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Relating Behavioral Elements of Household Food Negotiation to Childhood Overweight and Obesity¹

March 13, 2012

By

Mariah D. Ehmke, PhD (Contact)
Assistant Professor
Agricultural and Applied Economics
University of Wyoming
1000 E. University Ave., Department 3354
Laramie, WY 82070
Phone: (307) 766-5373
Fax: (307) 755-5544
e-mail: mariahdte@yahoo.com

Christiane Schroeter, PhD
Assistant Professor
Department of Agribusiness
California Polytechnic University

Kari Morgan, PhD
Associate Professor
Department of Family and Consumer Science
University of Wyoming

Enette Larson-Meyer, PhD
Associate Professor
Department of Family and Consumer Science
University of Wyoming

Nicole Ballenger, PhD
Professor and Vice Provost
Department of Agricultural and Applied Economics
University of Wyoming

¹ We appreciate research support from the United States Department of Agriculture's National Research Initiative. We are also indebted to Lindsey Willis, Travis Warziniak, and Heidi Hendersen for their research assistance.

Abstract

Researchers working in the fields of family studies and psychology show mother-child relationship dynamics affect the occurrence of childhood overweight and obesity. Many of the significant behaviors they identify relate to negotiation and generosity norms in the household. The primary objective of this study is to test the value of altruistic and collective models of household behavior using the dictator and 'carrot-stick' laboratory experiments. We also test exploratory hypotheses relating mother's generosity and child's punitive behavior and mother-child weight and fitness outcomes using dictator and 'carrot-stick' games. The data were collected from 50 mother-child pairs in Laramie, Wyoming. The children were all eight to 10 years old. The mother's completed a survey to measure family attitudes and beliefs around food and fitness. All of the mothers and children completed a fitness assessment and blood draw to measure their cholesterol, triglyceride, and hemoglobin levels in addition to the economic experiments. The data do not support altruistic models of familial utility maximization as suggested by Becker's Rotten Kid Theorem. We do find children overwhelmingly influence mothers' allocations to maximize child, not household, welfare or utility. Results also indicate there is a positive relationship between mother generosity for child junk food the child's waist circumference. Children who demand punitive behavior in the 'carrot-stick' game were less fit and more likely to be overweight and obese. The results of this study offer insights into household allocation processes which effect both mother and child weight and health outcomes.

Relating Behavioral Elements of Household Food Negotiation to Childhood Overweight and Obesity

Introduction

Rates of childhood obesity are rising around the world, in part, due to increased calorie consumption from food and beverages ((CDC/NCHS), 2006; World Health Organization, 2009). Household allocation processes directly affect the types of food and beverages children consume. Parents often act as children's agents in the market place—either allocating previously purchased goods or giving children money to spend on specific goods. Yet, there is a dearth of data to explain the complex negotiation processes by which children obtain food and beverages. Precise data and information are required to understand intra-household allocation processes for effective policy design to curb the rapid growth in childhood overweight and obesity in the United States.

Becker (1991) theorized familial utility functions are inter-connected and the utility of one family member is a function of another family member. Becker shows both family members who are altruistic and those who are selfish may make similar household allocation decisions in the Rotten Kid Theorem. For example, a selfish mother may care for her child if it brings rewards to herself. Likewise, a selfish child may contribute to the overall household good if it brings rewards to him or her. In the case of a selfish mother, she may give her child more to spend on snacks and treats if it creates less relationship stress with her child and makes her feel better. Conversely, a child may demand less money from his or her mother for snacks and beverages if it

allows more money in the household budget for goods the child prefers. Peters et al. (2004) use a Voluntary Contribution Mechanism or public goods game experiment to test Rotten Kid Theorem predictions with families in the laboratory. They expect children to avoid free-riding and maximize family income in the experiment. Their findings do not support the Rotten Kid Theorem. Children did not invest in the public account to the degree necessary to maximize family income.

