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Eating for pleasure or profit: the effect of incentives on children's enjoyment of vegetables

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Abstract

Use of rewards to encourage children to eat healthily is commonplace among parents but remains controversial because rewards are suspected of undermining intrinsic motivation. A cluster-randomized trial (N=422 children, 4-6yrs) examined effects on acceptance of a disliked vegetable of 12 daily taste exposures, paired with either tangible reward, social reward or no reward, compared with a no-treatment control condition. Liking and intake were assessed in a free-choice consumption task pre- and post-intervention, and 1 and 3 month follow-up. All three exposure conditions increased liking more than the control condition, with no differences between them. Effects were maintained at follow-up. Both reward conditions increased consumption, with effects maintained for 3 months, but the effects of exposure alone became non-significant by 3 months. These results indicate that external rewards do not necessarily produce negative effects and may be useful in promoting healthy eating.

Keywords

rewards; intrinsic motivation; eating; mere exposure; children

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A century of research has demonstrated the powerful effect of reinforcement (Thorndike, 1911). However rewards[1] have also shown paradoxical effects. Both over-justification theory (Lepper, Greene, & Nisbett, 1973) and self-determination theory (Deci, Koestner, & Ryan, 1999) propose that extrinsic rewards undermine intrinsic motivation, and behavioral economists have identified a similar phenomenon, 'motivational crowding-out', first described when it was found that paying people for blood donation undermined altruistic motivation (Titmuss, 1971).

In the food domain, some child-feeding experts counsel against offering rewards because of their potential to undermine liking, although many parents use them to encourage children to eat healthily (Campbell, Crawford, & Hesketh, 2007; Casey & Rozin, 1989). Are parents storing up trouble?

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[1]Incentives are defined as the offer of reward *before* performance of a behavior whereas rewards refer to the consequences of carrying out the behavior. However, in the child-feeding literature, the terms are used interchangeably.

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Behavioral research has produced conflicting results. Community-based studies have generally found that rewards increase acceptance. In ‘Kids Choice’, giving tokens for trying fruits and vegetables increased intake (Hendy, Williams, & Camise, 2005), and the ‘Food Dudes’ intervention, which combined rewards and peer-modeling, achieved substantial increases in intake, which were maintained after rewards were withdrawn (Lowe, Horne, Tapper, Bowdery, & Egerton, 2004). However, the opposite pattern of results has been obtained in laboratory studies. Unfavorable shifts in liking following rewards were observed in two classic studies (Birch, Birch, Marlin, & Kramer, 1982; Birch, Marlin, & Rotter, 1984), and this has been replicated in other laboratories (Mikula, 1989; Newman & Taylor, 1992).

Several factors may explain these discrepancies. One is the choice of outcome. Where *intake* is the outcome, the effects of rewards tend to be positive (Baer, Blount, Detrich, & Stokes, 1987; Hendy, 1999; Hendy et al., 2005; Stark, Collins, Jr., Osnes, & Stokes, 1986; Wardle, Cooke, Gibson, Sapochnik, Sheiham, & Lawson, 2003a). But where *liking* is the outcome, results are mixed (Birch et al., 1982; Birch et al., 1984; Hendy, 2002; Hendy et al., 2005; Mikula, 1989; Wardle, Herrera, Cooke, & Gibson, 2003b). External reward may undermine hedonic evaluation more than behavior, perhaps paralleling differences between liking and wanting (Berridge, 1996). The second factor is the type of reward. Increased consumption following the offer of food reward (e.g. dessert) has been observed (Hendy, 1999). However, using food in both parts of the instrumental contingency can increase liking for the unhealthy reward food (Mikula, 1989), which may be an undesirable side effect. Social rewards have been posited to have a less undermining effect (Henderlong & Lepper, 2002), although in the feeding context, tangible non-food rewards (Birch et al., 1984; Hendy et al., 2005; Stark et al., 1986) and social rewards (Baer et al., 1987; Birch et al., 1984) have each produced positive and negative effects. Thirdly, the level of initial liking may be a moderator. Deci and colleagues’ (1999) meta-analysis focused on behaviors that were already liked, and laboratory studies also tend to use palatable foods. In contrast, community studies usually target vegetables; children’s least favorite food.

