

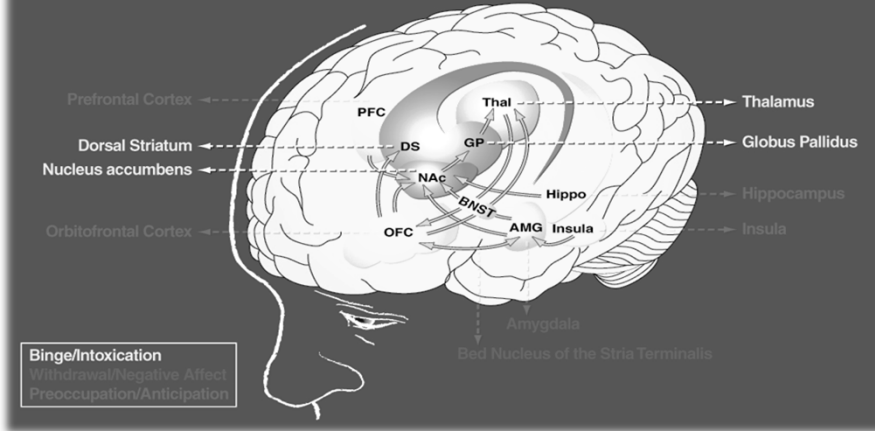
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## **How can we reduce drug overvaluation?**

- Changing beliefs and associations
  - e.g. does marijuana make you more creative? Are you really more socially adept when drunk?
- Increasing social support for abstinence
  - Connection with drug-free social networks (e.g. mutual help groups, religious groups, some sports teams)
- Decreasing social support for use
- Eliminating secondary benefits
  - e.g. ongoing Rx for an abused painkiller may validate the idea that the patient is disabled and doesn't need to try alternatives

## How can we reduce drug overvaluation? Existing and Future Medications for Addiction: Binge/Intoxication Stage



### Existing medications

- disulfiram
- naltrexone
- methadone
- varenicline
- buprenorphine

### Future targets

- partial agonists (intoxication blockers)
- drug vaccines (intoxication blockers)

## Medications Currently on the Market for Drug Abuse Treatment- Binge/Intoxication Stage

Generic name	Trade name	Indications	FDA approval	Description
Disulfiram	Antabuse	Alcohol addiction	1954	<ul style="list-style-type: none"> <li>• Disulfiram is an acetaldehyde dehydrogenase inhibitor used to prevent relapse in detoxified alcoholics. Disulfiram at average therapeutic doses of 250 mg/day (not to exceed 500 mg/day) blocks acetaldehyde dehydrogenase.</li> <li>• Disulfiram produces an aversive reaction if the subject drinks with adequate blood levels of disulfiram presumably due to increased acetaldehyde in the blood stream which is similar to the intense flush reaction of Asians known to have a deletion of one or two alleles of the ALDH2 gene.</li> </ul>
Naltrexone	ReVia	Alcohol addiction	1994	<ul style="list-style-type: none"> <li>• Naltrexone is a competitive opioid antagonist that has oral bioavailability and binds to the m, d, and k opioid receptors, with a higher affinity for the m than d or k receptors.</li> <li>• Naltrexone decreases heavy drinking in alcoholics and prevents relapses to heavy drinking at doses of 50 mg/day. Naltrexone has more efficacy when combined with associated behavioral treatments, particularly cognitive behavioral therapy.</li> </ul>
	Vivitrol		2005	
Varenicline	Chantix	Nicotine addiction	2006	<ul style="list-style-type: none"> <li>• Varenicline is a partial <math>\alpha 4\beta 2</math> nicotinic acetylcholine receptor agonist used for detoxification and treatment of nicotine addiction. Doses of 1 mg twice per day doubled abstinence rates in 12-week trials.</li> <li>• Varenicline has been associated with a number of reports of adverse effects related to suicidal ideation. As a result, the use of Chantix<sup>®</sup> is no longer accepted by the Federal Aviation Administration for aeromedical certification purposes.</li> </ul>
Buprenorphine	Subutex	Opiate addiction	2002	<ul style="list-style-type: none"> <li>• Buprenorphine is an oripavine derivative that is considered a partial agonist at m, k, and nociceptin/orphanin FQ receptors and an antagonist at d receptors.</li> <li>• Multiple controlled studies have shown that maintenance therapy with buprenorphine is an effective treatment for opioid dependence at doses of 16-24 mg/day (maximum 32 mg/day).</li> <li>• Buprenorphine can be prescribed as a sublingual tablet consisting of buprenorphine (Subutex<sup>®</sup>) or as a sublingual tablet consisting of buprenorphine with naloxone (Suboxone<sup>®</sup>). The addition of naloxone limits diversion because naloxone is inactive when taken orally, but if the preparation is diverted to intravenous use, the naloxone will block the effects of buprenorphine.</li> </ul>
	Suboxone			

From: Koob GF, Lloyd GK, Mason BJ. *Nat Rev Drug Discov*, 2009, 8:500-515.

### **How can we improve reward valuation?**

- Reframing
- Changing beliefs
- Addressing maladaptive associations
- Linking habits to values and goals
- Normative comparison
- Expose oneself to other reinforcers to compete with drug habits
- Guided exposure
- Remove secondary gain for bad habits and add for good habits
- Core components of motivational enhancement therapies

### **Brain Challenge #2 :Enriching Your Life to Tame the Need for Immediate Gratification**

#### **Reward Deficiency**

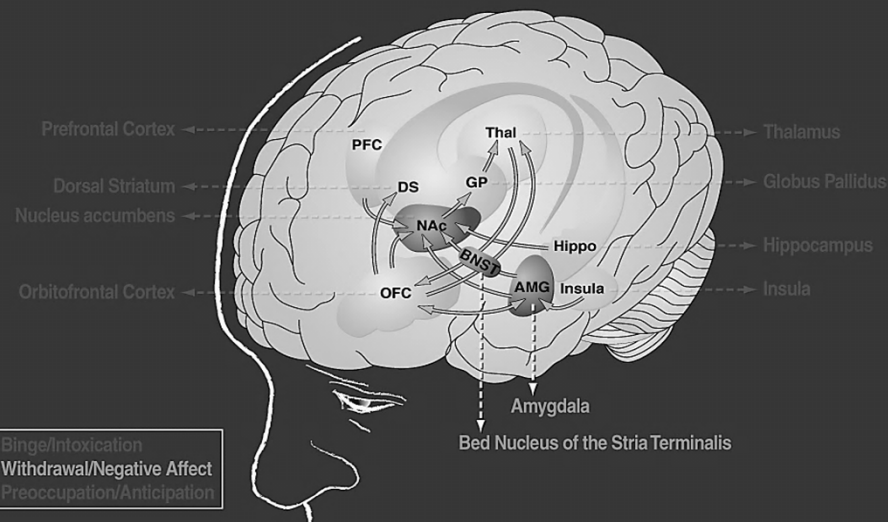
- Our drive for immediate gratification or short-term reward is adjusted based on the availability of rewards in our environment
  - In resource-rich environments, drive for immediate gratification is low
  - In resource-poor environments, drive for immediate gratification is high
- When drive for immediate gratification is high, we will be strongly driven by our habits and have difficulty focusing on long-term goals or following our conscious plans
- When we have a deficiency of rewards, we will be prone to bad habits and addictive behaviors

