

Understanding and Managing Food Addiction

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Outline of the presentation

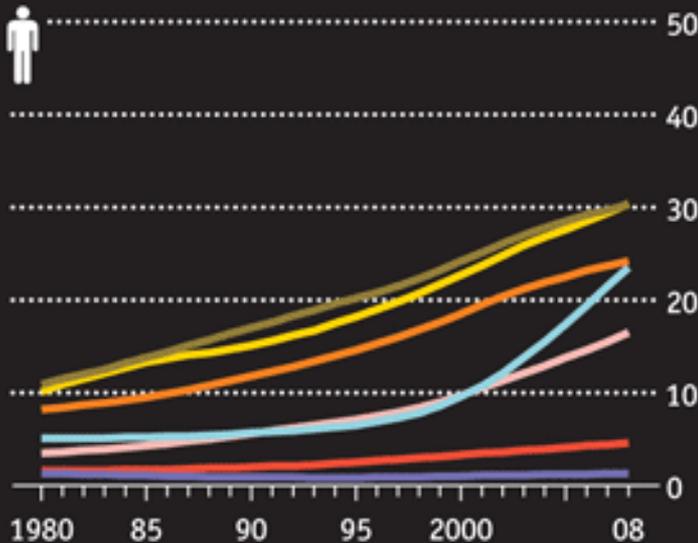
- The problem of obesity
- Our modern food landscape
- Some factors contributing to the obesity epidemic
- Background on food-reward and some of its associated brain systems
- Defining an addiction and contrasting it with “normal” rewarding experiences
- Assessment of “food addiction” in studies
- Managing “food addiction”: where should we look?

Obesity in the World

The world is round

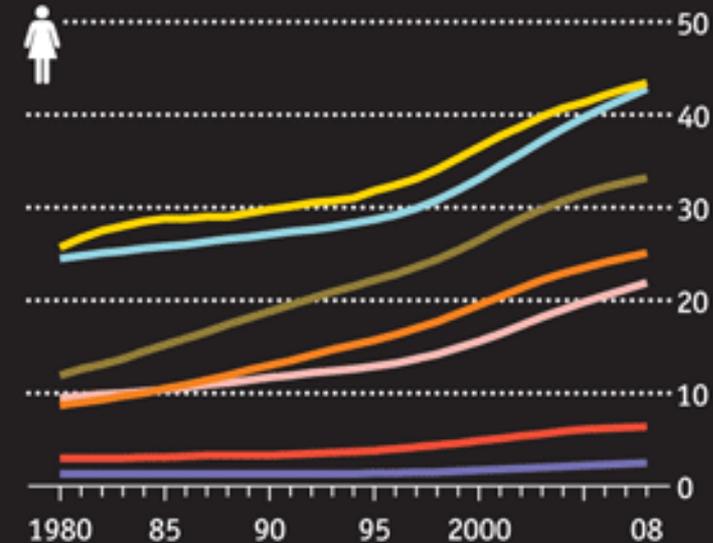
Obesity prevalence as % of total population*

United Arab Emirates United States South Africa



Source: Gretchen Stevens and Majid Ezzati, Population Health Metrics

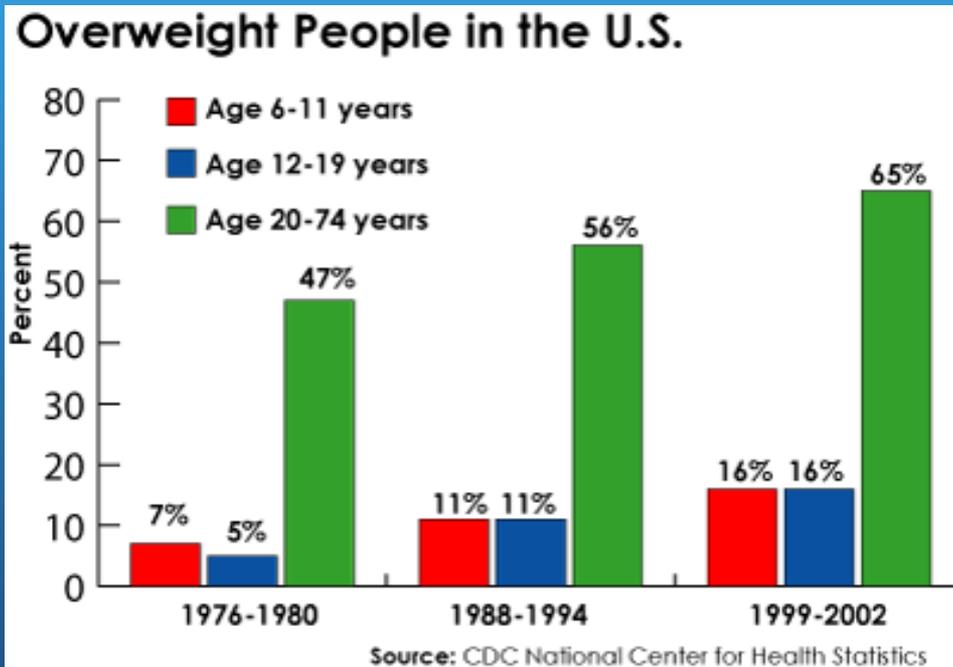
Britain Brazil China India



*Adults aged 20 and over with a body-mass index of 30 and above

The Economist (2012)

Obesity in the US



- ~65% of adults in the U.S. are overweight, of which ~36% are obese.
- Being obese or overweight is associated with multiple comorbid health concerns (e.g., heart disease, diabetes).
- Increased body weight can also have psychological, economical, and social consequences.

Why are so many people
overweight or obese?

Portion size and portion creep



Twenty years ago
333 calories



Today's Burger
590 calories



Original 8-ounce bottle
97 calories



12 ounce can
145 calories



20-ounce bottle
242 calories

Food Acquisition is Easier Than it Used to Be



Added Sugar Consumption in the United States

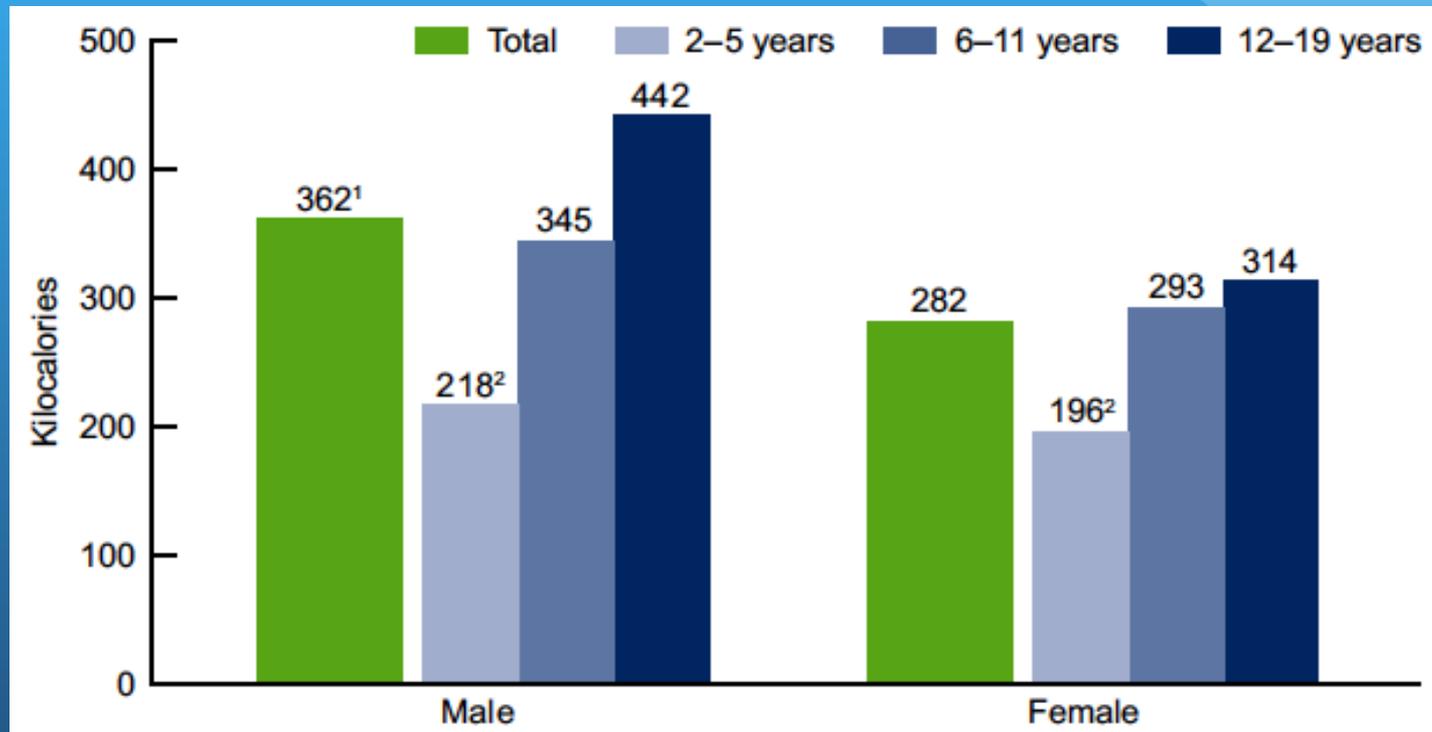
**Table 2. Usual Intake of Added Sugars (In Teaspoons),*
2001–2004**