A further complication is that reward studies inevitably involve repeated exposure to the taste of the target food, and so-called ‘mere exposure’ is an established technique for promoting food acceptance (Birch, 1987; Cooke, 2007; Wardle et al., 2003b). This makes it important to distinguish effects of reward from exposure *per se*. More importantly for the rewards debate, ‘mere’ exposure often involves a positive social context, created when an adult invites the child to taste a food and the child complies; social reward may therefore be an important ingredient.

The aims of the present study were to investigate short-term (acquisition) and longer-term (maintenance) effects of non-food rewards on liking and intake of a moderately-disliked vegetable, and to compare exposure without reward (pure mere exposure) with a no-exposure control condition. We expected exposure to increase liking and intake during acquisition. We expected rewards to increase intake during acquisition and for effects to persist in maintenance, but had no prediction concerning longer-term effects on liking.

Method

Participants and Design

In a cluster-randomized design we compared four conditions: exposure plus tangible non-food rewards (ETR), exposure plus social (praise) reward (EP), exposure alone (EA), and no treatment control (C) on liking and intake. We randomized at class level to avoid contamination. Power calculations for multilevel designs indicated that 16 classes in eight schools would give 90% power to detect a medium effect (d=0.50, rho=0.01). Out of a potential sample of 492 children, informed consent was received for 472, of whom 422 (53% boys) completed the study; 216 in Reception (4-5 yrs) and 206 in Year 1 (5-6 yrs). To ensure adequate representation of children from lower SES families, schools with above national average proportions of pupils eligible for free school meals, with English as a second language, and from a variety of ethnic backgrounds were selected, but we do not have individual child data on these variables. Ethical approval was obtained from the UCL Research Ethics Committee.

The study was scheduled in four waves, with one class randomized to each condition per wave. Sessions took place daily over three weeks, with intervention participants scheduled for 12 exposure sessions. The numbers randomized were: ETR: n=99; EP: n=106; EA: n= 105, and C: n= 112. Outcomes were assessed pre-intervention, post-intervention, and one and three months later. They included (a) a*d libitum* consumption and (b) rated and ranked liking.

Procedures

Pre-intervention—On Days 1-2, each child was seen individually and shown six vegetables (carrots, red-pepper, sugarsnap-peas, cabbage, cucumber, and celery), and introduced to the 3-point ‘faces’ scale, to indicate ‘yummy’, ‘just ok’ and ‘yucky’ (Birch, Zimmerman, & Hind, 1980). The child was asked to taste a small piece (~2.5 g) of each vegetable and indicate how much they liked it using the faces scale. The vegetable they liked most was then excluded and the procedure repeated to yield a rank-order of liking (1 – most liked to 6 – least liked). Each child’s target vegetable was their 4^{th} ranked; allowing for positive or negative shifts in preference. They were then invited to eat as many pieces as they wanted, with intake (g) assessed by weighing the dish before and after using digital scales (Mettler Toledo, Switzerland).

Intervention period—Children randomized to the intervention conditions were seen individually from Days 3 to 14, and offered a small piece of their target vegetable. Children in ETR were told that if they tasted the vegetable they could choose a sticker, those in EP who tasted the vegetable were praised (e.g. ‘Brilliant, you’re a great taster’), and those in EA were invited to taste with minimal social interaction. Control group children had no further contacts until post-intervention assessments.

Post-intervention and 1 and 3 month follow-ups—Outcomes were assessed on Day 15 and at 1 and 3 month follow-up. The procedure was similar to the pre-intervention assessment but care was taken to ensure that children in ETR understood that the sticker-reward was no longer available. Children rated and ranked their liking of all six vegetables and ad libitum consumption of their target vegetable was recorded.