### **Acquired dopamine deficiency**

- Repeated exposure to drugs of abuse or fatty foods leads to downregulation of dopamine receptors
- Dopamine-deficient animals show compulsive drug or food seeking (i.e. will seek out junk food or drugs despite punishment)

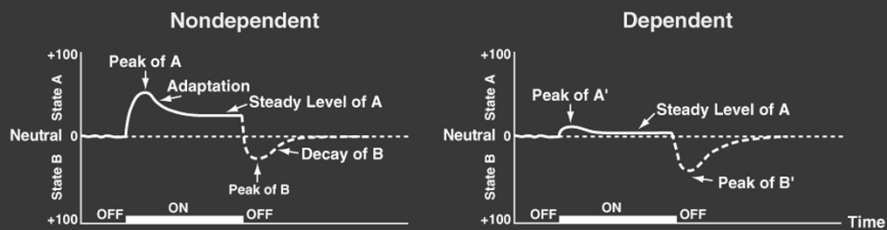
**See diagram on the following page**

## Withdrawal-Negative Affect Stage



From: Koob, G. F. and Volkow, N. D. Neurocircuitry of Addiction, *Neuropsychopharmacology Reviews* 35 (2010) 217-238

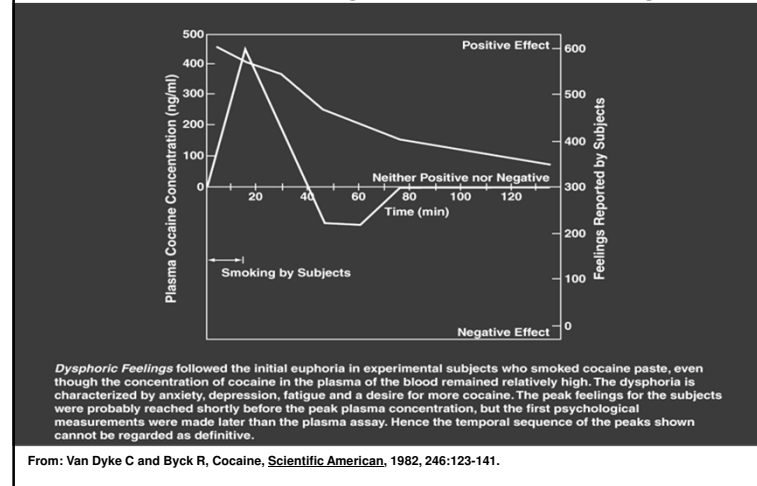
## Standard Pattern of Affective Dynamics Produced by Novel and Repeated Unconditioned Stimulus or "What Goes Up Must Come Down"



From: Solomon RL, *American Psychologist*, 1980, 35:691-712.

See diagram on the previous page

### Mood Changes Associated with Plasma Levels of Cocaine during Coca Paste Smoking



### Motivational Withdrawal

#### Common Elements of Negative Emotional States

- Anxiety
- Irritability
- Dysphoria
- Everything is gray
- Alexithymia
- Hyperkatifiea

### Reward Transmitters Implicated in the Motivational Effects of Drugs of Abuse

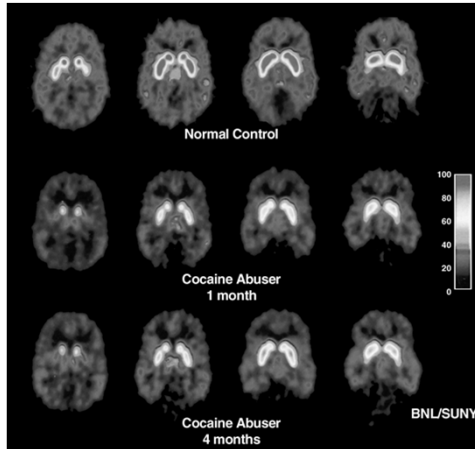
#### Positive Hedonic Effects

- ↑ Dopamine
- ↑ Opioid peptides
- ↑ Serotonin
- ↑ GABA

#### Negative Hedonic Effects of Withdrawal

- ↓ Dopamine ... "dysphoria"
- ↓ Opioid peptides ... pain
- ↓ Serotonin ... "dysphoria"
- ↓ GABA ... anxiety, panic attacks

### Decreased Dopamine D<sub>2</sub> Receptor Activity in a Cocaine Abuser



From: Volkow ND, Fowler JS, Wang GJ, Hitzemann R, Logan J, Schlyer DJ, Dewey S and Wolf AP, *Synapse*, 1993, 14:169-177.

### Addictive Features of Comfort Foods

- **Compulsive Eating Disorders**
  - A disorder of compulsive overeating
  - Food dependence: Hunger leads to eating which in the absence of additional eating is followed by hunger
  - Short-cutting this cycle can lead to overeating
    - Eating carbohydrates may increase reward neurotransmitter and improve mood
    - Eating to feel better and weight-related stigma can produce a dependence cycle
    - If you eat for relief when you feel bad but feel bad about yourself when you eat, then you will chronically overeat
  - Compulsive overeating is associated with decreased D<sub>2</sub> receptors in the basal ganglia in human and animal studies

### Are some people prone to reward deficiency?

- Genetic variability in adaptation of MS neurons
  - A1 allele of the D<sub>2</sub> dopamine receptor
  - People with A1 allele make fewer dopamine receptors
  - With fewer receptors, they adapt less to reward opportunities
  - Will have greater drive for immediate reinforcement with the same level of resources

### Genetic predisposition to reward deficiency

- Persons with the A1 allele are more likely to:
  - Develop alcohol or substance use disorders and have more trouble quitting
  - Develop gambling problems
  - Develop PTSD
  - Become obese
- But this is still shaped by the environment: Children with the A1 allele only developed novelty-seeking behaviors when they grew up in a home with a punitive parenting style

## Experience may also impact ability to adapt to rewards

### *Social Hierarchy and Dopamine Deficiency*

- Individually housed macaques
  - Few D2 receptors in striatum
  - Few opportunities
  - Compulsively use available cocaine
- Group-housed macaques
  - Subordinate: same as individually housed
  - Dominant:
    - Increased D2 receptor expression in striatum
    - More grooming, best access to food
    - Quickly get bored with available cocaine and stop or limit use
    - Low socioeconomic status may increase dopamine deficiency

Morgan et al. (2002) *Nat Neurosci.* 5(2):169-74.

