COPE Webinar Series for Health Professionals

September 16, 2020

Choice is Relative: Reinforcing Value of Food and Physical Activity in Obesity Treatment

Moderator
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M. Louise Fitzpatrick College of Nursing

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Today's Webinar Objectives

1. Describe how behavioral economic principles can influence obesity treatment.
2. Discuss the role of the home environment on obesity risk.
3. Learn how the use of substitutes and complements can be effective tools in obesity treatment.

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Choice is relative: Reinforcing value of food and physical activity in obesity treatment

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Jacobs School of Medicine & Biomedical Sciences
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CHOICE IS RELATIVE

Reinforcing value of food and activity in obesity treatment

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Jacobs School of Medicine and Biomedical Sciences
University at Buffalo

*McDonald Center for Obesity Prevention and Education (**COPE**)* Webinar Series
September 16, 2020

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Overview

- Reinforcing value of food and activities
- What modifies reinforcing value?
- How do we develop reinforcers?
- Behavioral Economic Principles for behavior change
- Role of the Cognitively enriched environment

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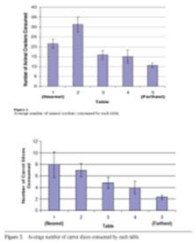
What is Reinforcing Value?

- Motivation to access a reinforcer
  - Food
  - Money
  - Physical activity
  - Sedentary Activities
  - Social activities
- To assess motivation
  - How much money would you spend?
  - How much effort would you expend?



Musher-Eizenman, et al. (2010). Health Education & Behavior. 37: 186-192.. 11

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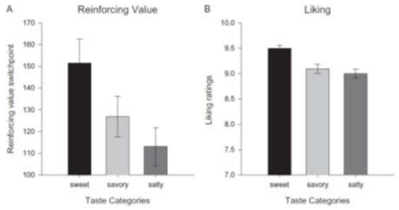
Types of Foods and Reinforcing Value



Epstein, et al. (2015). Appetite. 91: 226-232. 12

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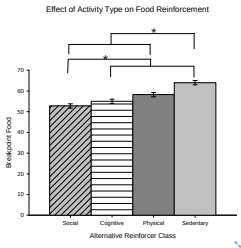
Relative food reinforcement

- Relative reinforcing value of food = measuring reinforcer motivation with alternatives available
- Types of alternatives can modify the relative reinforcing value of food



Carr and Epstein. (2018). Health Psychology. 37: 125-131. 13

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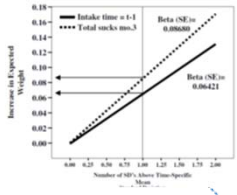
When does Food reinforcement Develop?

- Food is a natural reinforcer
  - Present at birth and represent a previous evolutionary biological advantage
  - Differences in food reinforcement at 3 months predicts weight gain



Stunkard, et al. (2004). International Journal of Obesity and Related Metabolic Disorders. 28: 503-513. 14

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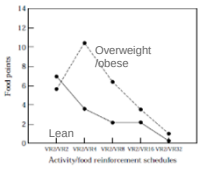
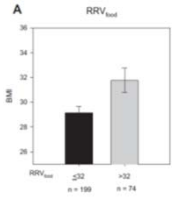
Reinforcing Value of food & Weight Status





Saelens and Epstein. (1996). Appetite. 27: 41-50. Epstein, et al. (2012). Appetite. 58: 157-62. 15

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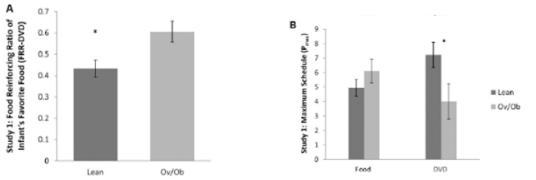
Infant Relative Reinforcing Value & Weight Status



Kong, et al. (2015). American Journal of Clinical Nutrition. 101: 515-522. 16

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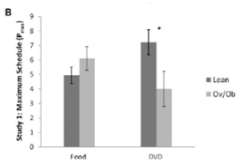
Infant Relative Reinforcing Value & Weight Status

- Reinforcing value of food
- Reinforcing value of alterantive



Kong, et al. (2015). American Journal of Clinical Nutrition. 101: 515-522. 17

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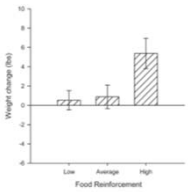
Reinforcing Value of Food & Weight Gain