Statistical Analysis

Analyses were conducted using MLwiN 2.20. Clustering by school was minimal therefore the final analyses only adjusted for clustering by class. Class and child were treated as random effects, and time as a fixed effect. Intake data were positively skewed, so were transformed (√x) for analysis. Linear models were used for intake, and ordinal multinomial models for liking. Time was included with linear and quadratic terms and as a repeated-measures indicator. Time and group were the primary independent variables, with age, gender and target vegetable as covariates. Significant effects were decomposed with chi-square tests. . Because we had hypotheses for acquisition and maintenance, overall effects across the study period are reported first, followed by separate results for acquisition (pre- to post-intervention) and maintenance[2] (post-intervention to follow-up).

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Results

Sample and Attrition

On key assessment occasions, 37 children were absent and 13 declined to participate. Data were therefore included from 422 children. There were some missing data at follow-up largely because of school absences. Intake data were analyzed on the full sample (N=422), but liking analyses were restricted to cases with complete data (n=344) because multinomial models cannot handle missing data. There were no significant group differences in the numbers of children included at each measurement time, nor differences in gender, age, choice of target vegetable, or baseline intake or liking.

Based on evidence that 10 exposures are needed to alter preferences (Sullivan & Birch, 1990), analyses were repeated for children who achieved at least 10 exposures (n=365 for intake; n=304 for liking). Because there were no differences, results are reported for the larger sample.

Compliance

Almost all children agreed to taste the vegetables in the exposure sessions. Mean (SD) number of tastings achieved by each group was: EA: 9.97 (2.87), EP: 10.45 (1.94) and ETR: 11.34 (1.45). Because the number of taste-exposures was negatively skewed, a Kruskal-Wallis test was used to examine group differences ($\chi^2(2, 310)=25.67$, $p<0.001$). Post-hoc analyses showed higher compliance in ETR than EP or EA (both $p<0.05$), which did not differ from each other. The number of taste-exposures was therefore included as a control variable in all analyses.

Liking

We assessed both rated and ranked liking, but children found both assessments easy and the results were identical, so we only present results based on ratings.

Overall effect—Over the study period, liking of the target vegetable increased ($z=3.91$, $p<0.001$). There was also a main effect of group ($\chi^2(3,344)=79.95$, $p<0.001$) and a group-by-time interaction ($\chi^2(3,344)=18.33$, $p<0.001$), with greater increases in the exposure groups than controls (see Figure 1).

Acquisition—There was a significant group-by-time interaction ($\chi^2(3,344)=32.33$, $p<0.001$), and a main effect of group ($\chi^2(3,344)=32.84$, $p< 0.001$). Between-group comparisons showed that liking increased more in the intervention groups than controls, with no significant differences between intervention groups (see Table 1).

Maintenance—The main effect of group remained ($\chi^2(3,344)=38.09$, $p<0.001$) indicating a persistent effect of the intervention, with no significant differences in maintenance (group-by-time interaction; $p=0.58$). There were no differences between intervention groups (see Table 1).

Intake

Overall effect—Consumption of the target vegetable increased over the study period ($z=7.685$, $p<0.001$). There was also a main effect of group ($\chi^2(3,422)=28.04$, $p<0.001$) and

[2]Data from follow-up1 were included in analyses but there were no differences between any post-intervention time points. For ease of presentation, the entire maintenance phase is reported as one three month period (i.e. post-intervention to follow-up2).

a group-by-time interaction ($\chi^2(3,422)=13.53$, $p<0.05$)), with greater increases in the exposure groups than control (see Figure 2).

Acquisition—There was a significant time-by-group interaction ($\chi^2(3,422)=33.59$ $p<0.001$) and a main effect of group ($\chi^2(3,422)=23.46$, $p<0.001$). All three intervention groups increased intake more than controls (all $p<0.05$). Consumption increased more in ETR than EP or EA, but the difference between EP and EA was not significant (see Table 2).

Maintenance—There was a significant group-by-time interaction ($\chi^2(3,422)=12.75$, $p=0.001$), and a main effect of group ($\chi^2(3,422)=30.19$, $p<0.001$). Intake remained higher in ETR and EP than in control, but this was not the case for EA. ETR and EP were not significantly different (See Table 2).

