Published in final edited form as:

Eat Behav. 2008 August ; 9(3): 319–327. doi:10.1016/j.eatbeh.2007.10.007.

Food reinforcement and impulsivity in overweight children and their parents[☆]

Leonard H. Epstein^{*}, Kelly K. Dearing, Jennifer L. Temple, and Meghan D. Cavanaugh

University at Buffalo School of Medicine and Biomedical Sciences, United States

Abstract

Pediatric obesity involves choices among healthy and less healthy alternatives, as well as choices whose consequences vary over time, such as engaging in unhealthy behaviors now at the expense of future health. The purpose of this study was to examine the relative reinforcing value of food and behavioral impulsivity under different experimental conditions in a sample of 50 families screened for participation in a pediatric obesity treatment program. Relative reinforcing value for food versus money was studied under conditions in which increased response requirements were placed on either access to food or money, and the amount of money, the alternative reinforcer, was varied. Impulsivity for small immediate versus larger delayed monetary rewards was studied under conditions in which the value of the immediate reward and the duration of the delay were varied. Results showed that response requirements affected the choice of food for both parents and children ($p < 0.001$), and there was a significant correlation between the number of food reinforcers chosen by parents and children ($r = 0.57$, $p < 0.001$). The value of the immediate reward differentially influenced choice of the immediate reward for parents and children ($p < 0.05$), with children ($p < 0.001$) but not parents ($p = 0.36$) more impulsive as value of the immediate reward increased. The length of the delay influenced both parent ($p = 0.004$) and child ($p < 0.01$) choice of the immediate reward. Parent and child impulsivity were not correlated ($r = 0.15$, $p = 0.29$). This study suggests that food reinforcement may be more similar between parents and children than behavioral impulsivity, though additional research using other measures of relative reinforcing value and impulsivity is warranted.

Keywords

Food reinforcement; Impulsivity; Overweight; Children

The development of obesity can be related, in part, to a series of choices that influence body weight. One set of choices are among concurrent alternative behaviors, do I eat or not eat, and if I eat, what foods and how much do I eat. The other set of choices involves the choice between immediate versus delayed consequences. Is it more important to eat very palatable

[☆]Appreciation is expressed to April M. Giacomelli and Dana D. Winiewicz, who helped implement the studies. Research for this article was funded in part by a grant from Foundation for Healthy Living, Latham, NY and grant HD39792 from the National Institute of Child Health, NIH, awarded to Dr. Leonard H. Epstein.

^{*}Corresponding author. Department of Pediatrics, School of Medicine and Biomedical Sciences, State University of New York at Buffalo, Farber Hall, Room G56, 3435 Main Street, Building #26, Buffalo, New York 14214-3000, United States. Fax: +1 829 3993. LHENET@acsu.buffalo.edu (L.H. Epstein).

high-energy dense food now, or eat less palatable, low energy dense food but perhaps be healthier in the long-term? In behavioral choice theory these two types of choices represent paradigms to study relative reinforcing value and impulsivity, respectively (Bickel, Madden, & Petry, 1998).

The relative reinforcing value of food, or reinforcing efficacy of food, is defined by how hard an individual is willing to work to gain access to food when given access to other alternatives (Epstein, Leddy, Temple, & Faith, 2007). Behavioral economic theory suggests that choice of a commodity is influenced by response requirements to gain access to the commodity, the availability of alternative commodities, as well as the relative value of the commodity (Bickel et al., 1998). Research has shown that obese individuals find food more reinforcing than their lean counterparts (Epstein et al., 2007; Johnson, 1974; Saelens & Epstein, 1996).