## How Does Our Drive for Immediate Gratification Lead to Bad Habits: A Self-medication Hypothesis?

- Low dopamine D2 receptors are associated with high impulsivity
- Low dopamine D2 receptors are associated with compulsive drug seeking
- Low dopamine may result from an impoverished environment
- Low dopamine may result from genetic factors
- Low dopamine can lead to development of bad habits

## If You Are Predisposed/Vulnerable to Reward Deficiency, then...

- **DON'T EXPECT TO MODERATE!**
- Shape your environment to fit your tendencies
- Focus on keeping your life rich with opportunity
  - Social isolation is risky
- Remove opportunities to do bad habits
  - Skip all-you-can-eat buffets
  - Use smaller dishware
  - Don't keep a cabinet full of liquor in the house
  - Don't keep a basket of mini-candy bars on your desk
  - Watch shows on the internet instead of TV so that you have to consciously interact to watch the next show

## Take-Home Points

- Learning to recognize reward opportunities will increase dopamine firing and increase restraint on habit performance
- Give you time to try something new and increase behavioral flexibility
- Enriching your life combats dopamine deficiency and reduces risk and maintenance of addictive disorders and other chronic bad habits

## Mindfulness

- Ability to experience thoughts, feelings, and situations without judgment or response
- Acceptance
- Requires a well-tuned habit system, a sense of control over stress, and balanced assessment of reward opportunities
- Improvements in acceptance/mindfulness are associated with recovery from many disorders of overconsumption and overavoidance
- Practice in safe, pleasant circumstances to start
  - Stop and smell the roses

## Brain Challenge #3: Enhancing Resiliency to New Threats and Chronic Stressors

### Threat-based Mental Habits

- Stress increases the value of immediate rewards
  - When you are stressed, your brain favors solutions to immediate problems, not longer-term goals
  - Prioritize quick fixes
- Stress enhances habit learning and reduces behavioral flexibility
- Stress raises hedonic thresholds, adding additional sources of reinforcement (i.e. negative reinforcement)

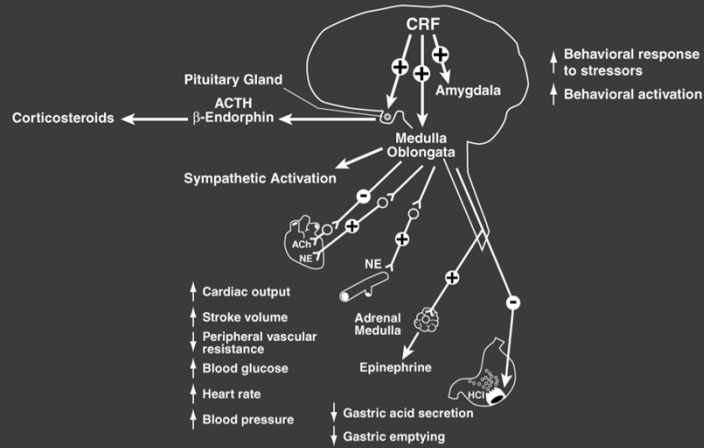
## Corticotropin-Releasing Factor and Stress

- CRF drives all three components of the body's stress response
  - Hypothalamic-pituitary-adrenal axis
  - Sympathetic nervous system
  - Brain stress and fear systems in the amygdala
- CRF appropriately directs our natural “fight or flight” response

*I saw Kazak out of the corner of my right eye. His eyes were pinwheels. His teeth were white daggers. His slobber was cyanide. His blood was nitroglycerine. He was floating toward me like a zeppelin, hanging lazily in the air. My eyes told my mind about him. My mind sent a message to my hypothalamus, told it to release the hormone CRF into the short vessels connecting my hypothalamus and my pituitary gland. The CRF inspired my pituitary gland to dump the hormone ACTH into my bloodstream. My pituitary had been making and storing ACTH for just such an occasion. And nearer and nearer the zeppelin came. And some of the ACTH in my bloodstream reached the outer shell of my adrenal gland, which had been making and storing glucocorticoids for emergencies. My adrenal gland added the glucocorticoids to my bloodstream. They went all over my body, changing glycogen into glucose. Glucose was muscle food. It would help me fight like a wildcat or run like a deer. And nearer and nearer the zeppelin came. My adrenal gland gave me a shot of adrenaline, too. I turned purple as my blood pressure skyrocketed. The adrenaline made my heart go like a burglar alarm. It also stood my hair on end. It also caused coagulants to pour into my bloodstream, so in case I was wounded, my vital juices wouldn't drain away. Everything my body had done so far fell within normal operating procedures for a human machine. But my body took one defensive measure which I am told was without precedent in medical history. It may have happened because some wire shortcircuited or some gasket blew. At any rate, I also retracted my testicles into my abdominal cavity, pulled them into my fuselage like the landing gear of an airplane. And now they tell me that only surgery will bring them down again.*

Breakfast of Champions by Kurt Vonnegut

## Brain Actions of Corticotropin-Releasing Factor (CRF)



## Major CRF Cell Groups and Fiber Systems Illustrated Schematically in a Sagittal View of the Rat Brain



From: Swanson LW, Sawchenko PE, Rivier J and Vale W, *Neuroendocrinology*, 1983, 36:165-186.