Discussion

The results of this study confirmed that repeated taste exposure to an initially-disliked food, either alone or associated with reward, increased children's acceptance compared with a no-treatment control condition. However, the effect varied depending on whether the outcome was hedonic (liking) or behavioral (intake) and during acquisition or maintenance. In the acquisition phase, all three exposure conditions achieved similar increases in *liking*, but effects on *intake* were larger in the tangible reward group than exposure-alone. During the maintenance phase, when rewards were withdrawn, *liking* remained higher in all the exposure groups, but effects on intake were maintained only in the reward groups.

Research on food choice has equated liking with intrinsic motivation, raising concern that rewards, even if beneficial in the short-term, might have a undermining effect on liking in the longer-term, as implicated in self-determination theory (Deci et al., 1999); and laboratory studies tended to confirm this expectation (Birch et al., 1982; Birch et al., 1984). However the present results gave no support for this; children given rewards alongside exposure achieved as much increase in liking as those receiving exposure alone. The most likely explanation for differences from laboratory results is the initial level of liking. Declines in preference following a reward contingency have typically been observed with reasonably well-liked foods (Birch et al., 1982; Birch et al., 1984); precisely as self-determination theory would predict. However, the present study, along with most community studies, targeted vegetables, which are probably children's least favorite food. Intrinsic motivation (or liking) at baseline was therefore already low and did not decline further.

Only one previous study had tested social reward (praise) alone (Birch et al., 1984), and found it decreased liking for the (initially liked) target food. However, the present results found social reward to be almost as beneficial as tangible rewards. Social reward might be particularly valuable in the home context by avoiding accusations of unfairness in offering incentives to a fussy child but not a sibling (Webber, Cooke, & Wardle, 2010).

One surprising effect was that 'exposure-alone' had no sustained effect on intake; although liking increased as expected. This is the first study to try to distinguish between 'mere exposure' and 'exposure with praise', with results indicating that social reinforcement is necessary for sustained behavior change, or alternatively, that the absence of praise when the child complied with the eating request was a negative experience. Liking and wanting are hypothesized to be independent determinants of consumption (Berridge, 1996), and it is possibly that the reward paradigm is another way to dissociate them (Finlayson, King and Blundell, 2007); a possibility worth exploring in future research. But it is also possible that

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differences between liking and intake were an artifact of differential sensitivity of the two measures.

There were group differences in compliance with the exposure tastings. Children in the tangible reward group (ETR) achieved significantly more exposures on average than children in the EA group, although controlling for number of exposures did not change the results. However, where compliance is problem (e.g. in the home), reward might be a valuable ally.

This study had limitations. Although control children did not receive the intervention, the repeated assessments gave them four *de-facto* exposures, and both intake and liking increased. This has been observed before (Wardle et al., 2003b) and suggests that even limited exposure can increase acceptance; but it therefore diluted the observed treatment effect. A school setting and unfamiliar researchers reduced ecological validity, so revisiting the issue with exposure delivered by parents in the home is necessary to assess real-life generalizability, although parents may require support to persist for 10 exposures.

This large study demonstrated that rewarding children for tasting an initially-disliked food produced sustained increases in acceptance, with no negative effects on liking.

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References

Baer RA, Blount RL, Detrich R, Stokes TF. Using intermittent reinforcement to program maintenance of verbal/nonverbal correspondence. J.Appl.Behav.Anal. 1987; 20:179–184. [PubMed: 3610897]

Berridge KC. Food reward: brain substrates of wanting and liking. Neuroscience and Biobehavioural Reviews. 1996; 20:1–25.

Birch LL. The role of experience in children's food acceptance patterns. J.Am.Diet.Assoc. 1987; 87:S36–S40. [PubMed: 3624720]

Birch LL, Birch D, Marlin DW, Kramer L. Effects of instrumental consumption on children's food preference. Appetite. 1982; 3:125–134. [PubMed: 7137991]

Birch LL, Marlin DW, Rotter J. Eating as the 'means' activity in a contingency: Effects on young children's food preference. Child Development. 1984; 55:431–439.