A second type of choice involves choice of small immediate rewards over larger delayed rewards, such as eating highly palatable foods now in favor of lower body weight or better health later. When people are provided with a choice between a small, immediate reward and a larger, delayed reward they reliably discount the value of delayed rewards, especially when the delay time is large or the difference between the value of the rewards is small (Bickel & Marsch, 2001). The degree to which individuals choose small immediate over larger delayed rewards has been suggested to be an index of impulsivity, with greater choice of immediate rewards indicating greater impulsivity (Dougherty, Mathias, Marsh, & Jagar, 2005). Impulsivity has been studied extensively in drug-dependent populations, with drug-dependent individuals more impulsive than non-dependent individuals (Bickel, Odum, & Madden, 1999; Coffey, Gudleski, Saladin, & Brady, 2003; Madden, Petry, Badger, & Bickel, 1997; Petry, 2001). Since maintaining a healthy weight is a delayed consequence of healthy eating, an overweight person may be expected to choose the immediate gratification of eating rather than achieving a healthy weight in the future. Delay of gratification studies has shown that overweight children chose the smaller immediate reward more often than the larger delayed reward when the reward was edible (Bonato & Boland, 1983; Johnson, Parry, & Drabman, 1978; Sobhany & Rogers, 1985).

Obesity shows similarity across generations (Garn & Clark, 1976), and parental overweight status is a reliable predictor of child overweight status (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Identifying factors that are related to obesity and are shared or common to parents and children may provide insight into the etiology of obesity, as well as factors that could be modified to simultaneously influence both parent and child weight in family-based behavioral obesity treatment programs. Research on behavioral genetics of behavioral economic variables is limited (Faith, Rose, Matz, Pietrobelli, & Epstein, 2006), and to our knowledge there have been no studies to assess parent-child relationships in relative reinforcing value of food or impulsivity. This experiment was designed to examine the relationship between parent and children responding in the context of choice experiments using relative reinforcing value and impulsivity paradigms. Evaluation of parent-child relationships in the context of experimental manipulations to evaluate factors that influence reinforcing value or impulsivity provides for the opportunity to assess whether parents and

their children are influenced in similar ways by the experimental manipulations, as well as to assess the correlation between parent and child values.

1. Materials and methods

1.1. Participants

Participants were 8 to 12 year-old overweight children and their parents from 50 families recruited for participation in a pediatric family-based behavioral weight control program at the University at Buffalo. The children in the study sample were: 20% Black, 70% Caucasian and 10% were of other races or more than one race. All of the children were overweight or at risk for overweight, defined as a Body Mass Index (BMI) percentile greater than or equal to 85% (Kuczmarski et al., 2002), while 68% of the parents were obese as defined by a BMI>30 (NHLBI Obesity Education Initiative Expert Panel, 1998) (Table 1).

1.2. Design and procedure

1.2.1. Relative reinforcing value task—Parents and children completed a validated multiple choice questionnaire to assess the reinforcing value of food (Goldfield, Epstein, Davidson, & Saad, 2005). There is criterion validity for the reinforcing value questionnaire, as the measure was related to responding on a standard laboratory task, and the measure was responsive to conditions that influence reinforcing value, such as food deprivation (Goldfield et al., 2005). The questionnaire asked participants to make a choice between two alternatives that differed in terms of the number of responses they were willing to make on a handcounter to receive either money or food. For the first trial, the number of button presses to earn access to food and money was the same ($n=20$). Depending on condition, the behavioral cost to obtain the food or the monetary reinforcer increased by 20 responses (button presses) on each trial through 320 (20, 40, 60, etc), while the amount of work required to gain access to the other reinforcer was held constant at 20 responses. The task ended after two consecutive switches to the reinforcer whose cost was held constant. To encourage valid responding at the end of the task participants picked a number out of a hat with each number representing a different choice trial, and then met the response requirements for the reinforcer they had chosen. The number of food reinforcers chosen was the dependent measure.

Families were randomly assigned to one of four conditions that varied the value of the monetary reinforcer and the work requirements for the two reinforcers. For two of the groups the value for the monetary reinforcer was set at \$1.00 for parents and \$0.50 for children and for the other two groups the value of the monetary reinforcer was set at \$0.50 for parents and \$0.25 for children. In addition, for two of the groups the amount of work required to obtain access to the snack food alternatives increased and for the other two groups the amount of work required to obtain access to the monetary alternative increased.