Browning, Chiaporri, and Lechene (2006) consider Becker's work in the development and delineation of collective household models. According to Browning et al., households may be represented by a utility function, U_h , but this function is the weighted sum of each individual member's utility functions. In a two person mother-child household, this may include two utility functions, U_M for the mother and U_c for the child. The weight applied to the individual functions is the Pareto weight $\mu(w)$. It is a function of the distributional factors w . The value of $\mu(w)$ ranges from zero to one. If it is zero, then the mother is the dictator and if it is one the child is the dictator. Past examples of distributional factors include time of first marriage and the sex-ratio in the geographic surroundings for husband-wife models. Often, such factors are simply (and incompetently) identified as structural errors in empirical models. The laboratory setting offers the opportunity to legitimately identify and measure these distributional factors. We expect mothers' household allocations to be influenced by the child's demand for punishments and rewards to the mother.

We build our basic hypotheses based on this work. We begin with Becker's assumption that one family members' utility is function of another family members' utility. In this case, the mother's utility function, U_M , may be represented by

$$U_M = U[Z_{iM}, \dots, Z_{nM}, \varphi(U_c)]$$

And the child's by

$$U_c = U[Z_{ic}, \dots, Z_{nc}, \varphi(U_M)]$$

Where U_c is the child's utility. Z_{ij} is the n^{th} commodity consumed by the mother when $j=M$ and child when $j=c$. The mother's utility is increasing in her child's utility. Likewise, the child's utility is increasing in their mother's utility. The mother will derive utility from her child's consumption only if the child derives utility from it and vice versa. We will consider the special case of altruism where

$$U_M = U(Z_{iM}, \dots, Z_{nM}) + \tau_M U_c(Z_{ic}, \dots, Z_{nc})$$

$$U_c = U(Z_{ic}, \dots, Z_{nc}) + \tau_c U_M(Z_{iM}, \dots, Z_{nM})$$

τ_M and τ_c are in the interval $[0,1)$. The household utility function in the general collective model is then

$$\begin{aligned} & \mu(w)U_M + (1 - \mu(w))U_c \\ &= (\mu(w) + (1 - \mu(w))\tau_c)U_M(Z_{iM}, \dots, Z_{nM}; d) \\ &+ (\mu(w)\tau_M + (1 - \mu(w)))U_c(Z_{ic}, \dots, Z_{nc}; d) \end{aligned}$$

where d are personal factors (Browning, et al., 2006). Using this framework, one sees correct identification and measurement of the Pareto function may allow for more accurate household models.

We use the dictator and 'carrot-stick' game experiments to measure mothers' generosity and children's demand for rewards and punishments to their mothers. These

experiments give us an opportunity to test our primary hypotheses that children will act in a way to maximize household wealth, demanding rewards for their mother in the ‘carrot-stick’ game. Our secondary hypothesis is that altruistic mothers will give more to their children when children demand punishment for their mother in the ‘carrot-stick’ game.

Our study also provides the opportunity to explore a number of exploratory hypotheses relating economic behavior to overweight and obesity in the household. Data from non-economic studies show parent-child negotiation behavior directly affect child overweight and obesity outcomes. In general, researchers have identified three parenting styles associated with various child weight outcomes. Two styles associated with children at-risk of overweight and obesity are authoritarian and permissive parenting styles. Authoritarian parents are overly restrictive of children’s food intake—encouraging food hoarding and bingeing. Children of permissive parents suffer from poor nutrition as they may eat food higher in fats and sugars without supervision. Authoritarian parenting styles tend to produce healthier children. Authoritarian parents are more likely to monitor what type of food enters the household, but allow their child to make independent food choices during regular meal and snack times (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Savage, Fisher, & Birch, 2007). Based on these intra-household negotiation-related results, we develop exploratory hypotheses relating mother-child negotiation behavior to mother-child health outcomes. We expect 1) restrictive or overly generous mothers will have less healthy children, 2) overweight and obese children will demand more punishment for their parents and 3) overweight and obese mothers will give more tokens for snack food to their child than healthy mothers.

Previous data collected by Ehmke et al. using a one-shot ‘carrot-stick’ reveals mother giving related more closely to the mothers’ own Body Mass Index (BMI) status than the child’s weight status (Ehmke, Morgan, Schroeter, Larson-Meyer, & Ballenger, Forthcoming). This experiment offers further exploration of this phenomenon over multiple periods of the ‘carrot-stick’ game.

The data from this study offer an opportunity to test the validity of the Rotten Kid Theorem and role of altruism in family resource allocation processes. The data also provide a bridge from economic behavior measurements to information about mother-child relationships and obesity in other literatures. Our evidence does not support the Rotten Kid Theorem—children did not maximize total household earnings in the ‘carrot-stick’ game. Mothers were more generous when their children demanded punishment. We do find laboratory measures of mother’s generosity and child’s demand for parental reward and punishment are related to household weight and fitness outcomes.

