Using food as reinforcer to shape children's non-food behavior: The adverse nutritional effect doubly moderated by reward sensitivity and gender

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A B S T R A C T

Purpose: Control rules are parental practices that use food, especially those high in fat or sugar, as an instrumental reinforcer to encourage children to behave in a normative manner in non-food domains. Past laboratory experiments show that repeatedly presenting snacks as a reward or associated with adults' attention, increases children's preference for the presented food. This field study aims to examine whether control rules are associated with children's increased everyday intake of food high in sugar/fat, and whether this effect is moderated by individual differences in neurobehavioral sensitivity to reward and in gender.
Design: 207 six- to twelve-year-old children's parents reported the children's everyday dietary intake through a food frequency questionnaire and provided information regarding the children's sensitivity to rewards as well as the frequency of enforcing control rules.
Results: Children who lived in families with a high frequency of using control rules exhibited more daily fat, carbohydrate, and total energy intake than did children whose parents use control rules less often. Furthermore, the effect of control rules on dietary pattern was particularly strong for children with high reward sensitivity, especially boys.
Conclusions: Control rules have adverse consequences on children's nutrition. The moderating effects of sensitivity to reward and gender are consistent to a reinforcement learning process—associating the high-fat/sugar food consumption with social-affective pleasure resulting from performing behavior desired by parents—through which parental control rules contribute to children's maladaptive dietary patterns.

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1. Introduction

Parental control rules, which use foods as instrumental reinforcers to encourage children to behave in a normative manner in non-food domains, are popular practices (Epstein, Leddy, Temple, & Faith, 2007). Because high-fat/sugar food is strongly tied to biological incentive and sensory pleasure (Epstein & Leddy, 2006), it is usually chosen as a reinforcer in parental practices (Cooke, Chambers, Añez, & Wardle, 2011; Newman & Taylor, 1992; Wardle, Herrera, Cooke, & Gibson, 2003). Besides shaping behavior, enforcing control rules may also embed a parent-induced instrumental learning into the natural process of food reinforcement. Early laboratory experimental studies have demonstrated that repeatedly presenting snack food as a reward for completing non-food tasks or with adults' attention increases children's preference

for the presented food (Birch, 1981; Birch, Zimmerman, & Hind, 1980). As such, control rules may lead to children's increased preference for food high in sugar/fat (highly reinforcing; HR). Under the control rules, the gratification of HR food often follows behaviors praised by parents, leading to a sense of achievement and parents' attention. After sufficient repetition, such contingent pleasurable experiences may be added to the "natural" reinforcing property of HR food.

Control rules attach added reinforcing properties to HR food, and this may be moderated by individual differences in neurobehavioral sensitivity to reward. High reward sensitivity is associated with greater responsiveness to incentives (Pickering & Gray, 2001). Children with greater neurobehavioral reward sensitivity find HR food strongly reinforcing (Carver & White, 1994; Gray, 1990), are more responsive to food incentive (Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006; van den Berg et al., 2011), more likely to abide by the control rules, and consequently experience the HR food eating accompanied with the contingent experience with higher frequency. In addition, highly reward-sensitive children tend to experience more pleasant consequences from parents'

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praise and from accomplishing challenging tasks (Bjørnebekk, 2007), adding greater contingent pleasure to the HR food.

Male gender may also be tied to the adverse effects of control rules on eating patterns. As boys are generally willing to make greater efforts to get food or non-food rewards than girls (Chelonis, Gravelin, & Paule, 2011; Rollins et al., 2014), boys' favored learning modes may be consistent with the HR food reinforcement involved in control rules. In addition, since control rules render emotional cues more salient stimuli in triggering HR food consumption, males are particularly vulnerable to such effect; they are more likely to rely on reward-seeking behaviors, such as HR food eating, to regulate emotions (Cooper, Russell, Skinner, Frone, & Mudar, 1992).

This field study aims first to examine whether control rules are associated with children's increased preference for HR food, as reflected in dietary intake high in energy, carbohydrate (sugar), and fat. Second, we also explore whether the effect is doubly moderated by individual differences in neurobehavioral sensitivity to reward, and by gender.

2. Material and methods

Participants were parents of 207 children (97 boys and 110 girls) aged 6–12 living in Montreal, Canada (Table 1 for descriptions). Children's dietary patterns were assessed by a web-based food frequency questionnaire (web-FFQ; Labonte, Cyr, Baril-Gravel, Royer, & Lamarche, 2012), which is a parental recall of children's food intake (last month) based on a food and beverages list (136 food items in 8 categories). Parents indicated how frequently their children consumed each food and typical portion size, which is estimated with visual reference presenting food in standardized dinnerware (SU.VI.MAX food atlas; Le Moullec et al., 1996). Children's daily nutrient intake was calculated from the frequency and portion size of each food based on the Nutrition Data System for Research (Schakel, Sievert, & Buzzard, 1988) and the Canadian Nutrient File (Health-Canada, 2007). For each child, the energy content (calories), the total intake (in grams) of fats and carbohydrates from his/her diet, was calculated as per published procedure (Labonte et al., 2012).