Participants picked two portions of snack food as reinforcers to work for. Child foods were one 1 oz bag of potato chips, 10 grapes, one 4 oz container of fruit flavored fat free yogurt, one 35 g bag of chocolate chip cookies, one 1 oz bag of tortilla chips, one 4 oz container of applesauce, one 1 oz pouch of fruit flavored gummy snacks and 15 baby carrots. Parental foods were two 1 oz bags of potato chips, one 6 oz container of fruit flavored low-fat yogurt,

two 35 g bags of chocolate chip cookies, two 1 oz bags of tortilla chips, one medium sized apple, 20 grapes, 30 baby carrots, and two 1 oz bags of cheddar cheese flavored popcorn.

1.2.2. Behavioral impulsivity task—The computer based impulsivity task assesses choice of immediate versus delayed rewards (Dougherty et al., 2005). Research has shown both criterion and concurrent validity for the impulsivity task (Dougherty et al., 2003, 2005). Participants make a series of choices for different delay-reward alternatives, with small, immediate rewards and larger, delayed rewards associated with different shapes. Participants used a computer mouse to click on the shape with the desired reward and were provided 1¢ for every point earned on the task. Participants were randomly assigned to one of four groups that varied the number of points associated with the immediate reward and the delay time for the delayed reward. For two of the groups the immediate reward was associated with two points after a two second delay and for the other two groups the immediate reward was associated with five points after a two second delay. In addition, for two of the groups individuals could earn ten points after a ten second delay and for the other two groups individuals could earn ten points after a twenty second delay.

Individuals were provided with a practice session to familiarize them with the task and the point values and delay times associated with each shape. The reinforcement task was always completed first.

1.3. Measurement

1.3.1. Height and weight—Participant's weight was assessed using a digital scale (TANITA Corporation of America Inc., Arlington Heights, Illinois). Height was assessed using a digital stadiometer (Measurement Concepts & Quick Medical, North Bend, WA). On the basis of the height and weight data, BMI (kg/m^2) was calculated.

1.3.2. Demographics—The Hollingshead (Hollingshead, 1975) Demographics questionnaire was used to assess socioeconomic status, based on education level and occupation of both parents. Race and ethnicity information was also obtained for the participating parent and child.

1.3.3. Dietary awareness—Dietary awareness was measured using an adaptation of the dietary restraint scale of the Dutch Eating Behavior Questionnaire (Hill & Pallin, 1998; van Strien, Fritjers, Bergers, & Defares, 1986). Examples of questions included on the restraint scale are “I have tried to lose weight”; “I try not to eat between meals because I want to be thinner”. For each question the response choices are Never (scoring 0), Sometimes (scoring 1) and Very Often (scoring 2). A restraint score is generated from the first six questions of the questionnaire and ranges in value from 0 to 12.

1.4. Analytic plan

One way analysis of variance (ANOVA) and Chi-Square tests were used to assess differences between groups. Differences in the reinforcing value of food were measured with a three-way ANCOVA with parent/child, the value of the monetary reinforcer (high, low) and reinforcer condition (food, money) as the between-subjects variables and square

root of the number of food reinforcers chosen as the dependent variable. Behavioral impulsivity was assessed using a three-way ANCOVA with parent/child, value of immediate reward (2 pts, 5 pts) and delay time for the delayed reward (10 s, 20 s) as the between-subjects variables and square root of the number of immediate points earned as the dependent variable. Gender was used as a covariate for both analyses to control for more males in the child (40%) than in the parent (22%) sample ($p=0.05$). Square root transformations were used to reduce skewness in the distributions of both dependent variables prior to analysis. Graphs are presented using the untransformed data to facilitate interpretation. Pearson product-moment correlations assessed similarities between parents and children. All analyses were conducted using SYSTAT (Systat Software, 2004).

2. Results

2.1. Relative reinforcing value

The number of food reinforcers chosen was influenced by which of the alternatives increased in cost ($F(1, 91)=129.53, p<0.001$), but not the amount of the reinforcer ($F(1, 91)=0.29, p=0.60$). Breakdown by parents and children showed that the number of food reinforcers was influenced by which alternative increased cost for both children ($p<0.001$) and parents ($p<0.001$). As shown in Fig. 1, when the behavioral cost of responding for food increased (left graphs), but the behavioral cost of responding for money stayed the same, children and their parents made fewer choices for food as the cost of obtaining food increased. When the behavioral cost of responding for money increased (right graphs), but the behavioral cost for food stayed the same, children and their parents allocated more choices for food as the cost of obtaining money increased. These are examples of own-price or demand elasticity. Choice for food was not related to the value of the monetary alternative to food for either children ($p=0.24$) or their parents ($p=0.90$), and there was no interaction between the behavioral cost of food or money and the value of the alternative to food ($p=0.37$) or the interaction of parent/child by behavioral cost of food or money and the value of the alternative to food ($p=0.55$). There was a significant correlation between the number of food reinforcers chosen by parents and children ($r=0.57, p<0.001$).