Birch LL, Zimmerman S, Hind H. The influence of social-affective context on the development of children's food preferences. Child Development. 1980; 52:856–861.

Campbell KJ, Crawford DA, Hesketh KD. Australian parents' views on their 5-6-year-old children's food choices. Health Promot.Int. 2007; 22:11–18. [PubMed: 17043065]

Casey R, Rozin P. Changing children's food preferences: parent opinions. Appetite. 1989; 12:171–182. [PubMed: 2774551]

Cooke L. The importance of exposure for healthy eating in childhood: a review. J.Hum.Nutr.Diet. 2007; 20:294–301. [PubMed: 17635306]

Deci EL, Koestner R, Ryan RM. A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. Psychol.Bull. 1999; 125:627–668. [PubMed: 10589297]

Finlayson G, King N, Blundell JE. Liking vs. wanting food: Importance for human appetite control and weight regulation. Neuroscience & Biobehavioral Reviews. 2007; 3:987–1002. [PubMed: 17559933]

Henderlong J, Lepper MR. The effects of praise on children's intrinsic motivation: a review and synthesis. Psychol.Bull. 2002; 128:774–795. [PubMed: 12206194]

Hendy HM. Comparison of five teacher actions to encourage children's new food acceptance. Ann.Behav.Med. 1999; 21:20–26. [PubMed: 18425650]

Hendy HM. Effectiveness of trained peer models to encourage food acceptance in preschool children. Appetite. 2002; 39:217–225. [PubMed: 12495695]

Hendy HM, Williams KE, Camise TS. "Kids Choice" school lunch program increases children's fruit and vegetable acceptance. Appetite. 2005; 45:250–263. [PubMed: 16157415]

Lepper MR, Greene D, Nisbett RE. Undermining children's intrinsic interest with extrinsic reward: A test of the "Overjustification" hypothesis. Journal of Personality and Social Psychology. 1973; 28:129–137.

Lowe CF, Horne PJ, Tapper K, Bowdery M, Egerton C. Effects of a peer modelling and rewards-based intervention to increase fruit and vegetable consumption in children. Eur.J.Clin.Nutr. 2004; 58:510–522. [PubMed: 14985691]

Mikula G. Influencing food preferences of children by 'if-then' type instructions. European Journal of Social Psychology. 1989; 19:225–241.

Newman J, Taylor A. Effect of a means-end contingency on young children's food preferences. J.Exp.Child Psychol. 1992; 53:200–216. [PubMed: 1578198]

Stark LJ, Collins FL Jr. Osnes PG, Stokes TF. Using reinforcement and cueing to increase healthy snack food choices in preschoolers. J.Appl.Behav.Anal. 1986; 19:367–379. [PubMed: 3804870]

Sullivan S, Birch LL. Pass the sugar, pass the salt: Experience dictates preference. Developmental Psychology. 1990; 26:546–551.

Thorndike, EL. Animal Intelligence: Experimental studies. Macmillan; New York: 1911.

Titmuss, RM. The Gift Relationship. Allen and Unwin; London: 1971.

Wardle J, Cooke LJ, Gibson EL, Sapochnik M, Sheiham A, Lawson M. Increasing children's acceptance of vegetables; a randomized trial of parent-led exposure. Appetite. 2003a; 40:155–162. [PubMed: 12781165]

Wardle J, Herrera ML, Cooke L, Gibson EL. Modifying children's food preferences: the effects of exposure and reward on acceptance of an unfamiliar vegetable. Eur.J.Clin.Nutr. 2003b; 57:341–348. [PubMed: 12571670]

Webber L, Cooke L, Wardle J. Maternal perception of causes and consequences of sibling differences in eating behaviour. European Journal of Clinical Nutrition. (in press) doi:10.1038/ejcn.2010.159.