Age, y	n	Mean	SE
1–3	1515	12.2	0.33
4–8	1701	21.0	0.54
Males 9–13	1061	29.2	0.92
Males 14–18	1424	34.3	1.03
Males ≥ 19	4650	25.4	0.48
Females 9–13	1112	23.2	0.82
Females 14–18	1362	25.2	0.71
Females ≥ 19	5063	18.3	0.37
All persons ≥ 1	17 888	22.2	0.29



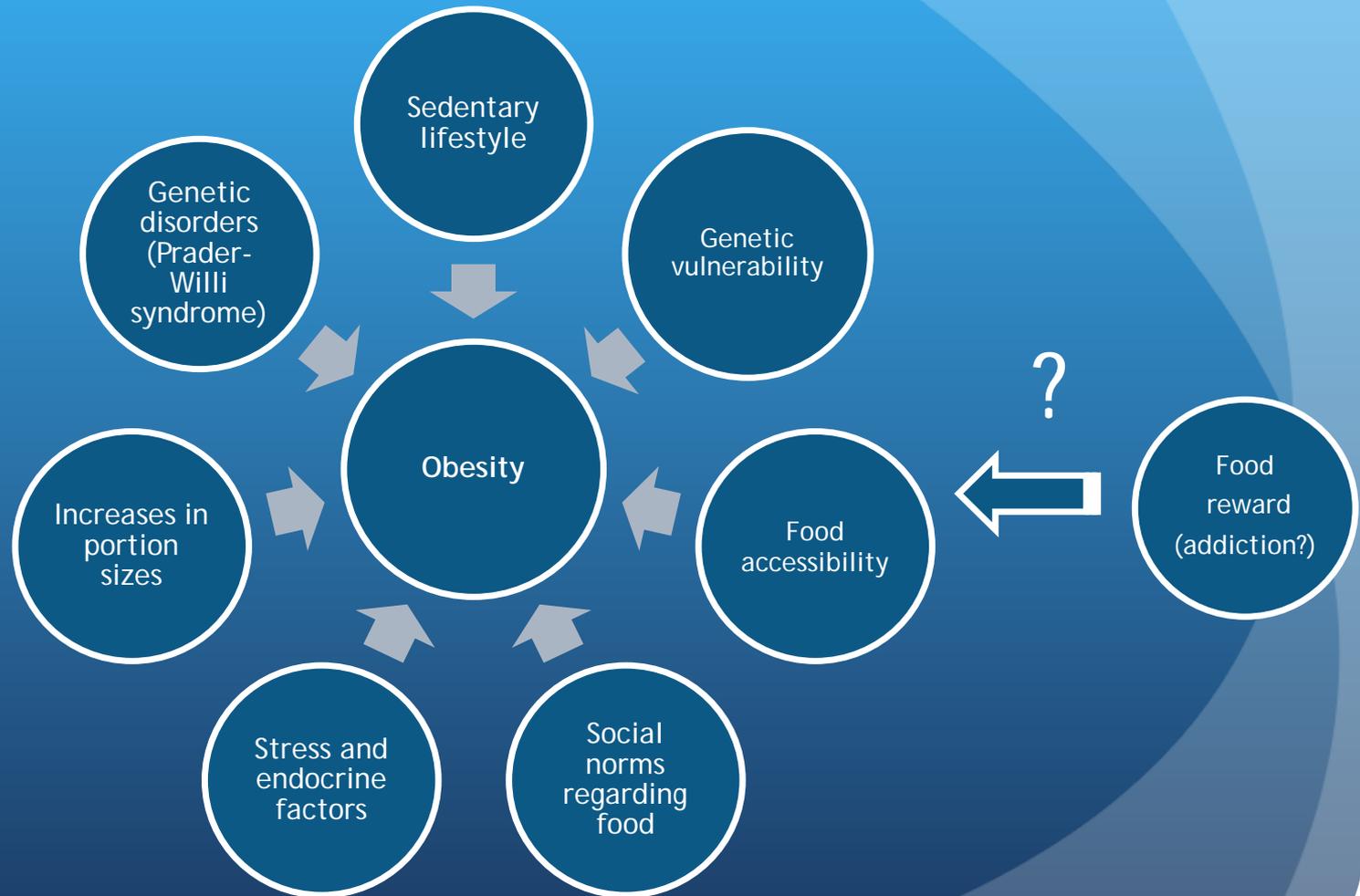
Added sugar, as measured here, includes: white, brown and raw sugar, syrup, honey, and molasses that were eaten separately or used as ingredients in processed or prepared foods such as breads, cakes, soft drinks, jams, and ice cream.

Consumption of Added Sugars in Children and Adolescents



Added sugars have been reported to constitute approximately 16% of children and adolescents' daily caloric intake.

Obesity is an endpoint, with multiple contributing factors



Hedonic eating vs. caloric need

- People sometimes eat because they *want* to eat, not because they *have* to eat (people may eat because of boredom, stress, etc.)
- Foods that are rich in fats and sugars, and consequently calories, taste good.
- Palatable food is ubiquitous for most people in our society.
- Food is a part of our social lives.

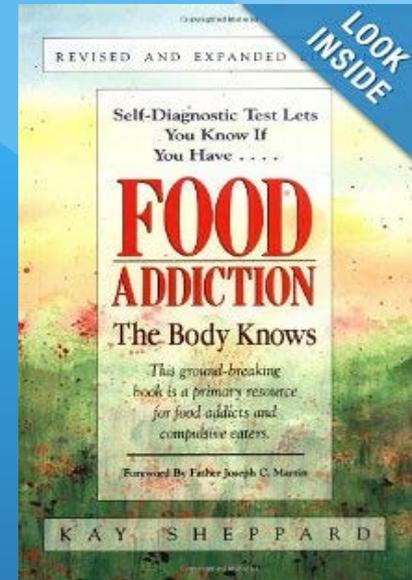
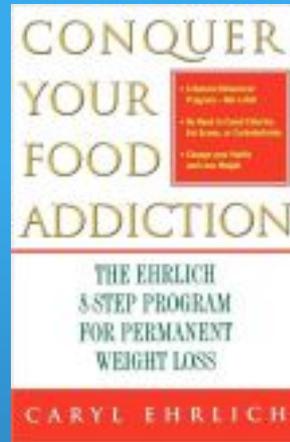
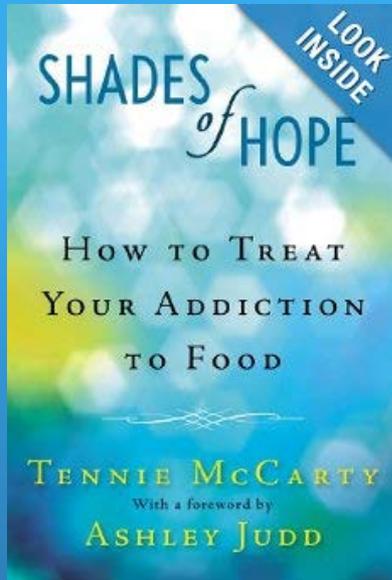


Who thinks food can be addictive?