## Neurobiology of Stress Response

Corticotropin-releasing factor (CRF) in the Hypothalamus, Medulla, and Amygdala

### 1. Hypothalamus

- Activation of endocrine (hormonal) stress response
- Stimulates release of ACTH from pituitary
- ACTH in turn stimulates release of glucocorticoids from adrenal gland
- Glucocorticoids increase blood sugar, suppress immune function and breakdown fats

## Neurobiology of Stress Response

Corticotropin-releasing factor (CRF) in the Hypothalamus, Medulla, and Amygdala

### 2. Medulla

- Activation of sympathetic nervous system-release of norepinephrine (noradrenaline)
- Stimulates nerve leading to adrenal medulla- release of epinephrine (adrenaline)
- Norepinephrine and epinephrine increase heart rate, increase blood pressure, and produce bronchial dilation

## Neurobiology of Stress Response

Corticotropin-releasing factor (CRF) in the Hypothalamus, Medulla, and Amygdala

### 3. Amygdala

- a. Coordination of behavioral responses to stress
- b. May be important in aspects of self-regulation failure associated with addiction

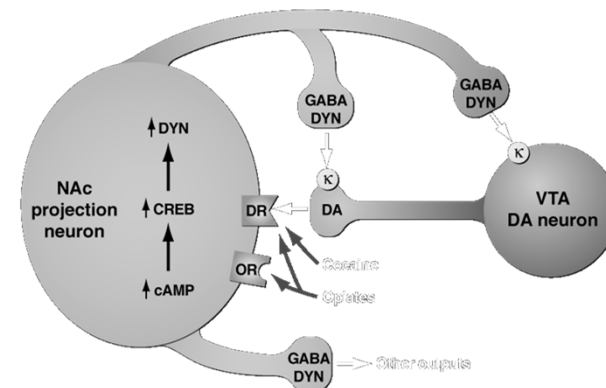
## CRF, Stress, and Bad Habits

- Stress will make you more likely to do bad habits
- Activation of these neurons also facilitates fear conditioning and prevents fading of these associations
  - Learning of fear cues by the amygdala
  - Chronic activation of these circuits can lead to generalized anxiety and exaggerated fear responses
- Fear can prevent behavior change and maintain bad habits

## Anti-Reward Transmitters Implicated in the Motivational Effects of Drugs of Abuse

- ↑ Dynorphin ... "dysphoria"
- ↑ CRF ... stress
- ↑ Norepinephrine ... stress

## Dynorphin Control of Mesocorticolimbic Dopamine- Within System?



From: Nestler E.J. *Nat Rev Neurosci*, 2001, 2:119-128.

### **Habits Contribute to Many Disorders**

- *Chronic Pain syndrome*

- A disorder of compulsive relief seeking
- Fear of reinjury and pain-related distress lead to avoidance of movement to relieve these negative emotions
- Lack of movement leads to deconditioning, disability, and disengagement from rewarding life experiences (e.g. work, family, activities)
- Loss of rewarding activities leads to chronic negative affect, which amplifies pain, and increases drive to seek relief

**See diagram on the following page**

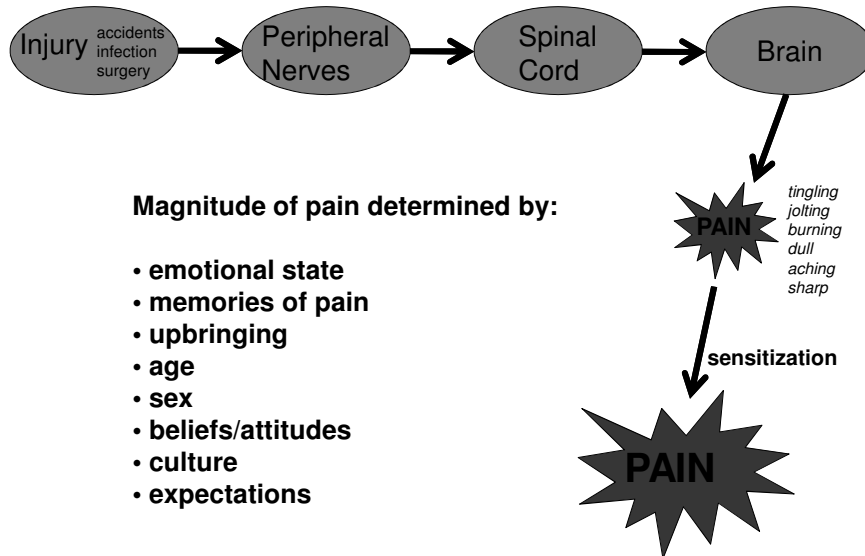
**See diagram on the following page**

### **Habits Contribute to Many Disorders**

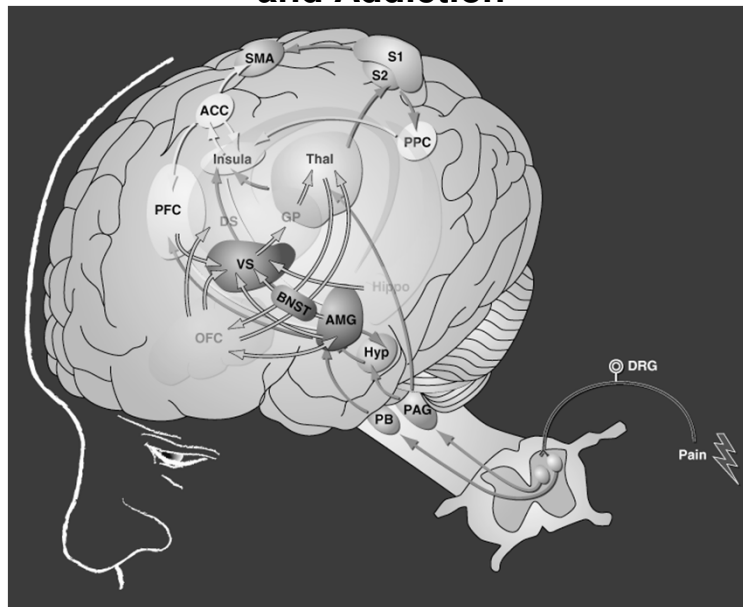
- *Depression*

- Another disorder of compulsive relief seeking
- Drive to avoid experiencing uncomfortable or distressing emotions or situations leads to disengagement from life
- Life disengagement and lack of rewarding experiences may lead to negative thoughts about oneself which may further decrease confidence regarding ability to handle distress
- Rumination occurs when anterior cingulate gyrus does not trigger a change in strategy. Changes in anterior cingulate response have been associated with recovery from depression

## The Pain Process



## Neurobiological Circuitry of the Overlap of Pain and Addiction



### **Schulkin, McEwen, Gold Hypothesis of Anticipatory Angst, Extended Amygdala and Depression**

- Depressed patients are often in a state of chronic expectation of negative outcomes, and loss of perceived control over the environment should exaggerate normal coping responses associated with activation and preparation for stressors.
- Expectations of aversive events induce anxiety and fear and can activate stress hormones such as glucocorticoids.
- The extended amygdala was hypothesized to be involved in anticipated fearful and anxiety-producing events
- Glucocorticoids facilitate corticotropin-releasing factor expression in the amygdala and this CRF activation was hypothesized to potentiate conditioned fear, anxiety and cautious avoidance
- The increase in CRF may amplify the negative emotional state