Parental control rules were assessed by using a subscale of food rules scale (Puhl & Schwartz, 2003), which asked how often parents used food as a reinforcer to encourage children's behavior (6 items; $\alpha =$

Table 1
Descriptions of study sample.

	Boys	Girls	Total
Sample size (n)	97	110	207
Household annual income (n)			
Less than (Canadian) $6,000	0	1	1
$6,000 to less than $10,000	1	0	1
$10,000 to less than $25,000	3	7	10
$25,000 to less than $45,000	11	12	23
$45,000 to less than $65,000	15	21	36
$65,000 to less than $95,000	28	29	57
More than $95,000	39	40	79
Language used for survey (n)			
English	40	46	86
French	57	64	121
Age: mean (SD.)	9.19 (1.54)	8.79 (1.77)	8.98 (1.67)
Children's BMI percentile (SD.)	58.76 (34.53)	53.51 (34.68)	56.01 (34.61)
Control rule scores: mean (SD.)	1.50 (0.57)	1.42 (0.44)	1.46 (0.50)
BAS (SD.)	6.56 (1.24)	6.74 (1.14)	6.15 (1.19)
Time spend on hard physical activities (minutes per week): mean (SD)			
	517.37 (402.15)	472.25 (287.91)	493.40 (346.03)

Note: Children's BMI percentile ranking among children of the same sex and age was transferred from children's BMI based on the Centers for Disease Control and Prevention (CDC) BMI-for-age growth charts.

0.66), such as "You (the child) received food as a reward for good behavior." By using control rules scores, children were divided into (median split at 1.33) *low control rule group* (n = 95; 43 boys and 52 girls) and *high control rule group* (n = 112; 54 boys and 58 girls). Children's neurobehavioral sensitivity to rewards was measured by the behavioral activation system (BAS) scales for young children (Blair, Peters, & Granger, 2004). Parents answered questions (13 items, $\alpha = 0.87$) regarding their children's reward responsiveness, drive, and fun seeking. Based on the median split of the BAS score (median = 6.77), each child was categorized into *high BAS group* (n = 103; 45 boys and 58 girls) or *low BAS group* (n = 104; 52 boys and 52 girls). Parents also reported household demographics, children's anthropometrics, and physical activities, which was a 7-day recall of how long the child had spent on hard physical activity (Leatherdale, Manske, Wong, & Cameron, 2008).

3. Results

Children's total daily energy, fat, and carbohydrate intake were analyzed in three ANCOVAs (see Table 2 for group means). Each model included gender, control rule group, and BAS group as between-subject factors. Children' physical activity was included in the models as a covariate, which was positively associated with energy, fat, and carbohydrate intake ($p < 0.03$). Since including participants' age, children's BMI percentile, and family income as covariates (all not significant, $p > 0.1$) did not change the results on focal effects, this paper only reported the results of models without these confounders.

3.1. Daily energy intake

The main effect of control rules on energy intake was significant ($F(1,198) = 8.51$, $p = 0.004$). Children who live in families with high control rules had higher daily energy intake than those in the low control rules group. A significant interaction of control rules by BAS group ($F(1,198) = 9.53$, $p = 0.002$) indicated that control rules effect was particularly salient for high BAS children. For the high BAS group, high control rule children had significantly higher energy intake than low control rules group children (post hoc comparisons $p < 0.001$; Bonferroni adjusted hereafter), whereas the control rules effect was not significant within the low BAS group. The interaction between control rules and gender ($F(1,198) = 9.94$, $p = 0.002$) revealed a significant effect of control rule for boys ($p < 0.001$) but not for girls.

The main effect of BAS group ($F(1,198) = 11.34$, $p = 0.001$) and gender ($F(1,198) = 9.18$, $p = 0.003$) as well as the interaction between BAS and gender ($F(1,198) = 7.24$, $p = 0.008$) were significant. Importantly, a marginal significant three-way interaction between gender, BAS, and control rules ($F(1,198) = 3.38$, $p = 0.07$) indicated that high control rules were associated with increased daily energy intake only for high BAS boys. Among high BAS boys, the high control rule group reported significantly higher energy intake than the low control rules group ($p < 0.001$). There was no significant control rules effect found for low BAS boys, low BAS girls, or high BAS girls.

3.2. Daily fat intake

In terms of children's total daily fat consumption, the main effect of control rules was significant ($F(1,198) = 7.58$, $p = 0.006$). High control rules children tended to consume more fat per day than low control rules children. All the two-way interactions involving control rules were significant (control rules by BAS: $F(1,198) = 8.20$, $p = 0.005$; control rules by gender: $F(1,198) = 10.03$, $p = 0.002$), showing that the effect of control rules was considerably stronger for high BAS children and boys; high BAS children with high control rules reported more fat intake than high BAS low control rule children did ($p < 0.001$), and no such effect was found for low BAS children. Boys with high control