TABLE 3
Longitudinal regression analyses for prediction of the change in adiposity at 1-y follow-up by the relative reinforcing value of food at baseline ($n = 316$)[1]

Outcome measure	Unadjusted model[2]		Adjusted model[3]	
	B (SE *B*)	*P* value	*B* (SE *B*)	*P* value
BMI	0.06 (0.02)	<0.001	0.05 (0.02)	0.003
BMI SD score	0.03 (0.01)	0.001	0.03 (0.01)	0.003
Waist	0.13 (0.07)	0.06	0.09 (0.07)	0.16
Waist SD score	0.02 (0.01)	0.05	0.02 (0.01)	0.08
Fat mass index	0.09 (0.03)	0.001	0.09 (0.03)	0.001



Children

Adults

Hill, et al. (2009). American Journal of Clinical Nutrition. 90: 276-281. Carr, et al. (2014). Obesity (Silver Spring). 22: 254-259. 18

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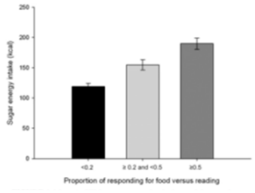
Reinforcing Value of Food & Energy Intake

- Energy is related to reinforcing value of food (Epstein, et al. (2004). Physiology and Behavior. 81: 511-517.)
- And sugar
- Energy intake mediates the relationship between reinforcing value of food and BMI (Epstein, et al. (2012). Obesity (Silver Spring). 20: 1815-1819.)



Epstein, et al. (2011). American Journal of Clinical Nutrition. 94: 12-18. 19

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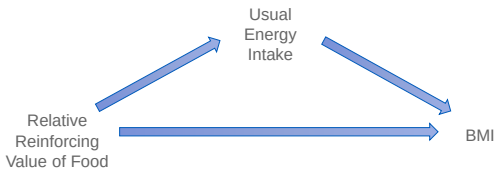
Energy Intake Mediates Reinforcing Value of Food & Obesity



Epstein, et al. (2012). Obesity (Silver Spring). 20: 1815-1819. 20

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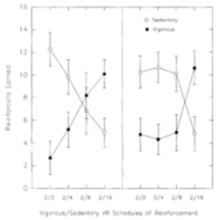
Reinforcing Value of Physical Activity

- Animals & Humans will work for access to physical activity

Preferred Physical activity versus Sedentary



Less Preferred Physical activity versus Sedentary

Epstein, et al. (1991). Health Psychology. 10: 311-316. 21

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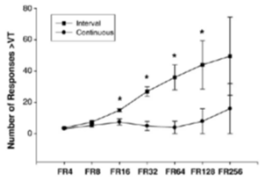
Types of Physical Activity



Barkley, et al. (2009). Physiology and Behavior. 98: 31-36. 22

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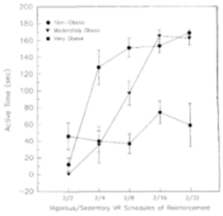
Weight Status and Reinforcing Value of Physical Activity



Epstein, et al. (1991). Health Psychology. 10: 311-316. 23

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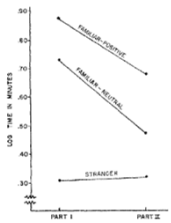
Can Social activities be reinforcers?

- Familiar: Adult provided supervision for children during a classroom activity
  - Neutral: Adult minimally interacted with child
  - Positive: Adult interacted individually with each child and responded to all questions/requests
- Stranger: Adult did not interact with child prior to the test session



McCoy and Zigler. (1965). Journal of Personality and Social Psychology. 1: 604. 24

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So far we know

- Food, Physical activities and social activities can be reinforcers for adults & children
- Reinforcing value of food is present at birth and
  - Predicts weight status
  - Predicts weight gain
- Energy intake mediates reinforcing value of food on BMI
- Individual differences between types of foods and physical activities

What can predict or modify the reinforcing value of food?