Schulkin, McEwen and Gold, Neuroscience and Biobehavioral reviews 18 (1994) 385-396

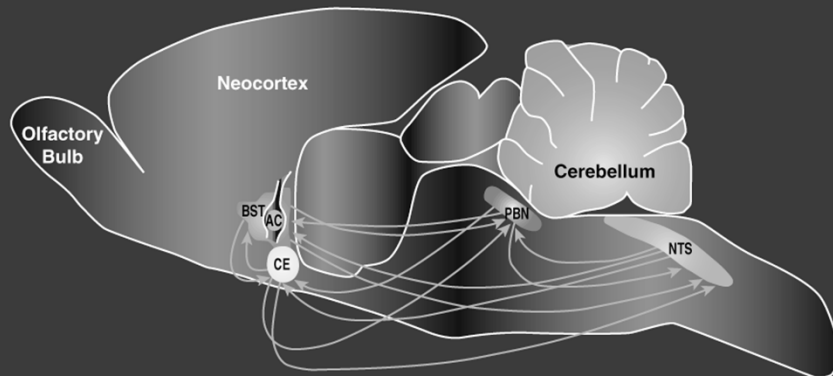
**See diagram on the following page**

### **Overcoming Threat-Based Habits**

### **How can we reduce stress-driven habits?**

- Scheduling and pacing
- Work rest cycles
- Overdoing it and inefficiency

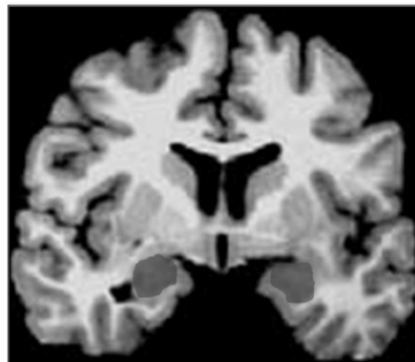
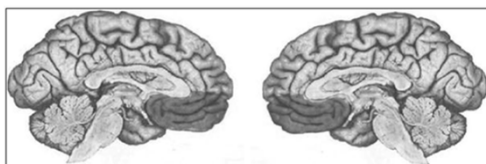
## Hypothetical Anatomical Circuit Underlying Melancholic Depression and Adversity



AC, anterior commissure; CE, central nucleus of the amygdala;  
BST, bed nucleus of the stria terminalis; LH, lateral hypothalamus;  
ZI, zona incerta; PBN, parabrachial nucleus; NTS, solitary nucleus

From: Schulkin J, McEwen BS and Gold PW, *Neurosci Biobehav Rev*, 1994, 18:385-396.

## Involvement of vmPFC and Amygdala in Stress (images from PTSD)



From: Koenigs M, Grafman J. *Neuroscientist*, 2009, 15:540-548.

### **How Can We Reduce Stress-driven Habits?**

- **Improving sleep adequacy and quality**
  - The dangers of lack of sleep
- **49% of MDs who were sometimes on call reported falling asleep while driving**
- **42% of junior physicians reported a fatigue-related medical error in the last 6 months**
- **Sleeping less than 5 hours a night is associated with development of diabetes**
- **Sleep deprivation increases risk-taking and immediate reward-seeking behaviors**
  - Addressing insomnia
  - Leaving enough time for sleep
  - Avoiding caffeine, alcohol, and pharmaceutical sleep aids

### **How Can We Reduce Stress-driven Habits?**

- **A sense of control over stress**
  - Stressors aren't stressful if you think you can escape or solve them at will
- **The brain has a system for turning off the brain stress systems when we think we have control over the stressful situation**

### **Control Over a Stressor**

- **Control activates the ventral prefrontal cortex (vPFC)**
- **vPFC turns off the stress response**
- **Eliminates the effects of stress**
- **After experiencing control, extrapolate to other stressors**
- **People with PTSD don't activate this region under stress**

**See diagram on the previous page**

### **Increasing a Sense of Control**

- **Assess stressors to identify things you can control**
  - Part of PTSD treatments
- **Preplanning**
  - Don't put yourself in situations where you cannot ensure your safety
  - Have a plan for resolving the stressor already worked out and tools at the ready
- **Problem-solving**
  - Dorsolateral prefrontal cortex can learn and use complex multipart strategies to solve problems and enact solutions
  - Learning and practicing multiple strategies increase cognitive ability and flexibility in solving problems
  - Increase ability and confidence in escaping potentially stressful situations

### **Cognitive Behavioral Therapy**

- **Overcoming skill deficits**
- **Increasing clients ability to cope with high risk**
- **Reversing negative thinking and negative mood states**

### **Take-Home Advice**

- **Reduce stress by scheduling and pacing, taking care of yourself, and developing a sense of control**
- **Learn and give time to pre-plan and practice problem-solving skills**

### **Brain Challenge # 4: Training Your Addiction Circuits to Make Healthy Behaviors Habitual**

#### **Using your Brain to Form New Habits**

**See diagram on the following page**

### **Using your Brain to Form New Habits: Functions of the Frontal Cortex**

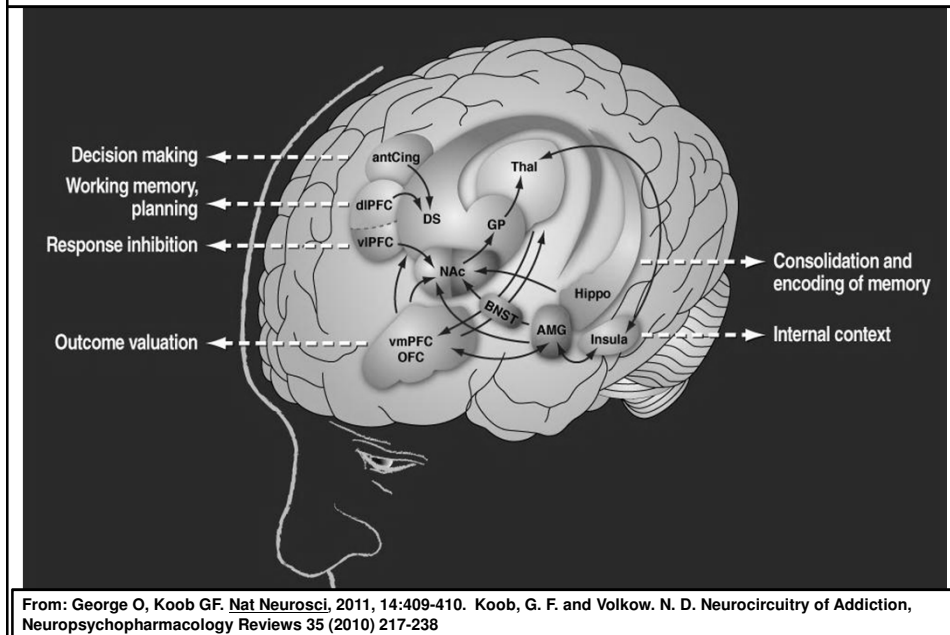
- Focused problem-solving
- Error recognition
- Adaptive response to changing conditions
- Central to intelligent behavior