2.2. Behavioral impulsivity task

As shown in Fig. 2, analysis showed an interaction of parent/child with the value of the immediate reward ($F(1,91)=3.98, p<0.05$), as the value of the immediate reward was related to choice of the immediate reward for children ($p<0.001$) but not adults ($p=0.36$). Main effects of the value of the immediate reward ($F(1,91)=12.74, p<0.001$) and the length of the delay for the delayed reward ($F(1,91)=17.03, p<0.001$) were also observed. Breakdown of the results by child and parent showed more impulsivity for both children ($p<0.01$) and their parents ($p=0.004$) when the delay for reward was longer. The choice of immediate rewards for parents and children across all conditions is shown in Fig. 3. There was no significant interaction between the value of the immediate reward and the length of the delay time of the delayed reward on the number of points ($p=0.62$) or the interaction of parent/child values by value of immediate reward by the delay to the delayed reward ($p=0.68$). There was not a significant correlation between the number of immediate choices made by parents and children ($r=0.15, p=0.29$).

3. Discussion

These results demonstrate that the reinforcing value of food is responsive to similar variables in parents and children, and that the reinforcing value of food is related in parents and children. Impulsivity, as measured by responses for small immediate versus larger delayed rewards was differentially influenced by the value of the immediate reward, with children more impulsive than parents. Both parents and children were more impulsive when the delay to the delayed reward was increased, impulsivity was not correlated between parents and children.

Studying parent and child relationships provides the opportunity to determine whether common genetic or familial factors influence both generations within a family. These relationships may be important to understand the etiology of obesity, as well as treatment, since a common intervention that targets these factors could modify these behaviors in parents and children. Reinforcing value for food is a dynamic measure of food choice which is operationalized by how hard someone will allocate their response efforts to gain access to food (Epstein et al., 2007). The number of choices for food reinforcers was significantly affected by the behavioral cost of the reinforcer. When the behavioral cost to obtain food increased, both parents and children shifted choice toward the alternative. Likewise, as the behavioral cost to obtain the alternative increased both parents and children shifted choice toward food.

However, the amount of the alternative did not influence responding. This may be due in part to the choice being limited to food versus money. While money is a powerful conditioned reinforcer, people do not have the choice of eating versus getting money. It is possible that providing alternative reinforcers may have shifted choice away from food in the condition in which the reinforcing value of the alternatives were manipulated. However, food is a very powerful reinforcer, and it may be challenging to find alternatives to food, particularly for obese persons (Epstein, Roemmich, Stein, Paluch, & Kilanowski, 2005). Obese persons find food more reinforcing than leaner peers (Johnson, 1974; Saelens & Epstein, 1996; Temple, Legerski, Giacomelli, & Epstein, submitted for publication). Future studies should examine whether the relative reinforcing value of food can be altered over time in an overweight and obese pediatric population. Previous research has shown a relationship between parent and child weight loss in family-based obesity treatment programs (Wrotniak, Epstein, Paluch, & Roemmich, 2004, 2005). Given that behavioral cost of food was a determinant of both parent and child motivation to eat, altering the behavioral cost of highly palatable high-energy dense foods may have an impact on reducing consumption in both parents and children.