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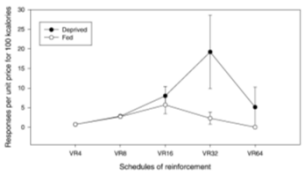
Food Deprivation; Hunger



- Deprived: 4 hours post-prandial
- Fed: provided caloric preload prior to session

Epstein, et al. (2003). Physiology and Behavior. 78: 221-227. 26

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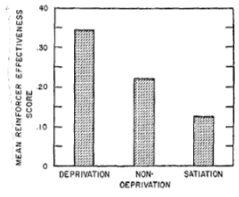
Social Deprivation



- Deprivation: 20 minutes by-self prior to test
- Non-deprivation: No wait prior to test
- Satiation: 20 minutes of play with adult present

Gewirtz and Baer. (1958). The Journal of Abnormal and Social Psychology. 57: 165-172. 27

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Physical Activity Deprivation?

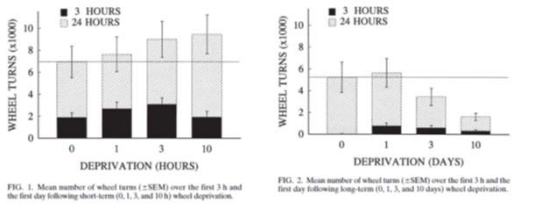

FIG. 1. Mean number of wheel turns (±SEM) over the first 3 h and the first day following short-term (0, 1, 3, and 10 h) wheel deprivation.

FIG. 2. Mean number of wheel turns (±SEM) over the first 3 h and the first day following long-term (0, 1, 3, and 10 days) wheel deprivation.

Mueller, et al. (1999). Physiology and Behavior. 66: 101-7. 28

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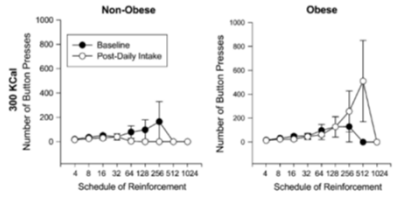
Sensitization
Recent Experience with Food



Temple, et al. (2009). American Journal of Clinical Nutrition. 90: 304-313. 29

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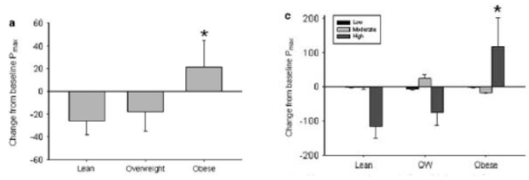
Sensitization
Recent Experience with Food



Temple and Epstein. (2011). International Journal of Obesity. 36: 1102-1107. 30

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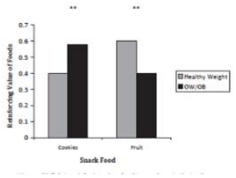
Food type and Weight Status



McCullough, et al. (2017). Appetite. 111: 187-194.

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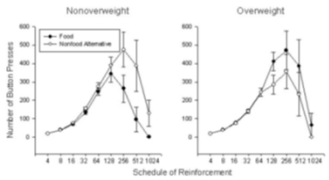
Weight Status & Alternative Reinforcers on Reinforcing Value of Food



Temple, et al. (2008). American Journal of Clinical Nutrition. 87: 1121-1127.

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Summary

- Reinforcing value of food is related to obesity status, energy intake and weight gain
- Exercise reinforcement is related to exercise engagement
- Deprivation (hunger) increases reinforcing value of food and social reinforcers
- Obesity status is related to the reinforcing value of sedentary and physical activities

How do reinforcers develop?

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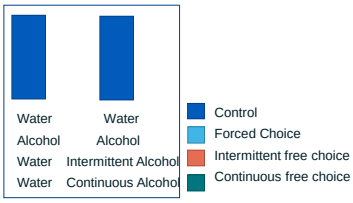
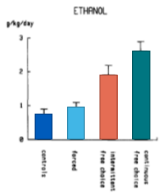
How do reinforcers develop?