**See slide on the following page**

### **Changing Reward Based Habits How Does Conscious Thought Modify This Process?**

- (1) Willpower - actively hold back habit
  - Ventrolateral prefrontal cortex can inhibit nucleus accumbens
- (2) Reframing, expectations, beliefs and values - alter value estimates
  - Change dopamine neuron firing
- (3) Do something else - bypass and override habit

## Functional Neural Circuitry of the Cognitive Modulation of Habits and Drug “Craving” (Preoccupation-Anticipation Stage)



## Functional Roles of Subregions of the Frontal Cortex Executive System

- **Anterior Cingulate Cortex-** facilitates online maintenance and selection of responses particularly under high attentional demands, planning, self-initiation and self-monitoring of goal-directed behaviors (Deficits: problems of initiation [mutism], compulsive checking, like OCD)
- **Dorsolateral Prefrontal Cortex-** working memory, planning, strategy (Deficits: impairments in planning, strategy, working memory).
- **Ventrolateral Prefrontal Cortex-** Response inhibition, sustained attention, memory retrieval, rule generation and shifting (Deficits: problems in cognitive flexibility, memory, and response inhibition)
- **Orbitofrontal Cortex (including ventromedial PFC) -** assignment of value, integration of reward and punishment (Deficits: reinforcer devaluation, reversal learning [cognitive inflexibility], delay discounting ['myopia for the future'], decision-making quality)
- **Hippocampus-** consolidation and encoding of memory (Deficits: problems of spatial, verbal recall, episodic, and contextual/configural memory)

### How Does Willpower Work?

- Ventrolateral prefrontal cortex can stall habitual behaviors
  - Hold off a habit
  - Stall an escape from distress
- This is an active process. It requires:
  - Active focus
  - Holding your intention in working memory
- Working memory is an area in the prefrontal cortex (dorsolateral) where we keep information that we plan to use in upcoming decisions. It provides quick access and reminders about key information for our current priorities and tasks.

### What Happens When You Use Willpower to NOT Do Something?

- First, you must put the thing you don't want to do in working memory.
  - You have to remember not to do it...
- That will incorporate that idea into your upcoming decisions. That is good if all you are doing is avoiding your bad habit. But if you do anything else, then it will incorporate that idea into those decisions as well.
- The White Bear effect (Daniel Wegner) - don't think about a white bear....

### What Happens When You Use Willpower to NOT Do Something?

- *Trying not to do something will make you constantly think about it, and usually increases rather than decreases the behavior*

### What Happens When You Use Willpower to NOT Do Something?

- Second, working memory is easily overwhelmed.
  - The more you fill up your working memory, the slower your ventrolateral frontal cortex will be in stalling your habit
  - Go-No Go task example
  - In normal life, where we multi-task constantly, our working memory is likely to be relatively full - and we will often do our bad habits before we catch ourselves.
- *Don't berate yourself for not being able to stop your bad habits using willpower. Brains are not designed to do this. Use a more effective strategy instead!!!*

### How Can Our Cortex Help?

- Change beliefs, values, expectations, and associations
- Connect habit to long-term consequences
  - As we mentioned, can change reward value expectations

### How Can Our Cortex Help?

- Preplan for high-risk situations
  - Anterior cingulate and dorsal prefrontal cortex can learn complex multipart strategies for solving problems. But is not always fast enough to solve problems before habit is released.
- Avoid high-risk situations
- Have a alternative solution ready
- More likely to be able to override the speedy habit system if you have an alternative ready to go

### How Can Our Cortex Help?

- Bring attention to when the habit isn't working and initiate a new strategy
- Orbitofrontal cortex monitors for punishments or failures. Triggers changes in strategy.

### Developing Good Habits

- How do we learn new behaviors?
- Observation!!!!
- We unconsciously mimic the behaviors of those around us, and our quick to learn behaviors we observe

### **Learning by Observation**

- **Mirror neurons**
  - **Map onto our motor systems**
  - **Fire as if we were doing what we are watching others do**
  - **Some of these neurons are focused on the goal of the action and tell us when and how people are doing work toward a goal**
  - **Saves us having to work out the physics of doing a completely novel behavior**

### **Learning by Observation**

- **The best way to learn new habits is to copy them from people who have successfully achieved our goal**
- **Find mentors or communities that share your goal.**
  - **Spend time around them, observe, and do what they do**
  - **This will speed learning and reinforce new behaviors**

### **Imagery**

- **Practicing or running through a new behavior in our imagination can speed learning**
  - **For example, real practice playing the piano reshaped representation of the fingers in the motor cortex. One week of imagining playing the piano for 2 hours a day caused the same motor cortex restructuring**

### **Teaching New Behaviors**

- **Demonstration and role-playing can help teach new behaviors**
- **Interventions that tell people what to do are less effective than those that show people how to do the behavior**
  - **Didactic education alone is not ideal.**

### Habits Appear Contagious

- Habits spread through populations like disease - close contact between people spreads habits
  - Examples: Smoking cessation, obesity, and happiness
- We tend to act, feel, and think like those around us.
- Why?