The failure to find relationships between parent and child impulsive responding may be due to a true lack of correspondence in impulsivity between parents and children, or due to other factors. For example, there are strong developmental trends in impulsivity, with children more impulsive than adults (Green, Fry, & Myerson, 1994). These developmental differences may also extend to differences in factors that influence parents and their children. This has not been explored. It is also possible that the measurement of choice of small immediate rewards over larger delayed rewards was not sufficiently sensitive. While

both the amount of the immediate reward and duration of the delay were varied, they were varied only with two values, which may limit the extent to which discounting of future rewards can be assessed. As noted by other investigators, the use of fixed choices does not provide any insight into how children or their parents make decisions about choice when reward magnitude and delay duration are systematically varied (Scheres et al., 2006). Future studies should use more detailed methods to assess impulsivity, particularly to estimate individual differences in delay discounting over a wide range of reward magnitudes and delay durations. The fixed order of studying reinforcing value before impulsivity may have influenced outcome, and future studies should either separate the tasks in different sessions, or counterbalance the order of task presentation.

Behavioral impulsivity is a multifaceted construct with different approaches to assess impulsivity (Dougherty et al., 2005). In addition to the study of choosing small immediate versus larger delayed rewards, impulsivity may involve preservation of responding after extinction or punishment for responding, as well as the failure to inhibit responding (Logan, 1994; Logan, Schachar, & Tannock, 1997). For example, Nederkorn and colleagues showed that obese children had lower levels of behavioral inhibition as assessed by the stop task and were more sensitive to reward as assessed by a response preservation measure than leaner children (Nederkorn, Braet, Van Eijs, Tanghe, & Jansen, 2006), and that impulsivity, as assessed by the stop task was a predictor of weight loss in a treatment program (Nederkorn, Jansen, Mulken, & Jansen, 2007). Other measures of impulsivity may show more similarity in responding between parents and children than the choice of immediate versus delayed rewards.

Obesity requires a series of choices about when to eat, how much to eat, and what to eat, and each of these choices is made in the context of alternatives to eating, as well as in the context of short-term versus long-term benefits. Rather than considering these two aspects of choice to be separate constructs, it may be worthwhile to develop paradigms that simultaneously tap into factors that influence both types of choice. For example, the traditional choice paradigm for studying relative reinforcing value provides the choice of two alternatives that vary in their value and accessibility. The typical discounting paradigm involves a series of choices about small immediate rewards versus larger delayed rewards, with the same rewards being compared at different values and at different durations. The delay discounting paradigm is valuable for understanding decisions about receiving a small reward now or a larger amount of the same reward later, but many obesity decisions are not whether you want to eat a small amount of food now or more food later, or exercise a small amount now or a larger amount later. Rather, the choice should be whether people would prefer to eat really palatable food now or not consume the food and be less healthy or healthier later, or be sedentary or active now, and be heavier or leaner later. For many health behaviors that choice may be among several alternatives, rather than smaller or larger amounts of the same alternative. One goal for future research may be to better integrate the strengths of these two paradigms to provide a better understanding of the choice processes that influence the development and maintenance of obesity, as well as methods to change these choice processes.