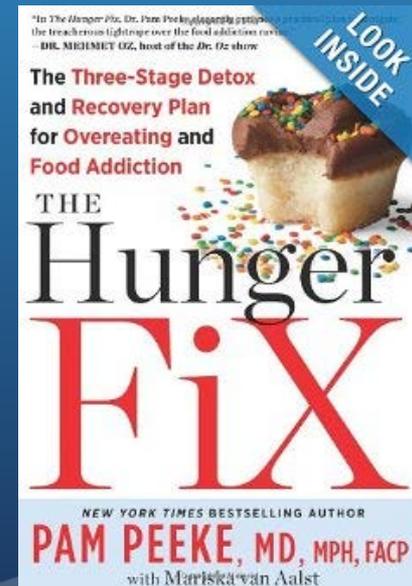
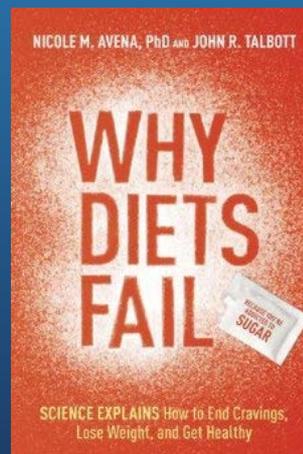
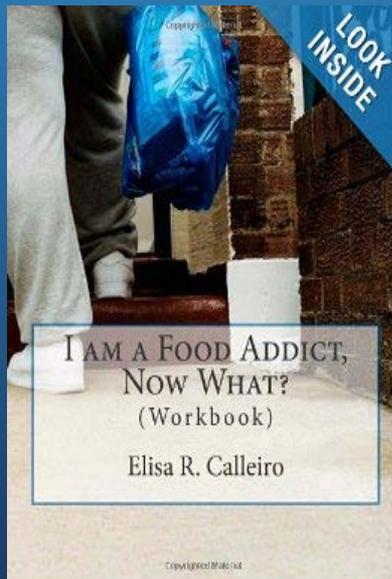


Food Addiction in Food Advertising





Food Addiction
in Popular Media





Food Addicts in Recovery Anonymous

6 Pleasant St. #402 • Malden, MA 02148 • (781) 321-9118



Information on the Science of Food Addiction
& Effective Treatments

ACORN

Food Dependency Recovery Services

{ Food Addiction
in Groups }

Food Addicts Anonymous TM



Food Addiction Program

What kinds of foods may be addictive?

Public Health Nutrition: 14(1), 5-13

doi:10.1017/S1368980010003241

Increasing consumption of **ultra-processed foods** and likely impact on human health: evidence from Brazil

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See corresponding article on page 371.

Variety and hyperpalatability: are they promoting addictive overeating?^{1–3}

Nicole M Avena and Mark S Gold

The hypothesis that food has evolved from a necessity and a boring staple to an object of desire and a substance of abuse has been debated for decades (1). However, over the past 10 y, empirical studies have revealed overlaps between maladaptive food intake patterns, which are sometimes seen in obesity, and drug addiction (2). As a result, “addiction” to palatable food has been suggested, with neurochemical and behavioral similarities seen in both human studies and in animal models (2, 3). In laboratory animals, signs of opiate-like withdrawal can be seen after administration of naloxone in cases in which the animals have a history of chronic overconsumption of sucrose. Furthermore, cross-tolerance and sensitization have been reported between alcohol, amphetamine, or cocaine and the overconsumption of sucrose. With these behaviors are concomitant changes in the mesolimbic dopamine and opioid

daily presentation group than in the groups exposed to the palatable food weekly (6).

The findings of Epstein et al (6) provide support and guidance in developing dietary advice, such as the suggestion that people try to eat the same food each day, in which case habituation may develop that would reduce the likelihood of overeating and subsequent obesity. However, previous work has shown that having a variety of tastes available can actually promote energy intake (8). Thus, variety in palatable food choices appears to be important in determining whether or not habituation or perhaps tolerance to food can develop. In our modern-day food environment, monotony and similarity in meals are rare. The variety of ethnic foods, multiple fast-food restaurants on virtually every corner, and the many choices of highly palatable food that these establishments