### Brain Challenge # 5: Making Flexible Decisions to Empower your Brain To Make Healthful Choices

#### Initiating and Maintaining Healthful Habits



Shoe by Chris Cassatt and Gary Brookins, [www.gocomics.com](http://www.gocomics.com)

### Development of Self-Regulation Capacity

#### Genetic makeup

- marshmallow experiments

#### Environment

- perinatal stress

#### Enriching your life

## Predicting Adolescent Cognitive and Self-Regulatory Competencies from Preschool Delay of Gratification: Identifying Diagnostic Conditions

Shoda Y, Mischel W, Peake PK  
Dev Psychol, 1990, 26:978-986

Variations of the self-imposed delay-of-gratification situation in preschool were compared to determine when individual differences in this situation may predict aspects of cognitive and self-regulatory competence and coping in adolescence. Preschool children from a university community participated in experiments that varied features of the self-imposed delay situation. Experimental analyses of the cognitive-attentional processes that affect waiting in this situation helped identify conditions in which delay behavior would be most likely to reflect relevant cognitive and attentional competencies. As hypothesized, in those conditions, coherent patterns of statistically significant correlations were found between seconds of delay time in such conditions in preschool and cognitive and academic competence and ability to cope with frustration and stress in adolescence.

Delay of gratification was assessed in various versions of the basic self-imposed delay waiting paradigm. Children were escorted individually into an experimental room in the Bing School, played briefly with some toys with the experimenter and were told they would play with them more later. The child was then seated at a table on which there was a bell, and was shown reward objects determined by pretest to vary in desirability (e.g., one small marshmallow vs. two, one small stick pretzel vs. two, one colored plastic poker chip vs. two). The particular objects in the contingency varied from study to study, but the items in each pair were all pretested to be of age-appropriate interest and to be sufficiently close in value to create a conflict for young children between the temptation to stop the delay and the desire to persist for the preferred outcome when the latter required delay. The experimental room was deliberately stripped of distractors. After asking which of the objects in the choice (e.g., one or two marshmallows) the subject preferred, the experimenter introduced the child to the contingency: The experimenter indicated that she or he had to go out of the room then but that "if you wait until I come back by myself then you can have this one (pointing to the preferred object). If you don't want to wait you can ring the bell and bring me back any time you want to. But if you ring the bell then you can't have this one (pointing to the preferred object), but you can have that one (pointing to the less preferred object)."

After testing the child's comprehension of the contingency, the experimenter left the room and returned when the subject rang the bell or reached a predetermined criterion time (usually 15 minutes, but sometimes 20 minutes, depending on the particular study). The time until the child rang the bell was measured in seconds, in the present data analysis to allow combining data across studies, delay times exceeding 15 minutes were truncated at 15 minutes.

## Individual Differences in Self-Regulatory Capacity- Preschool Predicts Adolescent Performance

*Correlations between preschool delay time and the parent's competence ratings when subjects were adolescents*

Adolescent Rating	1 <sup>st</sup> & 2 <sup>nd</sup> Delay	1 <sup>st</sup> Delay Only
<b>Girls (n = 51)</b>		
Academic competence	0.22	0.24
Social competence	0.34**	0.28**
Frequency of problems	-0.09	-0.09
Coping competence	0.21	0.23
<b>Boys (n = 36)</b>		
Academic competence	0.32*	0.26
Social competence	0.43***	0.45***
Frequency of problems	0.24	0.19
Coping competence	0.25	0.23
<b>Combined (n = 87)</b>		
Academic competence	0.27	0.24**
Social competence	0.39****	0.35***
Frequency of problems	0.05	0.03
Coping competence	0.23**	0.23**

Note: all *p* values are two-tailed.

\**p* < 0.10

\*\**p* < 0.05

\*\*\**p* < 0.01

\*\*\*\**p* < 0.001

## Behavioral and Neural Correlates of Delay of Gratification 40 Years Later

Casey BJ, Somerville LH, Gotlib IH, Ayduk O, Franklin NT, Askren MK, Jonides J, Berman MG, Wilson NL, Teslovich T, Glover G, Zayas V, Mischel W, Shoda Y  
Proc Natl Acad Sci USA, 2011, 108:14998-15003

We examined the neural basis of self-regulation in individuals from a cohort of preschoolers who performed the delay-of-gratification task 4 decades ago. Nearly 60 individuals, now in their mid-forties, were tested on "hot" and "cool" versions of a go/nogo task to assess whether delay of gratification in childhood predicts impulse control abilities and sensitivity to alluring cues (happy faces). Individuals who were less able to delay gratification in preschool and consistently showed low self-control abilities in their twenties and thirties performed more poorly than did high delayers when having to suppress a response to a happy face but not to a neutral or fearful face. This finding suggests that sensitivity to environmental hot cues plays a significant role in individuals' ability to suppress actions toward such stimuli. A subset of these participants (n = 26) underwent functional imaging for the first time to test for biased recruitment of frontostriatal circuitry when required to suppress responses to alluring cues. Whereas the prefrontal cortex differentiated between nogo and go trials to a greater extent in high delayers, the ventral striatum showed exaggerated recruitment in low delayers. Thus, resistance to temptation as measured originally by the delay-of-gratification task is a relatively stable individual difference that predicts reliable biases in frontostriatal circuitries that integrate motivational and control processes.

### **Early Learning of Stress Response**

- **Maternal separation experiments**
  - Stress responses are learned through early experiences with maternal response
  - Children of mothers who comfort and provide safety cues after stressors were more stress resilient
  - When mothers didn't provide safety cues or didn't have time to provide safety cues, children were more prone to stress-related disease, including addiction

### **Enriching Your Life**

- **Increasing reward opportunities**
- **Not all about financial resources**
  - Don't need to win the lottery
- **Social interactions are a huge source of rewards**
  - Improving communication and interpersonal skills can greatly increase opportunities for rewards such as social approval, respect, status
- **Modeling and role-playing difficult social interactions, addressing social anxiety and depression**

### **Increasing Reward Opportunities**

- **Remember negative reinforcement**
  - Solving a problem or resolving distress is a reward
  - Solvable problems and negative feelings or pain are reward opportunities!!!
- **Improving problem-solving skills, increasing positive coping skills, and learning solutions to common problems will increase reward opportunities**
  - Even if the skills don't directly address how to avoid or prevent the target behavior, they may strengthen basal ganglia neurons and make it easier to quit the bad habit

### **Take-Home Points**

- **Successful attempts to eliminate bad habits initiate with efforts to enrich your life with other rewards**
- **Important learning required to change a bad habit does not need to focus on the bad habit**
  - If someone is "not ready to quit" or doesn't feel capable of stopping a bad habit, then you can still make great progress toward recovery by directing efforts toward increasing healthful reward opportunities in their life

### Take-Home Points

- Ending a bad habit is not about taking away something that provides pleasure or relief
- It is about optimizing your life patterns so that you are as healthy and happy as possible
- Bad habits inherently lead to poor health - physical and emotional sickness
- Replacing bad habits with healthy habits will improve your life...but it is absolutely necessary to **REPLACE** your bad habits, not deprive yourself