- Control
- Forced Choice
- Intermittent free choice
- Continuous free choice



Wolffgramm and Heyne. (1995). Behavioural Brain Research. 70: 77-94. 34

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Offering Choices to Kids

No choice – Carrots
Before Dinner choice
During Dinner choice

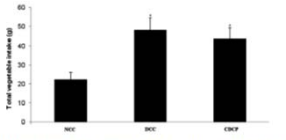

Fig. 1. Means and standard error means of total vegetable consumption, including one or two vegetables, depending on the condition ($p<0.05$).

de Wild, et al. (2015). Appetite. 91: 1-6. 35

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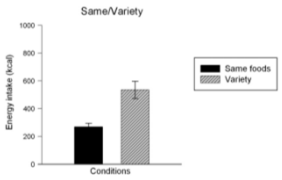
Variety and Energy Intake

- Favorite snack food
- Random Access to 4 different snack foods



Epstein, et al. (2009). American Journal of Clinical Nutrition. 89: 746-54. 36

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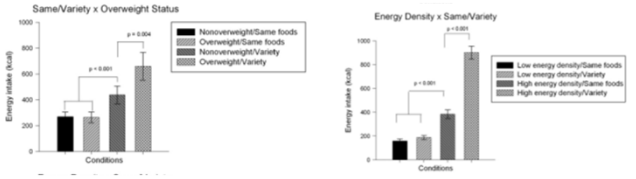
Variety and Energy Intake



- Children with overweight status eat more than non-overweight status when exposed to variety
- Variety increases energy intake for High energy dense snack foods, but not low

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Variety and Physical Activity

- Low choice: 2 Activities
- High choice: 8 Activities
- 30 minutes free play

Table 2 Young Children's Accelerometer Counts, Activity Intensity, Sedentary Time, and Liking of 30-Minute High- and Low-Choice Conditions

	High choice	Low choice
Counts (CPM)*	3224 ± 280	2675 ± 294
Activity intensity (MET)*	6.3 ± 0.4	5.6 ± 0.4
Sedentary time (minutes)	6.5 ± 1.9	9.2 ± 2.1
Physical activity time (minutes)	23.5 ± 1.9	20.8 ± 2.1
Liking (cm)	8.3 ± 0.4	7.9 ± 0.4

Note. Data are mean ± SD.
* Greater than the Low choice condition, $P \leq .03$.

Sanders, et al. (2016). Journal of Physical Activity and Health. 13: 428-432. 38

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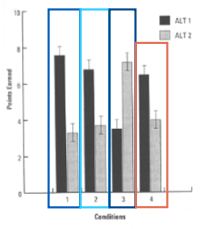
Exercise and Variety

- Favorite sedentary vs. favorite exercise
- Favorite sedentary versus two sedentary activities (including favorite)
- Favorite exercise versus two exercises (including favorite)
- Favorite sedentary versus two exercise activities



Vara and Epstein. (1993). Research Quarterly for Exercise and Sport. 64: 356-360. 39

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Choice & Variety in Obesity Treatment

- Increase Fruits/Veggies
- Decrease high fat/high sugar foods
- Parent only treatment

Table 2. Changes in servings per day of fruits and vegetables and high-fat/high-sugar foods, and changes in percentage of overweight over 12 months for parents and children in the increase fruit and vegetable or decrease fat and sugar groups (mean ± SD)

	Groups:		Significance level:	
	Increase Fruit and Vegetable	Decrease Fat and Sugar	Time	Group X Time
Parent				
Fruits and vegetables	3.41 ± 3.47	−0.23 ± 3.66	0.035	0.017
High-fat high-sugar	−4.47 ± 4.63	−8.22 ± 6.19	<0.001	NS
Percentage of overweight	−12.01 ± 11.05	−3.94 ± 4.17	<0.001	0.028
Child				
Fruits and vegetables	0.72 ± 1.11	−0.55 ± 1.31	NS	0.12
High-fat high-sugar	−4.50 ± 7.97	−8.50 ± 7.58	<0.001	NS
Percentage of overweight	−1.10 ± 5.29	−2.40 ± 5.39	NS	NS

NS, not significant.

Epstein, et al. (2001). Obesity Research. 9: 171-178. 40

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For Treatment,

- Choice is an important component for developing new reinforcers
- Variety can be used by
  - Increasing variety of healthy foods and behaviors to increase engagement
  - Decreasing variety of unhealthy foods and behaviors to decrease engagement

What Behavioral Economic Strategies can be used to change health behaviors?