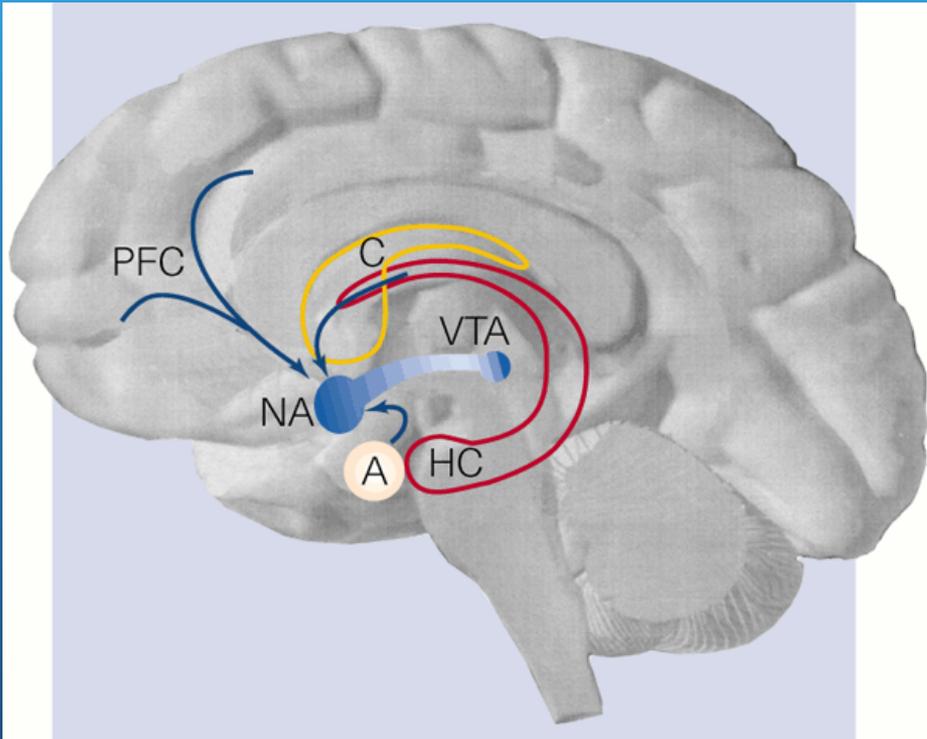






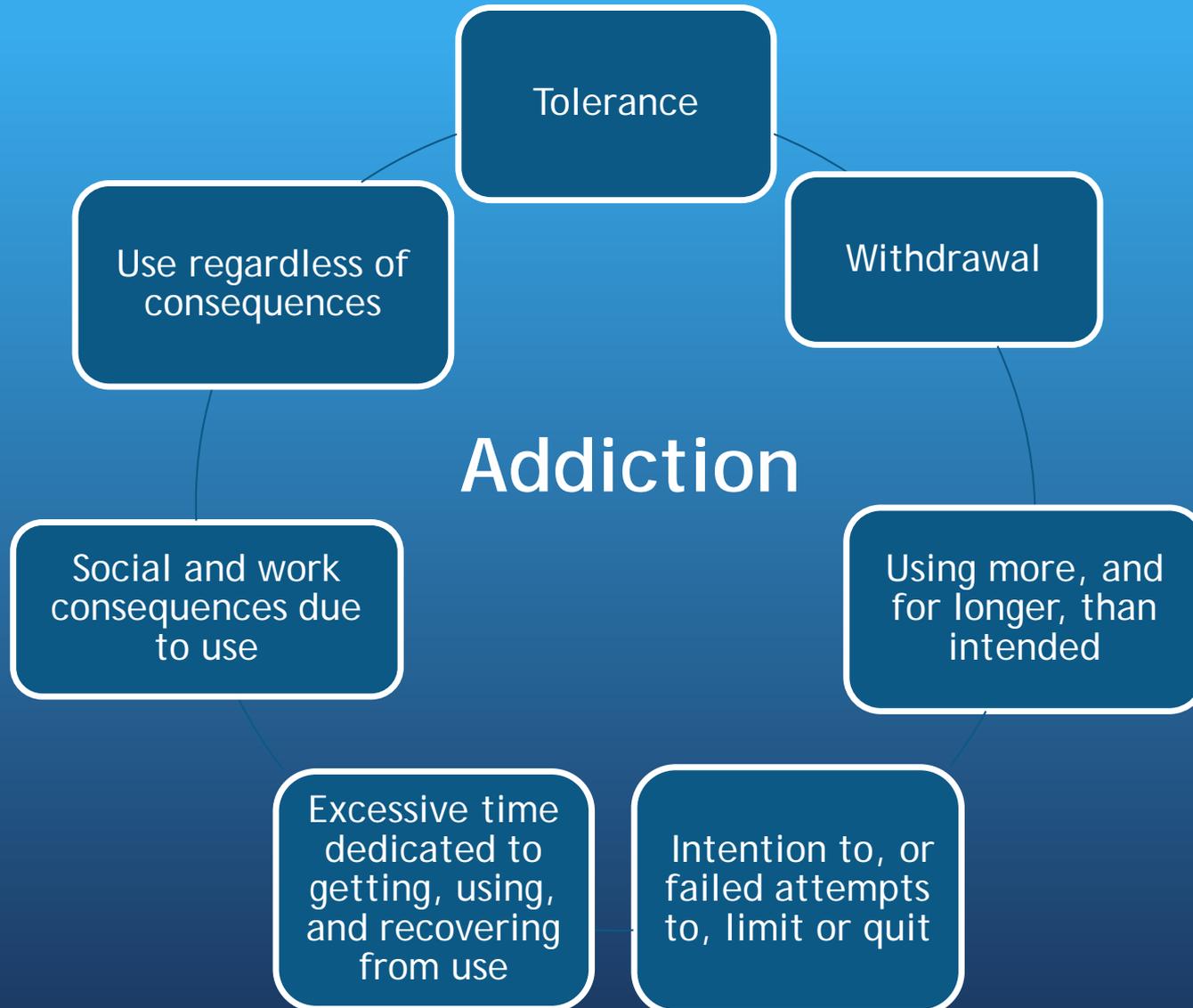


What happens in the brain when we eat?



- Drugs that are abused act on brain systems that evolved to reinforce natural behaviors (e.g., sex, feeding).
- There are overlaps in the brain pathways activated by palatable foods and drugs of abuse.

Defining an addiction



Could some people be “addicted” to eating highly-palatable foods rich in sweets and fats in ways that resemble drug addiction?

Could such out-of-control eating result in increased body weight and obesity in some individuals?



Comparing and contrasting normal feeding and drug addiction

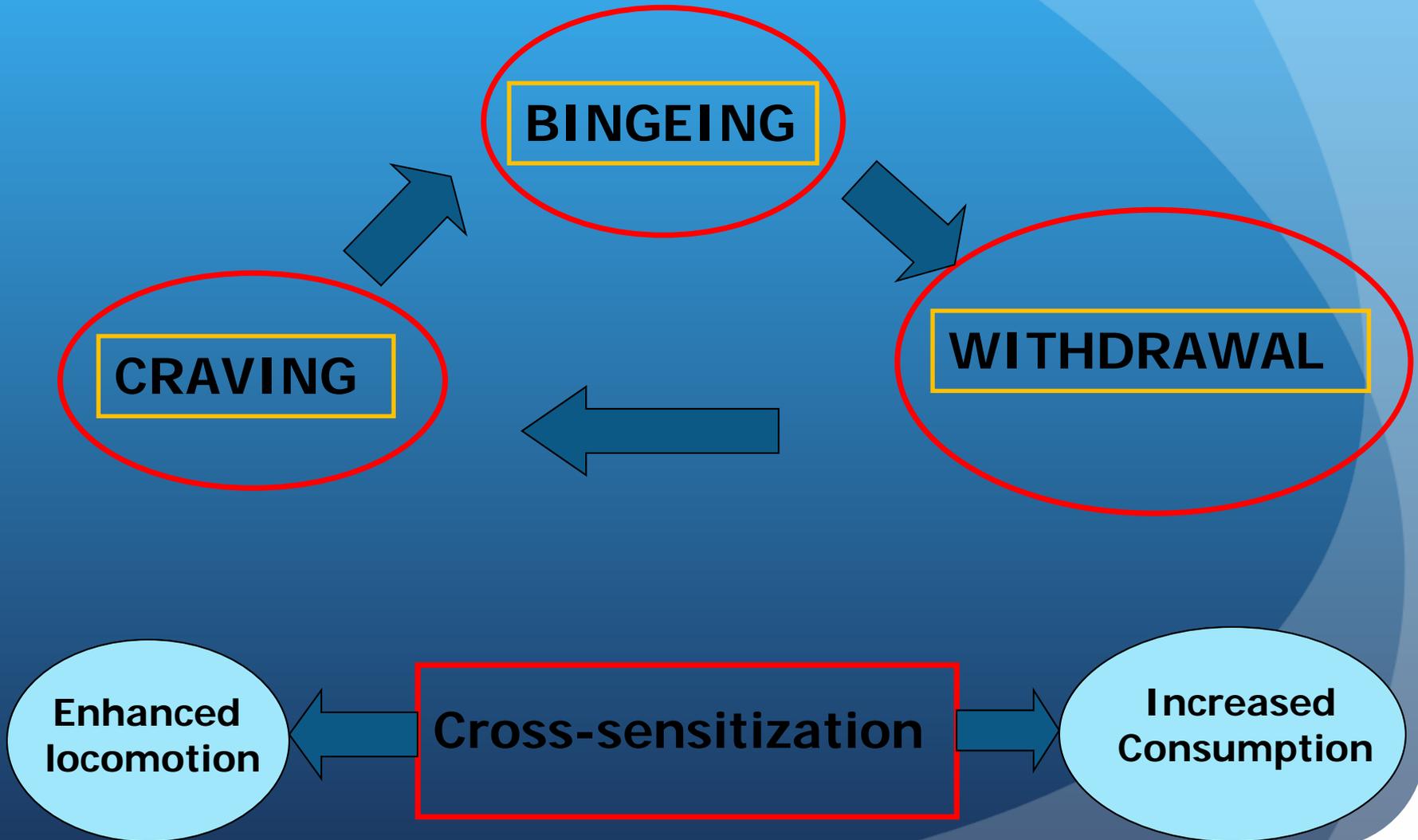
Normal Feeding

- We need food to survive (but not hyperpalatable foods).
- Food is not regulated, eating is socially accepted and encouraged, and food is readily available.
- Food cues are everywhere (sights, smells, even sounds).

Drug Addiction

- We don't need drugs of abuse to survive.
- Drugs of abuse are illegal, discouraged by society, and hard to procure.
- Drug cues and advertisements are not common.