Methods

Data for this study were collected from November 2007 through June 2008. Children eight to 10 years of age and their mothers were recruited from local schools and the community via poster advertisement, flyers, community events, Email list serves, and referrals. A phone screening was used to determine interested mother-child pairs were in good general health, not taking medications with heart-rate and weight-related side effects, and to solicit informed consent. The human experiments were reviewed and approved by the Institutional Review Board for Human Research at the University of Wyoming.

Following study admission, the mother-child pairs completed a two and a half hour visit to the experimental economics and the nutrition and exercise laboratories to participate in a series of economic experiments, to complete a questionnaire on family attitudes and beliefs regarding food, eating and physical fitness, and to take a variety of tests to determine health and physical fitness.

Economic Experiments

We use adaptations of two common economic experiments referred to as the dictator and ‘carrot-stick’ games to test our hypotheses (Andreoni, Harbaugh, & Vesterlund, 2003; Camerer, 2003). In the dictator game, the mother (the dictator) was endowed with 25 tokens each worth \$0.05 (or \$1.25 total). She determined how many tokens she would give to the child (the recipient). In the dictator and ‘carrot-stick’ game she was required to give at least 20 percent of the endowment to the child. In the dictator game, the child could then use the tokens to purchase items from a “snack store” that we stocked with “junk” food similar to that found in a convenience store or vending machine (following experimental design presented by Harbaugh, Krause, & Steven G. Liday, 2003). The mother was told about the store ahead of her giving decision, but was not allowed to accompany her child to the store. From the beginning of the game, the mother and child knew that the child’s earnings would have to be spent at the snack store. The mother and child were in separate rooms and conducted their transactions through the experimenter. The mother received her earnings as a cash reimbursement for her final token earnings at the end of all experiments.

For the ‘carrot-stick’ experiment, the mother was again endowed with \$1.25 worth of tokens. The mother was required to pass a minimum of five tokens (20 percent

of the endowment) to the child. The child was asked to count the tokens and to decide if she or he liked the allocation. The child then had three options: 1) accept the allocation, 2) increase the mother's tokens, or 3) decrease mother's tokens. If the child wished to change the number of tokens retained by the parent, then the child paid the experimenter one token and the mother's tokens were increased or decreased by four. For example, if the child wanted to increase the mother's tokens then she or he paid the experimenter one token and the experimenter gave the mother four additional tokens from the experiment bank (not from the child's allocation). The parent received cash earnings at the end of the experiment session, while the child had the opportunity to spend his or her tokens at the so-called snack store. The 'carrot-stick' game was played over four rounds.

Family Eating and Health Questionnaire

The mother completed a questionnaire assessing the family's attitudes and beliefs regarding food, eating, and physical fitness. Content items were selected based on published study outcomes (Bakir, Rose, & Shoham, 2006; Blake & Bisogni, 2003; Campbell, Crawford, & Ball, 2006; Feldman, Eisenberg, Neumark-Sztainer, & Story, 2007; Neumark-Sztainer, Hannan, Story, Croll, & Perry, 2003) and included questions on family meals, family food and eating habits, food purchasing and shopping habits, perceptions of child and mother health, control of child eating, mother and child exercise and physical activity, and family food security. Family demographic information was also collected, including the number of household members, mother's marital status, mother's and household income, mother's education level, mother's and

child's ethnic identity, and mother's current and past participation in nutrition assistance and education programs.

Health and Fitness Assessment

The mother-child health and fitness assessment included measures of basic body measurements, blood pressure, and fasting lipids, and an estimate of aerobic fitness using the six-minute walking test (Enright & Sherrill, 1998; Li et al., 2007). Specifically, we measured each subject's body mass and height without shoes using standardized procedures; waist circumference was measured at the level of the navel, and blood pressure was measured following five-minutes of seated rest. The body mass index (BMI) was calculated to assess the healthfulness of the weight status of the mother and the child. We used the CDC BMI-for-age growth charts (for either girls or boys) and percentile ranking for the child (Centers for Disease Control and Prevention, 2007). The six minute walk test was performed on a small track (approximately 10 laps per mile), and we measured the distance covered during the six minute test (following Enright & Sherrill, 1998; Li, et al., 2007). We also measured the subject's heart rate response to the exercise and the rate of perceived exertion. Heart rate was measured continuously using a portable heart rate monitor (Polar S610i, Kempele, Finland) and perceived exertion was measured using the Borg Scale (Borg, 1982). Serum cholesterol, HLD, LDL and triglycerides were evaluated from the screening blood draw by an external laboratory using standardized procedures.