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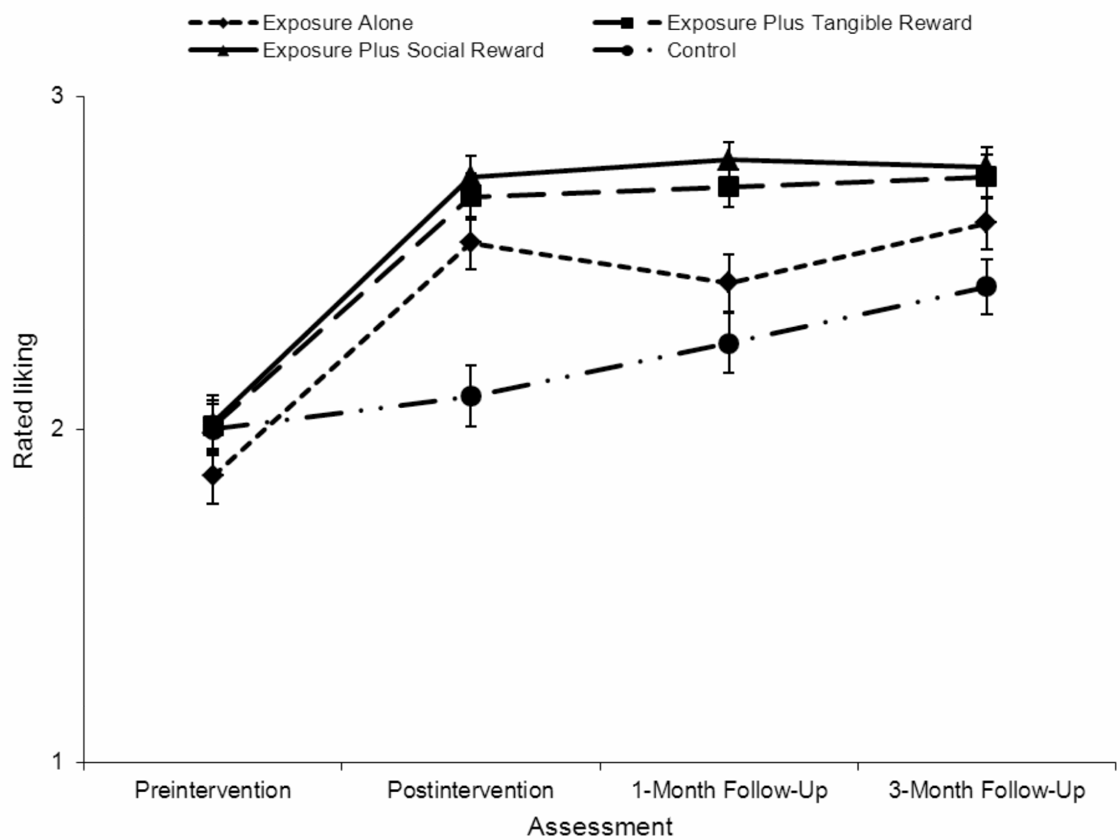

Fig. 1.
Rated liking of the target vegetable across the duration of the study, as a function of condition: exposure plus tangible nonfood rewards, exposure plus social reward, exposure alone and control. Ratings were made on a 3-point scale. Error bars represent standard errors of the mean.