Assessing Addiction Using Animal Models



Evidence for sugar addiction: Behavioral and neurochemical effects of intermittent, excessive sugar intake

Nicole M. Avena, Pedro Rada, Bartley G. Hoebel*

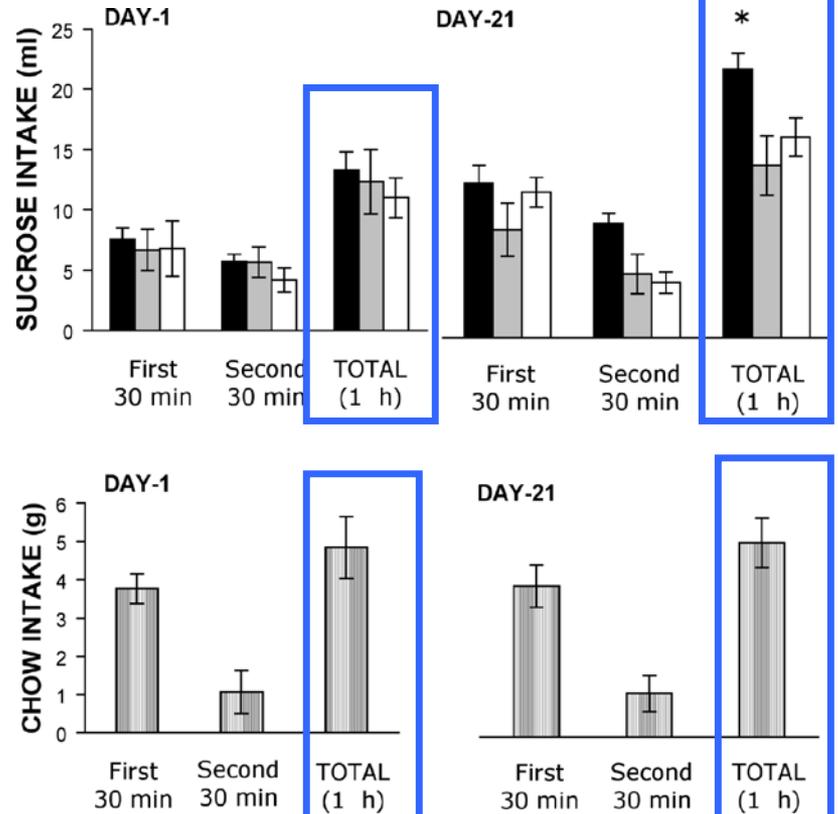
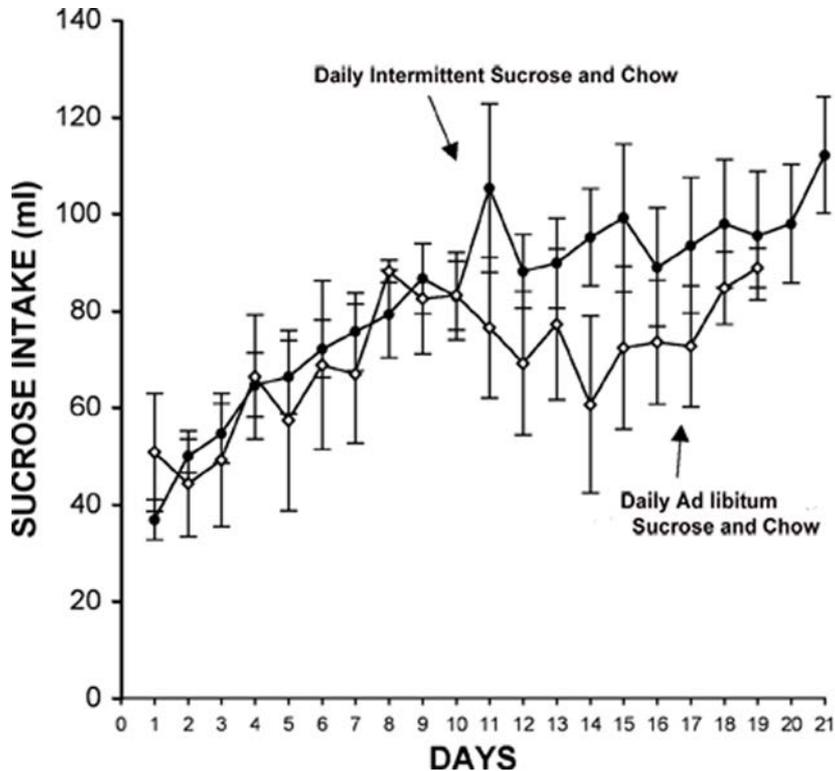
Department of Psychology, Princeton University, Princeton, NJ 08540, USA

Table 1
Summary of findings in support of sugar addiction in rats using an animal model of sucrose or glucose bingeing.

Substance dependence	Animal model of sugar dependence
A. DSM-IV-TR	
<i>Tolerance</i>	Escalation of daily sugar intake (Colantuoni et al., 2001)
<i>Signs of withdrawal</i>	Somatic signs (teeth-chattering, tremor), Anxiety measured by plus-maze, Ultrasonic distress vocalizations (Colantuoni et al., 2002 and Avena et al., 2008)
<i>Consuming more than intended</i>	Deprivation effect (Avena et al., 2005)
B. Behavioral signs	
<i>Locomotor cross-sensitization</i>	Amphetamine (Avena and Hoebel, 2003)
<i>Proclivity to consume other drugs of abuse</i>	Alcohol (Avena et al., 2004)
C. Neurochemical changes in the NAc	
<i>Repeated release of DA</i>	Rada et al. (2005) and Avena et al. (2006)
↑ <i>D₁ receptor binding</i>	Colantuoni et al. (2001)
↓ <i>D₂ receptor binding</i>	Colantuoni et al. (2001)
↑ <i>D₃ receptor mRNA</i>	Spangler et al. (2004)
↓ <i>preproenkephalin mRNA</i>	Spangler et al. (2004)
<i>DA/ACh imbalance during withdrawal</i>	Colantuoni et al. (2002) and Avena et al. (2008)

*Taken with permission from Avena, N. M., & Hoebel, B. G. (in press). Bingeing, withdrawal and craving: an animal model of sugar addiction. In K. Brownell, & M. Gold (Eds.), *Handbook of food and addiction*. Oxford University Press.