References

- Bickel WK, Madden GJ, Petry NM. The price of change: The behavioral economics of drug dependence. *Behavior Therapy*. 1998; 29:545–565.
- Bickel WK, Marsch LA. Toward a behavioral economic understanding of drug dependence: Delay discounting processes. *Addiction*. 2001; 96:73–86. [PubMed: 11177521]
- Bickel WK, Odum AL, Madden GJ. Impulsivity and cigarette smoking: delay discounting in current, never, and ex-smokers. *Psychopharmacology*. 1999; 146:447–454. [PubMed: 10550495]
- Bonato DP, Boland FJ. Delay of gratification in obese children. *Addictive Behaviors*. 1983; 8:71–74. [PubMed: 6880927]
- Coffey SF, Gudleski GD, Saladin ME, Brady KT. Impulsivity and rapid discounting of delayed hypothetical rewards in cocaine-dependent individuals. *Experimental and Clinical Psychopharmacology*. 2003; 11:18–25. [PubMed: 12622340]
- Dougherty DM, Bjork JM, Harper RA, Marsh DM, Moeller FG, Mathias CW, et al. Behavioral impulsivity paradigms: A comparison in hospitalized adolescents with disruptive behavior disorders. *Journal of Child Psychology and Psychiatry*. 2003; 44:1145–1157. [PubMed: 14626456]
- Dougherty DM, Mathias CW, Marsh DM, Jagar AA. Laboratory behavioral measures of impulsivity. *Behavior Research Methods*. 2005; 37:82–90. [PubMed: 16097347]
- Epstein LH, Leddy JJ, Temple J, Faith M. Food reinforcement: A multilevel analysis. *Psychological Bulletin*. 2007; 133:884–906. [PubMed: 17723034]
- Epstein LH, Roemmich JN, Stein RI, Paluch RA, Kilanowski CK. The challenge of identifying behavioral alternatives to food: Clinic and field studies. *Annals of Behavioral Medicine*. 2005; 30:201–209. [PubMed: 16336071]
- Epstein LH, Temple JL, Neaderhiser BJ, Salis RJ, Erbe RW, Leddy JJ. Food reinforcement, the dopamine D2 receptor genotype and energy intake in obese and non-obese humans. *Behavioral Neuroscience*. 2007; 121:877–886. [PubMed: 17907820]
- Faith MS, Rose E, Matz PE, Pietrobelli A, Epstein LH. Co-twin control designs for testing behavioral economic theories of child nutrition: Methodological note. *International Journal of Obesity*. 2006; 30:1501–1505. [PubMed: 16801929]
- Garn SM, Clark DC. Trends in fatness and the origins of obesity. *Pediatrics*. 1976; 57:443–456. [PubMed: 1264536]
- Goldfield GS, Epstein LH, Davidson M, Saad F. Validation of a questionnaire measure of the relative reinforcing value of food. *Eating Behaviors*. 2005; 6:283–292. [PubMed: 15854874]
- Green L, Fry AF, Myerson J. Discounting of delayed rewards: A life-span comparison. *Psychological Science*. 1994; 5:33–36.
- Hill AJ, Pallin V. Dieting awareness and low self-worth: Related issues in 8-year-old girls. *International Journal of Eating Disorders*. 1998; 24:405–413. [PubMed: 9813765]
- Hollingshead, AB. Four factor index of social status. New Haven, Conn: Yale University; 1975.
- Johnson WG. Effect of cue prominence and subject weight on human food-directed performance. *Journal of Personality and Social Psychology*. 1974; 29:843–848. [PubMed: 4836365]
- Johnson WG, Parry W, Drabman RS. The performance of obese and normal size children on a delay of gratification task. *Addictive Behaviors*. 1978; 3:205–208. [PubMed: 735906]
- Kuczmariski, RJ.; Ogden, CL.; Guo, SS.; Grummer-Strawn, LM.; Flegal, KM.; Mei, Z., et al. *Vital Health Statistics Series*. Vol. 11. Vol. 246. Hyattsville, MD: National Center for Health Statistics; 2002. CDC growth charts for the United States: Methods and development; p. 1-90.
- Logan, GD. On the ability to inhibit thought and action: A users' guide to the Stop Signal Paradigm. In: Dagenbach, D.; Carr, TH., editors. *Inhibitory processes in attention, memory, and language*. San Diego: Academic Press, Inc; 1994. p. 189-236.
- Logan GD, Schachar RJ, Tannock R. Impulsivity and inhibitory control. *Psychological Science*. 1997; 8:60–64.
- Madden GJ, Petry NM, Badger GJ, Bickel WK. Impulsive and self-control choices in opioid-dependent patients and non- drug-using control participants: Drug and monetary rewards. *Experimental and Clinical Psychopharmacology*. 1997; 5:256–262. [PubMed: 9260073]