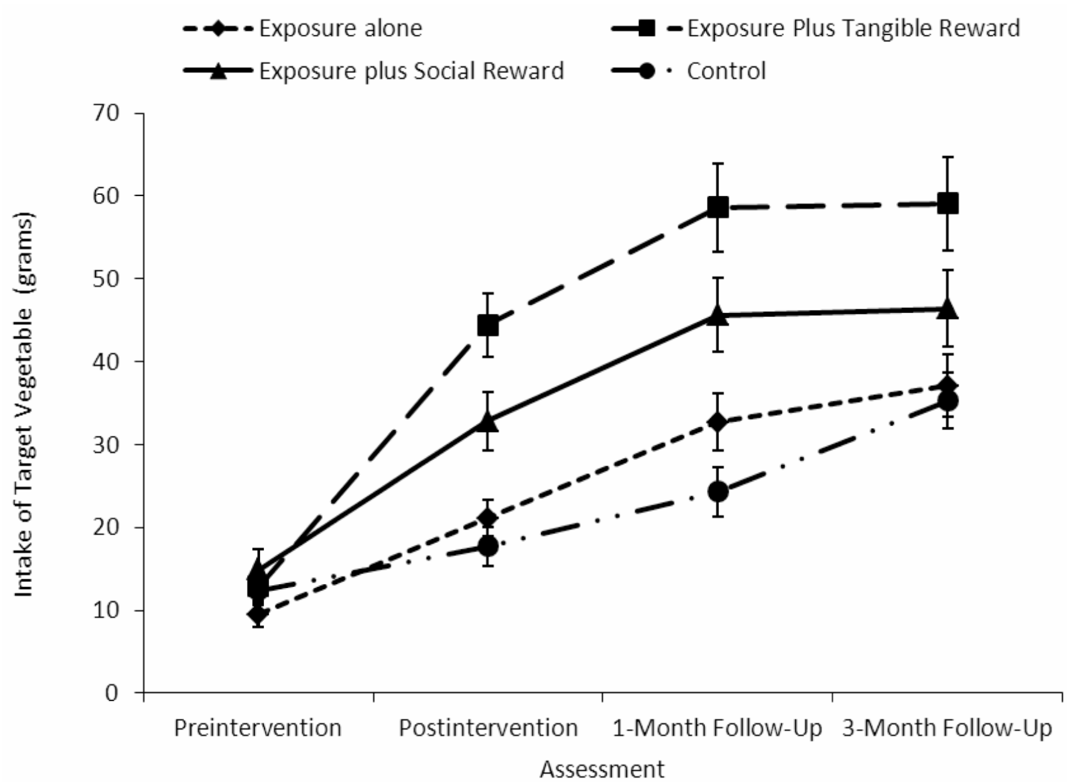

Fig. 2.

Intake of the target vegetable across the duration of the study, as a function of condition: exposure plus tangible nonfood rewards, exposure plus social reward, exposure alone and control. Error bars represent standard errors of the mean. The figure is based on raw data; statistical analyses were carried out on transformed data to allow for skewed distributions.

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Table 1

Results of Chi-square Tests Comparing Rated liking of the Target Vegetable Between Conditions.

	df	N	χ^2	*p*	Odds ratio	95%CI
Acquisition						
EA *vs.* C	1	172	17.68	<0.001	6.07	(2.62, 14.08)
ETR *vs.* C	1	174	18.74	<0.001	6.61	(2.81,15.54)
EP *vs.* C	1	174	22.40	<0.001	8.59	(3.52,20.96)
Maintenance						
EA *vs.* C	1	172	11.98	<0.001	3.17	(1.65, 6.11)
ETR *vs.* C	1	174	24.40	<0.001	4.98	(2.63, 9.41)
EP *vs.* C	1	174	28.47	<0.001	6.73	(3.34, 13.54)

Note: Subjects were divided into four groups: exposure plus tangible nonfood rewards (ETR), exposure plus social reward (EP), exposure alone (EA), and control (C). Only significant comparisons are shown. CI= confidence interval

Table 2

Results of Chi-square Tests Comparing Intake of the Target Vegetable Between Conditions.

	df	n	χ^2	*p*	*d*
		Acquisition			
EA *vs.* C	1	196	11.08	<0.001	0.26
ETR *vs.* C	1	196	23.31	<0.001	0.93
EP *vs.* C	1	199	14.51	<0.001	0.58
EA *vs.* ETR	1	194	7.31	<0.05	0.72
EA *vs.* EP	1	197	0.31	>0.58	—
ETR *vs.* EP	1	191	4.95	<0.05	0.34
		Maintenance			
EA *vs.* C	1	201	1.74	>0.18	—
ETR *vs.* C	1	202	10.93	<0.001	0.72
EP *vs.* C	1	196	6.66	<0.05	0.42
EA *vs.* ETR	1	191	8.44	<0.005	0.57
EA *vs.* EP	1	197	1.84	>0.18	—
ETR *vs.* EP	1	191	2.51	>0.11	—

Note: Subjects were divided into four groups: exposure plus tangible nonfood rewards (ETR), exposure plus social reward (EP), exposure alone (EA), and control (C).