### Developing Self-Efficacy: Four Ways to Increase Self-efficacy

- Do it - “enactive attainments”
- Observe it - “vicarious experience”
  - Models that are “like you” are more effective
- Be encouraged - “verbal persuasion”
  - Trusted/knowledgeable coaches/cheerleaders are more effective
- Reduce anxiety - “observation of your physiological state”
  - Anxiety can abort or impair performance of a behavior

From Albert Bandura

### Take-Home Points

- Positive psychology
  - Use your strengths to start you down the path
  - Successes will build your confidence and self-efficacy for next steps
  - Successes will enrich your life to reduce impulsivity and make habit changing easier
- Don’t start with the scariest, hardest part. Take whatever little step seems easy or fun to you right now. Mastering that step will reshape your brain and new steps will start to seem manageable.
- Avoid the “get discovered by Oprah” plan. Don’t get stuck on the goal, focus on walking down the path.

### Making Your New Behavior a Habit

Repetition and reward are key

- Repetition
  - You must practice the behavior to make it automatic - able to be done without conscious focus
  - The amount of practice needed to make a behavior automatic will depend on the complexity of the task, anything from a few tries to years of repetition
- Reward
  - You must reward the behavior to drive your habit system to perform it whenever possible
  - Removing the rewards will make you do the behavior less, but you won’t forget how to do the behavior
- You might stop going on bike-rides but you won’t forget how to ride a bike

### **Novel Behaviors Require Focused Attention**

- To plan and complete a new behavior, we must engage cortical systems to plan and consciously work us through the behavior
- With repetition, the behavior pattern gets encoded in the basal ganglia, where it can now be done without conscious attention
- However, only behaviors that rely on consistent cue response logic can be encoded
  - If multiple problem-solving strategies must be used, then the behavior cannot be automated (e.g. long division)

### **Automating Health Habits**

- Important so that you continue to respond in healthful ways when you are stressed, multitasking, or distracted
- *We can't always focus on acting healthfully! We must train up our autopilot.*

### **Remember: Habits Aren't Just Behaviors**

- Can automate emotional responses, thought patterns, and attention
- Working to shape directed attention can have a huge impact on your perceived environment and behavior
  - Learn to notice opportunities for healthful responses
- Habitually look for stairs, vegetables, happy healthy people, things you can fix and you will find them everywhere.
  - Learn to disregard opportunities for unhealthful responses
- Practice ignoring threats, unsolvable problems, and sugary treats, and you will eventually not notice them that often
- Your environment is what you notice more than what is there

### **Reinforcing Healthy Behaviors**

- Social support is an ideal reinforcer
- Support and mutual help groups are extremely effective for starting and maintaining recovery from bad habits
  - Alcoholics Anonymous
  - Weight Watchers
- Provide social reinforcement of healthy behaviors, model healthy behaviors, and help with problem solving when you hit barriers to improvement
- Active referral to mutual help groups, including connecting with someone who will accompany the client to a meeting, is a highly effective intervention

### **Reinforcing Healthy Behaviors**

- Contingency management
  - Setting up “artificial” immediate rewards can encourage behaviors whose benefits are more long-term
- Programs that reward patients for completing target behaviors are effective for treating addictive disorders and other bad habits
  - Proven intervention for substance use and overeating
- Example: Gift vouchers for drug-free urine tests, money for meeting weight goals

### **Reinforcing Healthy Behaviors**

- Monitoring and feedback provides a simple version of this concept
  - Social or even personal approval can reinforce monitored behaviors
- Provide secondary gain for healthy behaviors
  - Use the same tricks to increase good habits
- If doing healthful things gets you attention, praise, relief from distress, or out of doing unpleasant things, then you’ll keep doing them

### **Triggering Healthy Behaviors**

- Create advertising/cues for healthy behaviors
  - Reminders
- Visual cues, prompts, mood cues, thought triggers
  - Scheduling
- Plan time and opportunities for healthy behaviors
  - Associations
- Create positive associations with healthy behaviors
- Mindfulness can help here - notice the pleasures associated with the healthful things you are doing
  - Make it easy to do the right thing
- Create a physical space that facilitates healthy choices

### **Take-Home Points**

- What should you do to improve healthy habits?
  - Correct expectations and associations around unhealthful and healthful habits
  - Set up triggers and cues for healthy habits
  - Avoid triggers and cues for unhealthy habits
  - Associate with social groups that value healthy living
  - Reshape interactions that encourage bad behaviors

### **Take-Home Points**

- **Enrich your life!**
  - **Make doing the healthy things that you enjoy a regular part of your life**
  - **Learn effective problem-solving and coping skills so that problems, challenges, and stressors become opportunities**
  - **Improve your social interactions**
- **Don't try to deprive yourself and expect it to work.**

### **Take-Home Points**

- **If you are prone to immediate-gratification seeking don't tempt yourself or expect to moderate**
  - **Do not expose yourself to opportunities to overdo it on bad habits**
  - **Be honest with yourself and don't feel bad about an inability to moderate**
  - **Focus on creating an environment that works for you instead of trying to act better in an unsupportive environment**

### **Take-Home Points**

- **Reduce stress**
  - **Get enough sleep and rest**
  - **Eat on regular intervals - don't skip meals**
  - **Pace - don't overdo it at work or activities**
  - **Develop a sense of control over stress**
- **Learn what you can control and use this power to reduce exposure to the things you can't**
- **Pre-plan solutions to avoid crisis**

### **Take-Home Points**

- **Improve problem-solving**
  - **Play! Challenge yourself with diverse problems games where failure doesn't endanger you**
  - **Learning diverse strategies will improve the speed and effectiveness of your prefrontal cortex and make you more adaptable and creative**

*Keep the faculty of effort alive in you by a little gratuitous exercise every day. That is, be systematically heroic in little unnecessary points, do every day or two something for no other reason than its difficulty, so that, when the hour of dire need draws nigh, it may find you not unnerved or untrained to stand the test. Asceticism of this sort is like the insurance which a man pays on his house and goods. The tax does him no good at the time, and possibly may never bring him a return. But if the fire does come, his having paid it will be his salvation from ruin. So with the man who has daily inured himself to habits of concentrated attention, energetic volition, and self-denial in unnecessary things. He will stand like a tower when everything rocks around him, and his softer fellow-mortals are winnowed like chaff in the blast.*

William James- Principles of Psychology

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