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Behavioral economic principles

- Availability and Access to reinforcers
- Alternative choices to unhealthy behaviors
- Substitutes
- Complements

- Alternatives to food & the environment

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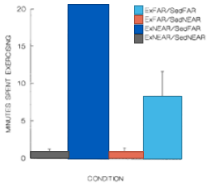
Availability and accessibility of reinforcers

- Availability
  - Reinforcers that are not available are not choice options
- Access
  - Changing how accessible a choice is in your home changes choice



Raynor, et al. (1998). Research Quarterly for Exercise and Sport. 69: 99-103. 43

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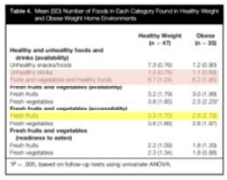
Home Food and Physical Activity Environment



- Availability of unhealthy foods
- Accessibility of vegetables

- Accessibility of Television

Boles, et al. (2013). Journal of Nutrition Education and Behavior. 45: 222-231. 44

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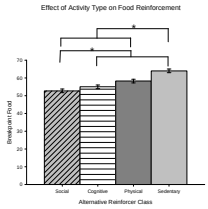
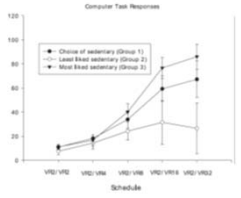
How do the alternative choices play a role?





Carr and Epstein. (2018). Health Psychology. 37: 125-131. Epstein, et al. (2004). International Journal of Behavioral Medicine. 11: 236-242. 45

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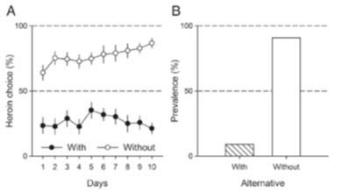
Animal Data;
Food can be a very powerful Reinforcer

- With saccharin sol. available
- Without saccharin sol. available



Ahmed. (2005). European Journal of Pharmacology. 526: 9-20. 46

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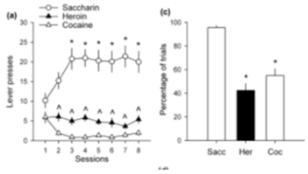
Animal Data;
Food can be a very powerful Reinforcer



Madsen and Ahmed. (2015). Addiction Biology. 20: 433-44. 47

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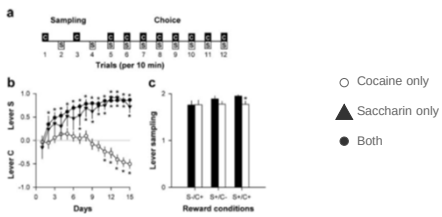
Animal Data;
Food can be a very powerful Reinforcer



Lenoir, et al. (2007). PLoS One. 2: e698. 48

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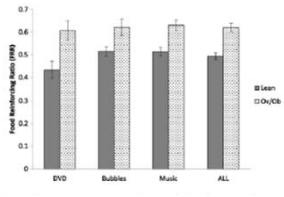
Alternatives & Infant Weight Status



Kong and Epstein. (2016). Preventive Medicine. 92: 100-105.

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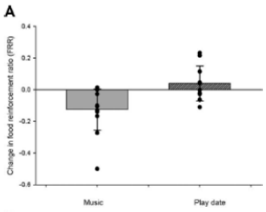
Increasing Relative Reinforcing Value of Alternatives in Infants



Kong, et al. (2016). Obesity (Silver Spring). 24: 917-923.

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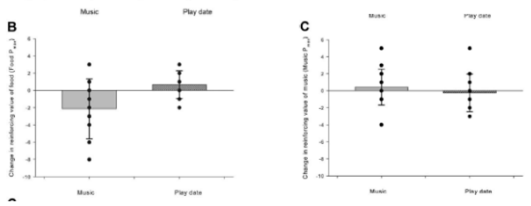
Increasing Relative Reinforcing Value of Alternatives in Infants



Change in Reinforcing value of Food

Change in Reinforcing Value of Music

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Substitutes

- Reinforcers that can be consumed in place of one another depending on the access/price

- Increasing the price (access) to the preferred reinforcer will result in increases in consumption of the less preferred reinforcer

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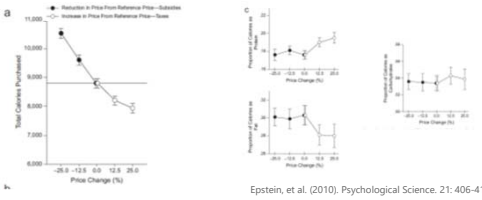
Substitution
Taxes & Subsidies