- Nederkoorn C, Braet C, Van Eijls Y, Tanghe A, Jansen A. Why obese children cannot resist food: The role of impulsivity. *Eating Behaviors*. 2006; 7:315–322. [PubMed: 17056407]
- Nederkoorn C, Jansen E, Mulken S, Jansen A. Impulsivity predicts treatment outcome in obese children. *Behavior Research and Therapy*. 2007; 45:1071–1075.
- NHLBI Obesity Education Initiative Expert Panel. Clinical Guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—The evidence report. *Obesity Research*. 1998; 6(2):51S–209S. [PubMed: 9813653]
- Petry NM. Delay discounting of money and alcohol in actively using alcoholics, currently abstinent alcoholics, and controls. *Psychopharmacology (Berl)*. 2001; 154:243–250. [PubMed: 11351931]
- Saelens BE, Epstein LH. The reinforcing value of food in obese and non-obese women. *Appetite*. 1996; 27:41–50. [PubMed: 8879418]
- Scheres A, Dijkstra M, Ainslie E, Balkan J, Reynolds B, Sonuga-Barke E, et al. Temporal and probabilistic discounting of rewards in children and adolescents: Effects of age and ADHD symptoms. *Neuropsychologia*. 2006; 44:2092–2103. [PubMed: 16303152]
- Sobhany MS, Rogers CS. External responsiveness to food and non-food cues among obese and non-obese children. *International Journal of Obesity*. 1985; 9:99–106. [PubMed: 4030200]
- Systat Software. Systat 11.0. Richmond, CA: SYSTAT Software, Inc; 2004.
- Temple JL, Legerski C, Giacomelli AM, Epstein LH. Food is more reinforcing for overweight than lean children. Manuscript. submitted for publication.
- van Strien T, Fritjers JER, Bergers GPA, Defares PB. The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders*. 1986; 5:295–315.
- Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *New England Journal of Medicine*. 1997; 337:869–873. [PubMed: 9302300]
- Wrotniak BH, Epstein LH, Paluch RA, Roemmich JN. Parent weight change as a predictor of child weight change in family-based behavioral obesity treatment. *Archives of Pediatric and Adolescent Medicine*. 2004; 158:342–347.
- Wrotniak BH, Epstein LH, Paluch RA, Roemmich JN. The relationship between parent and child self-reported adherence and weight loss. *Obesity Research*. 2005; 13:1089–1096. [PubMed: 15976152]

Fig. 1.

Percentage of choices for the food versus monetary alternative for children (top graphs) versus adults (bottom graphs). The conditions in which the schedules increase for the food alternative are on the left, while the conditions in which the schedules for the monetary alternative increase are on the right. Analysis of covariance showed that increasing the behavioral cost for food or money influenced responding for both children ($p < 0.001$) and their parents ($p < 0.001$), while there were no effects of increasing the value of the monetary alternative.

Fig. 2.

The interaction of choice for the immediate reward for children and their parents based on value of the immediate reward (Mean+SEM). The child ($p<0.001$) but not parent ($p=0.36$) choice of the immediate reward was influenced by the value of the immediate reward.

Fig. 3.

Group differences on the impulsivity task based on delay time and value of the immediate reward (Mean+SEM). The child choice of the immediate reward was influenced by both the value of the immediate reward ($p<0.001$) and the duration of the delay ($p<0.01$), while parents were only influenced by the duration of the delay ($p=0.004$).

Table 1

Demographics for children and parents

	Group 1			Group 2			Group 3			Group 4		
<i>Reinforcement task</i>												
Value for money		High		Low			High			Low		
Response requirements		Food		Food			Money			Money		
<i>Impulsivity task</i>												
Immediate reward (pts)	2		2		5						5	
Delay (s)	10		20		10						20	
Child N	13		11		13						13	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	P
<i>Child age</i>	10.87	1.15	10.46	1.01	10.20	0.97	10.45	0.98	NS			
Child zBMI	2.25	0.35	2.33	0.38	2.02	0.50	2.20	0.29	NS			
Parent age	42.35	6.89	42.04	6.16	43.91	8.29	42.62	3.95	NS			
Parent BMI	34.08	8.56	30.48	4.83	32.00	5.96	31.71	8.53	NS			
Child restraint	7.31	2.02	7.73	1.49	7.62	2.90	6.69	2.69	NS			
	N	%	N	%	N	%	N	%		N	%	
<i>Child race</i>									NS			
African-American	3	23	2	18	2	15	3	23				
Caucasian	8	62	7	64	11	85	9	69				
Other	2	15	2	18	0	0	1	8				
Parent income									NS			
Under \$29,999	3	23	1	10	3	23	4	31				
\$30,000-\$69,999	5	38	5	50	5	38	6	46				
\$70,000	5	38	4	40	5	38	3	23				
<i>Parent education</i>									NS			
HS/vocational	7	54	5	45	3	23	5	38				
College or greater	6	46	6	55	10	77	8	62				