Bingeing/Tolerance

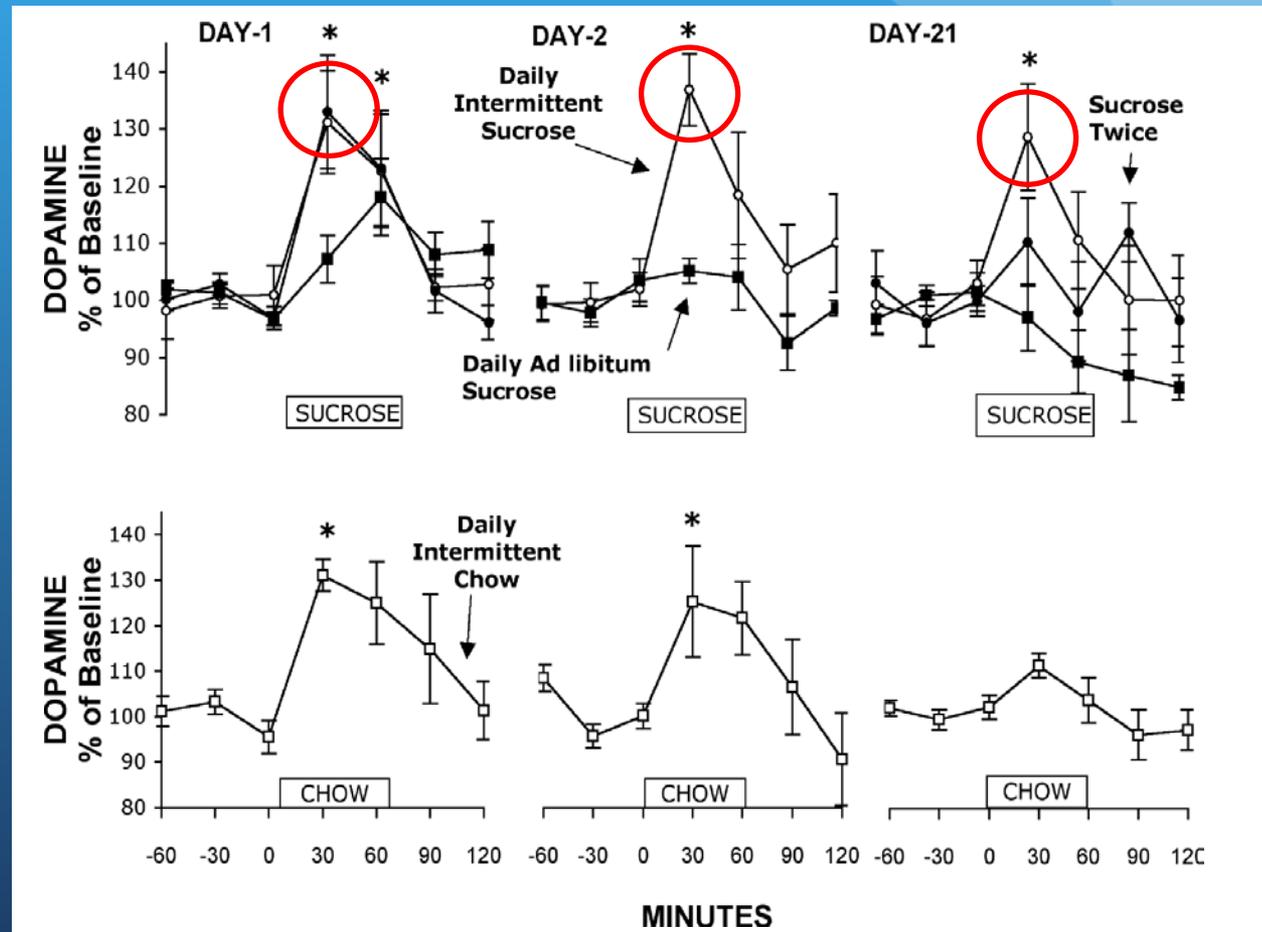


Rada, Avena, and Hoebel (2005)

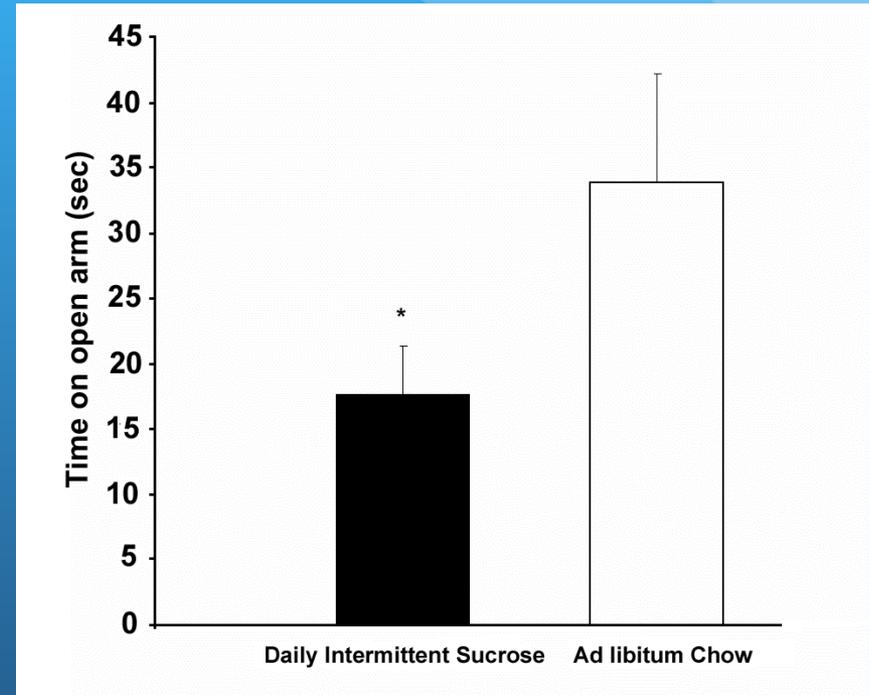
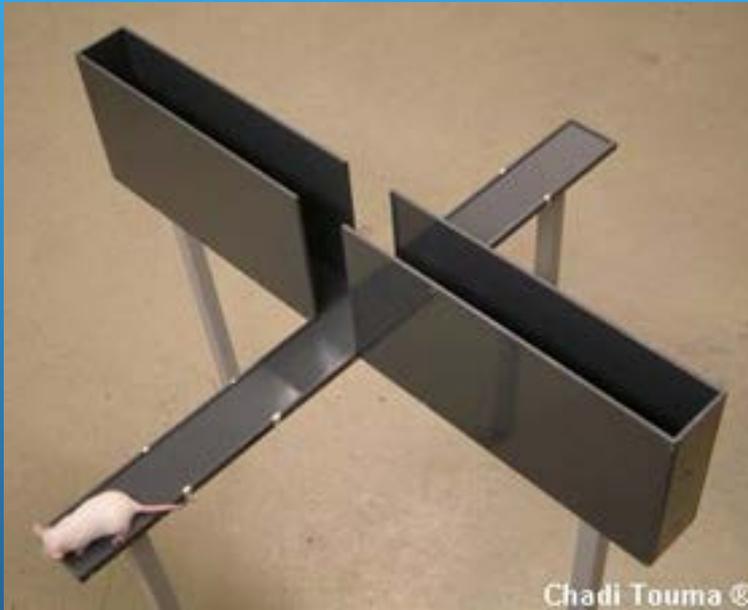
- Daily Intermittent Sucrose and Chow
- Sucrose Twice
- Daily Ad libitum Sucrose and Chow

Alterations in Brain Dopamine Levels

- Increases in dopamine release wane with repeated exposure to chow, however, these increases continue in response to sugar.
- This effect is only seen in sugar-bingeing rats, not control rats.
- This effect is also seen in response to fat (Liang, Hajnal, & Norgren, 2006).
- Rats are not overweight.



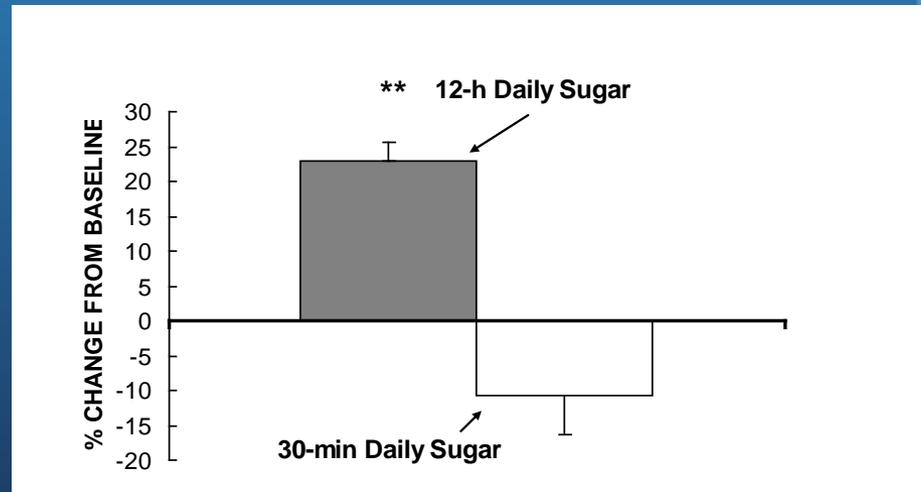
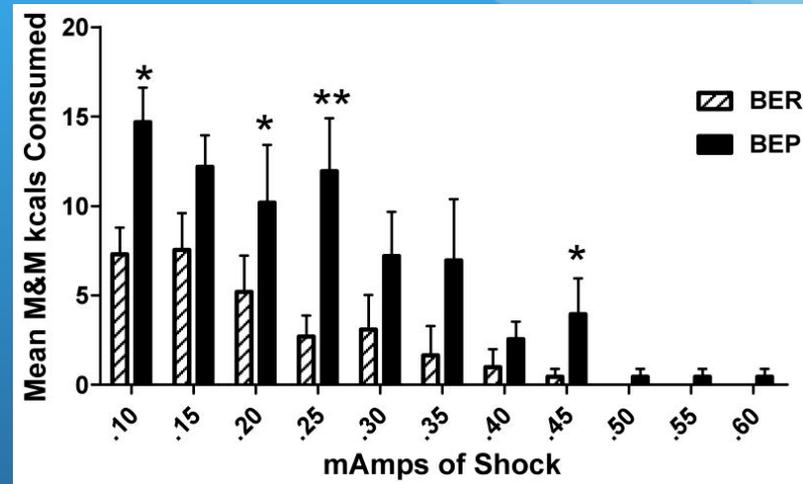
Withdrawal