Results

The demographic characteristics and health and fitness data for the 50 mother-child pairs are shown in Table I. The pairs represent approximately seven percent of the qualifying local population in Laramie, Wyoming.

Factor analysis of mother and child health

Using the family questionnaire data, and health and fitness assessment data, exploratory factor analysis was used to develop factors describing the health status of our study subjects. Because our study included only 50 mother and child observations, no more than 10 variables could be loaded for each factor (e.g., parent's body mass index, child's body mass index, parent's distance covered during the walk test, etc.) (Hatcher, 1994). The factors were estimated using SAS (Version 9.3, SAS, Cary, NC). Two types of factors were calculated, and the estimations resulted in four factors based on the answers to the family questionnaire and two factors based on the clinical health and fitness assessments. The six factors and their interpretations are presented in Table II. For example, the factor named Health and Fitness increases in value with the mother's BMI score, the child's waist circumference and BMI percentile, and the less the distance walked by the mother during the 6-minute test.

Dictator and 'Carrot-Stick' Game Results

Our primary null hypothesis, that children will not maximize household health (i.e., give their mothers tokens in the 'carrot-stick' game), is supported by the data. The majority of children never demanded reward tokens for their mothers. Children

demanded an average of only 4.8 percent of a single period's endowment, total, as rewards for their mothers. Only eight children gave their mothers tokens in one or more rounds. The results offer even less support for the sub-game perfect equilibrium of the 'carrot-stick' game. Only six children never changed their mother's token endowment by not demanding rewards or punishments. Our secondary hypothesis, that mothers are more generous after their child demands punishment is supported by the data. When children demanded punishment for their mother in one round of the 'carrot-stick' game, it resulted in a more generous token transfer from their mother to them in the next round of the game. We tested this relationship through simple correlation coefficients and then estimated ordinary least squares (OLS) models to control for outside demographic and family practice influences. These models are presented in Table III. Round 3 was the only round in which previous round demand for punishment did not significantly influence mother generosity. In this round, the household wealth dominated within game play. In round 4, demographic factors are omitted due to multicollinearity with the child taking variable.

Now, we turn our attention to mother and child behavioral differences based on their health status. Mother and child giving behavior and child taking behavior are summarized in Table II. The results are separated by round of the game and the child's weight status where at-risk children are within or above the 85th BMI percentile and healthy children are below the 85th BMI percentile. The child's taking behavior is further summarized in Figure 1 and the mother's giving behavior is presented in Figure 2. Overall, mothers gave their children an average of 59 percent of the endowment or \$0.74 worth of tokens to use in the snack store in the dictator game. Mother's of healthy

children (i.e., children below the 85th BMI percentile) gave their children slightly more than average, 61 percent of the endowment, while mothers of at-risk children (i.e., children at or above the 85th BMI percentile) received 56 percent of the endowment on average.

Pearson correlation coefficients between mother and child game play and health outcomes are presented in Table IV. These are used to test possible relationships between mother-child economic behavior and health outcomes. We first test the hypothesis that only restrictive mothers or overly generous mothers will have less healthy children. We do not find significant differences in mother generosity based on child weight status as it is measured by BMI. We do find mother generosity was related to child waist rank. Children with higher waist ranks received more tokens from their mother in round three of the game.

Child weight status is correlated with economic behavior differences. Child taking behavior of children at-risk of overweight and obesity and healthy children diverged after the two rounds of play based on the child's weight status. This divergence is illustrated in Figure 2. Wilcoxon one-way test results show at-risk children began taking significantly more ($p= 0.08$) than healthy children beginning in the third round of play. At-risk children began taking an average of 70 percent of the endowment back from their mother, even though they were receiving similar levels of tokens to healthy children during previous rounds. They increased their higher taking rate through the last round of the game. Healthy and fit children (i.e., those who walked longer distances in the walking test) were more likely to give their mother's tokens in rounds 1 and 4 of the 'carrot-stick' game than other children. Healthy children were also less likely to give

their mother tokens in the first round of the ‘carrot-stick’ game. Looking beyond weight, children with high cholesterol took more from their mother in the last round of the ‘carrot-stick’ game than other children.