- Experimental Online Grocery Store
- Taxes on variety of high energy dense, low nutrient dense foods
- Subsidies on variety of low energy dense, high nutrient dense foods



Epstein, et al. (2010). Psychological Science. 21: 406-414. 53

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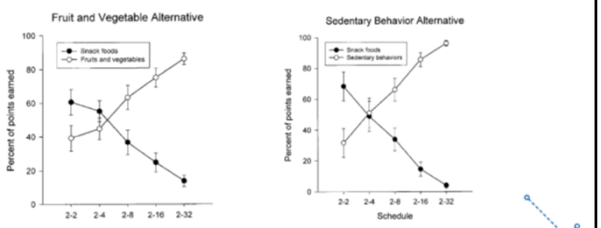
Substitution in the Laboratory
Health foods and Sedentary Behaviors



Goldfield and Epstein. (2002). Health Psychology. 21: 299-303. 54

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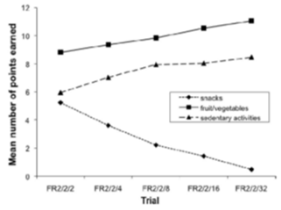
Substitution in the Laboratory
More than one alternative



Giesen, et al. (2010). Health Psychology. 29: 222-226. 55

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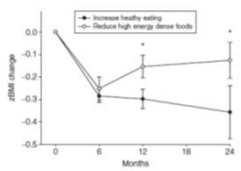
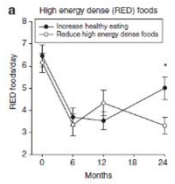
Substitution
Increasing Healthy foods versus Decreasing Energy Dense foods





Epstein, et al. (2008). Obesity (Silver Spring). 16: 318-326. 56

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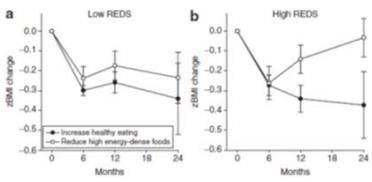
Substitution
Increasing Healthy foods versus Decreasing Energy Dense foods



Epstein, et al. (2008). Obesity (Silver Spring). 16: 318-326. 57

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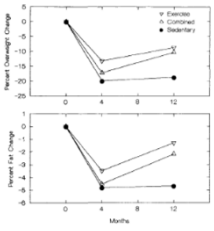
Substitution
Sedentary and Physical Activities

- Weight loss treatment +
  - Increase exercise
  - Decrease sedentary activities (e.g. Television/screens)
  - Both



Epstein, et al. (1995). Health Psychology. 14: 109-115.

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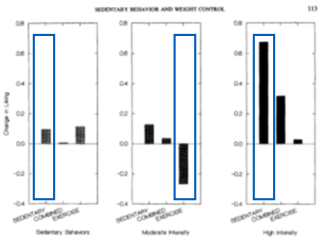
Substitution
Sedentary and Physical Activities

- Changes in liking of sedentary, moderate intensity physical activities and high intensity physical activities



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Complements

- Reinforcers that are generally consumed together

- Decreasing access to one reinforcer will decrease consumption of both

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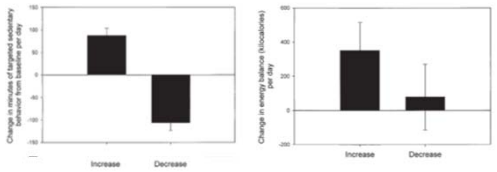
Complements to Eating
Television



- Increases versus Decreases in complements are not always symmetrical

Epstein, et al. (2002). Journal of Pediatrics. 140: 334-339. 61

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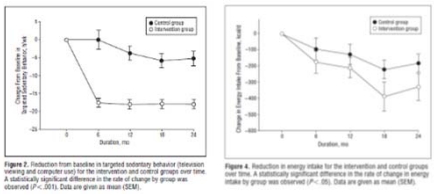
Complements to Eating
Changes in Sedentary Activities

- Intervention group: decreased television/screen time by 50% in 10% increments
- Control: Free access to screens
- No weight loss treatment provided



Epstein, et al. (2008). Archives of Pediatric and Adolescent Medicine. 162: 239-245. 62

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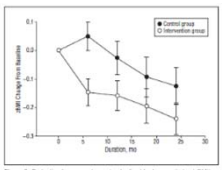
Complements to Eating
Changes in Sedentary Activities



Epstein, et al. (2008). Archives of Pediatric and Adolescent Medicine. 162: 239-245. 63

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How does environment play a role?