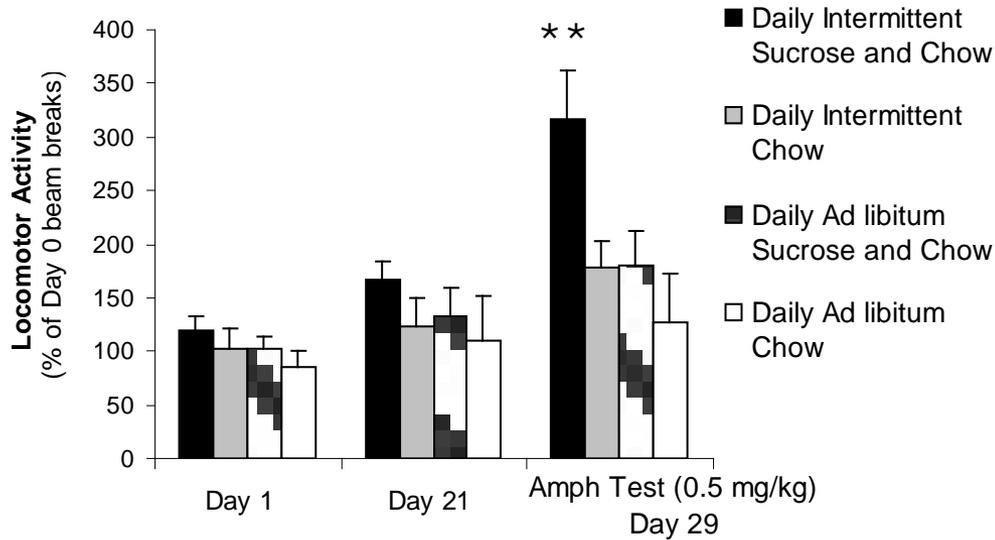
- Sugar bingeing rats show signs of anxiety when given an opioid antagonist (naloxone), or when fasted from all food for 36 h.
- Opioid systems are perturbed by overeating, as revealed by increased mu-opioid receptor binding in these animals prior to withdrawal.

Craving

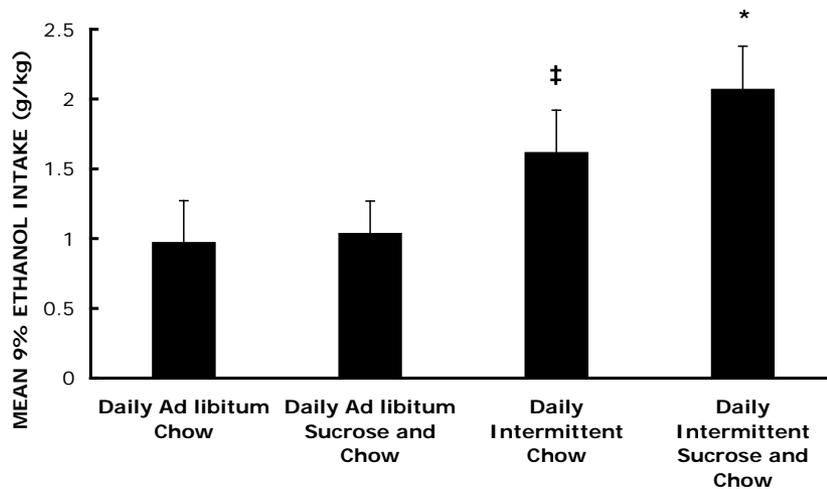
- Rats prone to overeat are more likely to cross a shock grid to get access to palatable food (Oswald, Murdaugh, King & Boggiano, 2011).
- Rats that overeat sugar daily show an increase in intake following a period of abstinence (Avena et al, 2005), and will work harder to get access to sugar-associated cues (Grimm et al., 2005).



Cross-sensitization to drugs of abuse



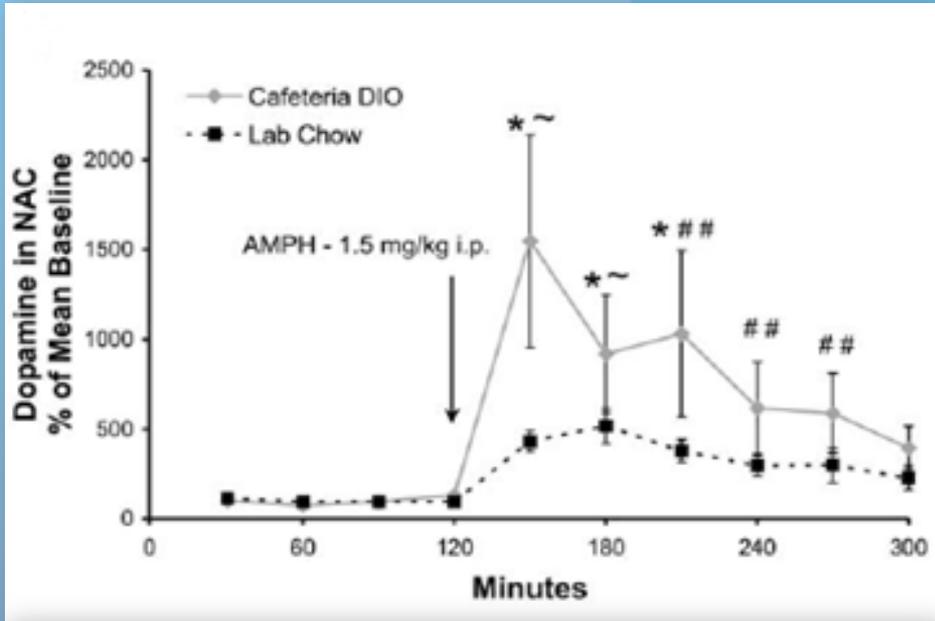
- Sugar-bingeing rats are hyperactive in response to a low dose of amphetamine.



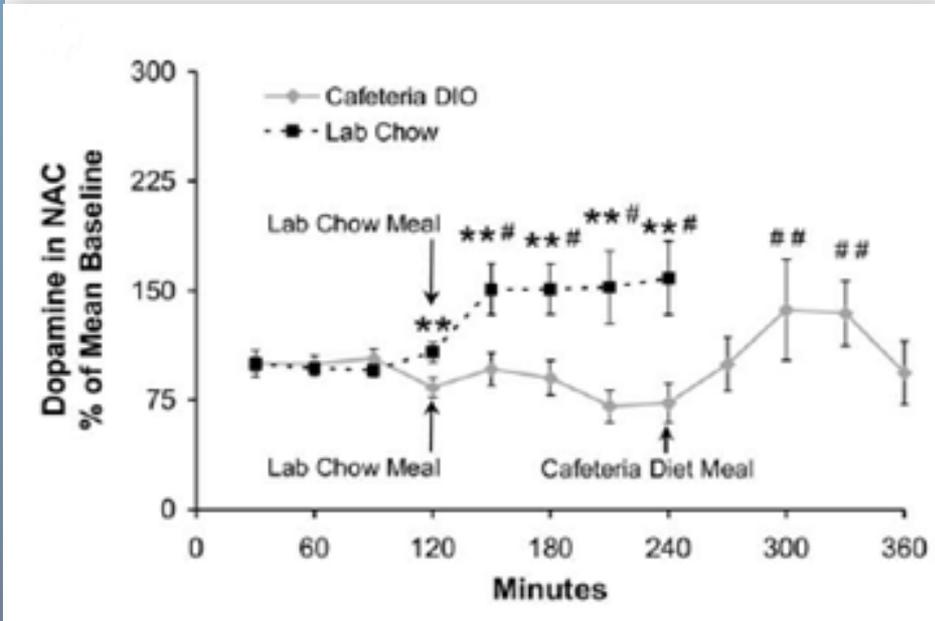
- Sugar-bingeing rats consume more alcohol.

Food variety attenuates habituation to food in humans....when you have variety, you eat MORE.





- Rats with access to a cafeteria-style diet are hyper-responsive to amphetamine in terms of dopamine release.



- However, they do not respond to a lab chow meal. These rats need “junk food” to release accumbens dopamine.