We did not find any differences in mother giving based on her weight status. We did, however, find additional correlations between mother-child health and other survey and health measures. These results are presented in Table V. Child waist rank and mother’s BMI were both strongly correlated with parental diet restrictions. The high level of correlation between the parental diet restrictions factor and the Healthy Child and Child’s Waist Rank variables points to possible endogeneity—mothers are more concerned about their child’s diet as children’s risk of overweight and obesity increases. Children took more in round three of the ‘carrot-stick’ game if their mother’s had a higher BMI. The mother’s HDL or “good” cholesterol level was positively correlated with higher child giving in round 2 and regular family meal time. The mothers’ HDL cholesterol is negatively correlated with her education and income levels. Finally, children who have high cholesterol were in households where the mother has less shopping decision power (i.e., the child has more say in household food purchases). These relationships warrant further analysis with consideration of the possible economic behavior relationships as well.

Conclusions

The data do not support the Rotten Child Theorem—children did not maximize household wealth. Neither did mothers nor children behavior according to the game theoretic predictions of the dictator and ‘carrot-stick’ games. We did find mothers were affected by children’s demands for mother punishment and gave children more tokens

after they demanded such punishment. Mother generosity was positively correlated with child waist rank, but not child BMI. Finally, children who were at-risk of overweight and obesity took more at strategic points of the 'carrot-stick' game.

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Table I. Summary of family demographic and health data

Variable	N	MIN	MAX	MEAN	STD
Parent BMI	50	20.22	48.26	28.75	6.57
Mother BMI < 26	50	0.00	1.00	0.44	0.50
Child BMI Percentile	50	6.60	99.00	70.83	23.84
Child BMI Percentile < 85th	50	0.00	1.00	0.62	0.49
Parent Cholesterol Ratio	49	1.86	5.86	3.25	0.92
Children with High Cholesterol ^a	50	0.00	1.00	0.24	0.43
Parent Distance	50	438.70	846.10	641.45	77.99
Child Distance	50	419.55	765.80	606.79	75.62
Hispanic	50	0.00	1.00	0.12	0.33
Income lower than 185% of poverty	50	0.00	1.00	0.62	0.49

^aThe ratio of total cholesterol to HDL cholesterol is greater than 3.5.

Table II. Factors developed from family questionnaire and physical health and fitness measurements

Factor Number	Factor Name	Interpretation
<i>Family Questionnaire Factors: Attitudes and beliefs regarding food, eating, and physical fitness</i>		
1.	No Family Meals	Families are often too busy to eat together. Family mealtime is not common.
2.	Parental Diet Restrictions	Mother tries to control and limit the child's dietary intake.
3.	Shopping	Mother has more control over household purchase decisions.
4.	Fruit and Vegetable	The child regularly eats fruits and vegetables.
5.	Exercise	Mother actively plays with child.
<i>Mother and Child Health and Fitness Factors</i>		
5.	Health and Fitness Factor	Higher score for high mother BMI, higher child waist circumference and BMI percentile, and less distance walked by the mother
6.	Cholesterol	Higher score for higher mother and child LDL cholesterol concentrations

Table III. Mother generosity as a function of child taking in previous rounds, family shopping behavior, and family demographic measures

Variable	Mother Giving Round 2	Mother Giving Round 3	Mother Giving Round 4
Intercept	0.4188*	0.6278***	0.5327***
Child Taking Round 1	0.1854 0.3661***	0.1915	0.0576
Child Taking Round 2	0.1310	0.1730 0.0971	
Child Taking Round 3			0.1488* 0.0791
Poor 185	-0.0161	-0.1748**	
Shopping Factor	0.0801 -0.0332	0.0822 -0.0481	
Mother's BMI	0.0450 0.0024	0.0464 0.0012	
Hispanic	0.0061 0.0775	0.0063 0.1276	
	0.1237	0.1262	
R-Square	0.1900	0.2000	0.0800
F-Statistic	2.0900*	2.1300*	4.2800**