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Cognitively Enriched Environment

- Access to cognitively stimulating activities
  - Parents support Child's Hobbies
  - Visits to Museums, Zoos, Aquariums
  - Visits to the public Library
  - For younger kids – availability of cognitively stimulating toys (blocks, etc., not screens)

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Cognitive Enriched Home Environment 6-year Data

TABLE 3. Six-Year Cumulative Incidence and Risk of Childhood Obesity According to Demographic and Socioeconomic Factors

	Cumulative Incidence (%)†	Risk 95% CI	Adjusted Risk‡ 95% CI
Maternal education			
College or professional	6.6	1.0	
High school only	8.1	1.24 (.92–1.68)	.97 (.63–1.51)
Less than high school	9.4*	1.47 (1.04–2.08)*	.96 (.67–1.37)
HOME score (cognitive)			
High (>85th percentile)	3.7	1.0	
Middle (15th percentile < score ≤ 85th percentile)	8.3	2.32 (1.39–3.88)**	2.67 (1.43–4.97)**
Low (≤15th percentile)	9.3	2.64 (1.48–4.70)***	2.28 (1.10–4.72)*
HOME score (emotional)			
High (>85th percentile)	7.4	1.00	
Middle (15th percentile < score ≤ 85th percentile)	7.7	1.05 (.72–1.54)	.90 (.59–1.37)
Low (≤15th percentile)	7.3	.98 (.59–1.59)	.65 (.36–1.15)

Strauss and Knight. (1999). Pediatrics. 103: e85.

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Cognitive Enriched Home Environment 10 year data

Home environment factors	Appealing physical environment	Growth fostering materials	Developmentally stimulating experiences	Provision for active stimulation	Total physical environment*
	β ± SE	β ± SE	β ± SE	β ± SE	β ± SE
21-year BMI (intercept)	−0.29*** ±0.11	−0.21† ± 0.11	−0.20* ± 0.09	−0.29*** ±0.12	−0.16 ± 0.13
Change in BMI (slope)	−0.19*** ±0.07	−0.19*** ±0.07	−0.12* ± 0.05	−0.07 ± 0.07	−0.19** ± 0.08
Rate of BMI change (quadratic)	−0.03 ± 0.02	−0.03 ± 0.02	−0.01 ± 0.01	−0.01 ± 0.02	−0.04 ± 0.02

East, et al. (2019). Childhood Obesity. 15: 1-11.

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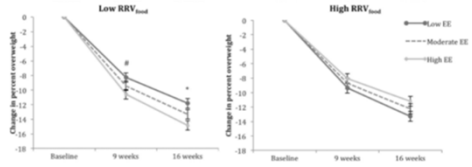
Cognitive Enriched Environment, Reinforcing Value and Weight loss



- Cognitive enriched environment improved treatment outcomes for children with low reinforcing value of food, but had no effect on high reinforcing value of food

Best, et al. (2012). Journal of Consulting and Clinical Psychology. 80: 1086-1096.

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Summary

- Reinforcing value of food and activities are related to behavior
- Hunger increases reinforcing value of food
- Choice is important for developing reinforcers
- Access & Availability of foods and alternatives
- Substitutes to food can be increased
  - Food and non-food alternatives
- Complements to food can be decreased to limit energy intake
  - Television and screens
  - Unclear how mobile devices play a role
- Cognitively enriched home environment should be considered

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- Undergraduates: Aneesah Baksheh, Whitney Spencer, Kaylie Schemm
- Graduate students: Sara O'Donnell, Kelseanna Hollis-Hansen

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  Dialectical behavior therapy and behavioral weight loss for emotional eating and obesity
- **11/11/20 Lauren R. Sastre, PhD, RD, LDN**
  Sharing the "weight" of obesity management in primary care: Integration of RDs/RDNs
- **12/2/20 Michelle Long, M.D.**
  Nonalcoholic Fatty Liver Disease and Obesity Treatment

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A study of the COVID-19 workforce

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Questions?

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