Assessing Addiction-like Responses to Palatable Food in Humans

- The Yale Food Addiction Scale has been created to study food addiction by applying the DSM-IV criteria for substance dependence to eating behaviors

Sample items:

“I find myself continuing to consume certain foods even though I am no longer hungry”

“I eat to the point where I feel physically ill”

“I find that when I start eating certain foods, I end up eating much more than planned”

- The items are answered using a Likert type scale (i.e., Never, Once a month, 2-4 times a month, 2-3 times a week, 4 or more times or daily)

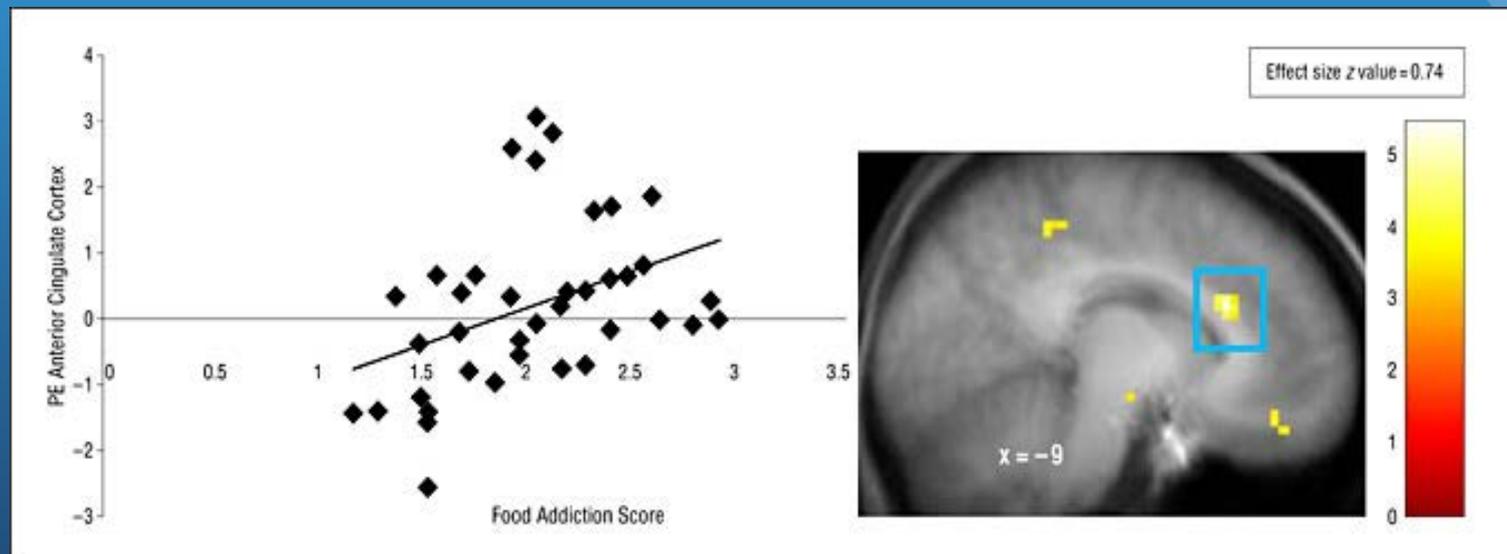
Neural Correlates of Food Addiction

Ashley N. Gearhardt, MS, MPhil; Sonja Yokum, PhD; Patrick T. Orr, MS, MPhil; Eric Stice, PhD; William R. Corbin, PhD; Kelly D. Brownell, PhD

(REPRINTED) ARCH GEN PSYCHIATRY

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WWW.ARCHGENPSYCHIATRY.COM



Select Findings from Studies using the Yale Food Addiction Scale

- In a group of about 200 undergraduate students, 11.4% met the criteria for food addiction (Gearhardt et al., 2009)
- Among 72 obese participants, 25% met the criteria for food addiction (Davis et al., 2011)
- Two studies assessing food addiction symptoms in obese individuals with binge eating disorder reported that 42-57% met the criteria for food addiction (Gearhardt et al., 2012; 2013)
- Recently, this scale has been adapted to use in children and adolescents. A preliminary study using the YFAS-C found 7.2% of the 72 children and adolescents met the criteria for food addiction (Gearhardt et al., 2013)

Food addiction has been associated with:

- Binge eating disorder (BED) / binge eating
- Depression
- Impulsivity
- Lower self-esteem
- Emotional eating
- Food cravings
- Snacking on sweets
- Mixed evidence regarding weight loss outcomes

Summary

Table 1

Common dietary obesity and DSM IV criteria for addictive disorders. Three of the 7 criteria need to be met for diagnosis.

DSM IV criteria	Animal model	Humans	Evidence
1 Tolerance	✓	✓	Food binging, hyperphagia, delayed satiety
2 Withdrawal	✓	✓	Hypofunctioning brain dopamine system, opiate withdrawal-like symptoms, psychological and physical dependence
3 Use more than intended in longer periods of time	✓	✓	Hyperphagia, change of eating patterns and meal frequency (snacking), negative experience triggers, cue-induced behaviors, larger portion size, proximity to food sources, lower cost of high-energy foods
4 Attempts to cut back		✓	Dietary restraint Participation in weight loss programs
5 Spend time in the pursuit/use/recovery of the substance	✓	✓	Anticipation and preoccupation, cravings, food thoughts, increased brain dopamine levels in response to anticipation and consumption, negative experience triggers, cue-induced behaviors, change of eating patterns and meal frequency, increase in habitual (vs. physical) hunger
6 Missed important activities	✓	✓	Social & occupational activities given up, social marginalization, psychological distress, discrimination
7 Persistent behavior in spite of knowledge of consequences	✓	✓	Lack of diet compliance, failure to achieve long-term weight loss, hyperphagia resistant to aversive cues

From Allen et al. (2012)

How might we manage food addiction?

Managing Food Addiction

1. One step to managing food addiction is to assess and try to alter certain *social norms* surrounding food, such as...

- Using food as reinforcements in children
- Having food as the central part of most social gatherings
- Including popular toys in unhealthy food packages to market toward children



As a society, we have to stop being
"food pushers"

Managing Food Addiction

2. We have to become *savvy food consumers*

- Understanding nutrition labels
- Know where sugars are hidden
- Following new research to learn the latest

3. *Pharmacological approaches.*

- Researchers are currently studying pharmacological agents known to target brain regions associated with reward (i.e., dopaminergic and opioidergic systems) in order to identify possible drug treatments that may suppress overeating, particularly of highly-palatable foods.

Nutrition Facts

Serving Size: 1 cup (205g)

Amount Per Serving

Calories	830	Calories from Fat	81
% Daily Value*			
Total Fat	8.96 g		14%
Saturated Fat	8.44 g		42%
Trans Fat	0.15 g		
Cholesterol	0 mg		0%
Sodium	30.75 mg		1%
Potassium	24.6 mg		1%
Total Carbohydrate	186.1 g		62%
Dietary Fiber	0 g		0%
Sugars	155.47 g		
Sugar Alcohols			
Protein	0.39 g		
Vitamin A	0 IU		0%
Vitamin C	136.94 mg		228%
Calcium	0 mg		0%
Iron	0 mg		0%

Managing Food Addiction

In addition to the social and neurochemical aspects of food addiction, there may also be important psychological reasons that people may develop an unhealthy attachment to food. In order to address these factors, it may be helpful to recognize:

- When we typically overeat (when we are bored? Stressed? Depressed? Lonely? In groups?)
- When we first began this pattern of overeating
- What function overeating may serve for us

We have a lot more work to do to understand how to manage food addiction

Thank you!

Collaborators:

Mark Gold

Pedro Rada

Sarah Leibowitz

Students:

Miriam Bocarsly

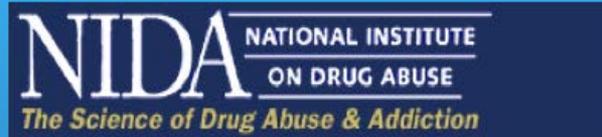
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