*> 0.90 statistical significance, **>0.95 statistical significance, and

***>0.99 statistical significance

Table IV. ‘Carrot-Stick’ Game Summary by Round and Child Health Status

Game Round	Child Status	Variable	N	MIN	MAX	MEAN	STD
Round 1	At-Risk	Mother Giving	19	0.2	1	0.49	0.23
		Child Giving	19	0	0.32	0.04	0.09
		Child Taking	19	0	0.8	0.25	0.29
	Healthy	Mother Giving	31	0.2	1	0.59	0.27
		Child Giving	31	0	0.16	0.01	0.03
		Child Taking	31	0	1.12	0.27	0.32
Round 2	At-Risk	Mother Giving	19	0.2	1	0.57	0.23
		Child Giving	19	0	0.32	0.02	0.07
		Child Taking	19	0	1.6	0.43	0.43
	Healthy	Mother Giving	31	0.2	1	0.59	0.32
		Child Giving	31	0	0.16	0.01	0.04
		Child Taking	31	0	1.28	0.43	0.42
Round 3	At-Risk	Mother Giving	19	0.2	1	0.70	0.23
		Child Giving	19	0	0.32	0.02	0.07
		Child Taking	19	0	2.4	0.70	0.67
	Healthy	Mother Giving	31	0.2	1	0.61	0.32
		Child Giving	31	0	0.16	0.01	0.04
		Child Taking	31	0	1.92	0.45	0.53
Round 4	At-Risk	Mother Giving	19	0.2	1	0.64	0.28
		Child Giving	19	0	0	0.00	0.00
		Child Taking	19	0	4	0.82	1.19
	Healthy	Mother Giving	31	0.2	1	0.60	0.33
		Child Giving	31	0	0.16	0.01	0.03
		Child Taking	31	0	2.4	0.58	0.70

Table V. Pearson correlation coefficients to test correlations between Mother-Child Health Measures and Game Behavior, Family attitudes and beliefs around food and fitness, and socio-economic status

Health Measure	Correlate	Rho	p-value
Healthy Child	Child CS Giving Round 1	-0.29	0.04
	Parental Diet Restrictions	-0.61	<0.01
Child has high cholesterol	Child CS Taking Round 4	0.24	0.09
	Shopping Factor	-0.34	0.02
Child's Waist Rank	Mother's CS Giving Round 3	0.29	0.04
	Parental Diet Restrictions	0.59	<0.01
Child's Walking Distance	Child CS Giving Round 4	0.29	0.04
Mother's BMI	Child CS Taking Round 3	0.30	0.03
	Parental Diet Restrictions	0.44	<.01
Mother's HDL or "Good" Cholesterol	Child CS Giving Round 2	0.29	0.04
	Regular Family Meals	0.28	0.05
	Lower Education Level	-0.26	0.08
	Low Income	-0.29	0.04

Figure 1. Mother's Mean 'Carrot-Stick' Giving According to Child Weight Status

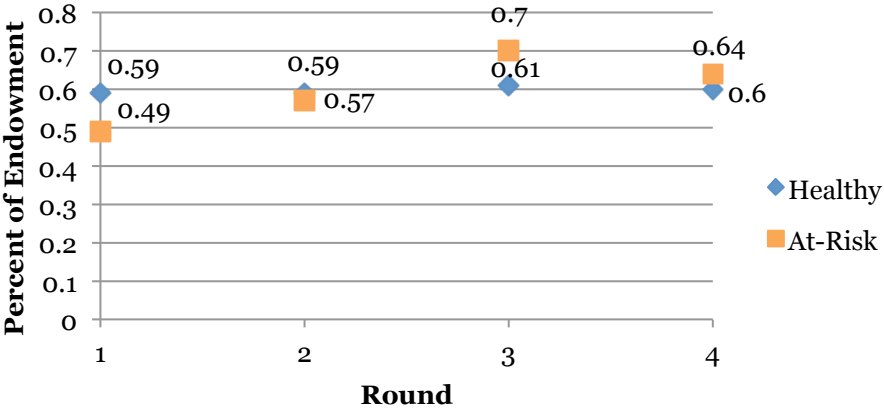


Figure 2. Child's Mean 'Carrot-Stick' Taking

