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Title: Preschoolers exhibit conformity to computer-simulated food portion selection behaviors of remote peers

Authors: Elizabeth B. Kim^{1,2}, Chuansheng Chen¹, and Bobby K. Cheon^{2,3}

Affiliations: ¹School of Social Ecology, University of California Irvine, Irvine, CA 92697, U.S.A

²Clinical Nutrition Research Centre, Singapore Institute for Clinical Sciences, Agency for Science, Technology and Research (A*STAR), Singapore 117599

³School of Social Sciences, Nanyang Technological University, Singapore 637332

Please address correspondences to:

Elizabeth B. Kim

Address: Department of Psychological Science
4201 Social and Behavioral Sciences Gateway
University of California, Irvine
Irvine, CA 92697-7085
Ekim26@uci.edu
+65 9855-9054

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Abstract

Children have been found to rely on others for food choice and food intake cues, but it is unclear whether a similar type of social modeling occurs for food portion selection, especially among young children. Given that portion size predicts energy intake, it is important to understand the role of social influence on portion selection behavior early in life. The present study aimed to determine preschoolers' conformity to food portion selection patterns of remote peers using a computerized Portion Selection Task and examined the role of parents' feeding styles in children's susceptibility to others' food portion choices. Seventy-five 3-6 year old Singaporean children ($M = 62 \pm .72$ months) were asked to make food portion selections of high-energy-density (ED) foods and low-ED foods both independently and after having viewed remote peers' portion selections of the same foods. In the unhealthy peers condition, children saw peers choose large portions of high-ED foods and small portions of low-ED foods, while in the healthy peers condition, children saw peers select large portions of low-ED foods and small portions of high-ED foods. Parents were surveyed about their child feeding practices. Results revealed that participants exhibited conformity to the portion sizes of remote peers for both high-ED and low-ED foods under the healthy peers condition, but only marginally for high-ED foods under the unhealthy peers condition. Parents' higher restriction of foods for child's health was marginally associated with lower conformity to peers' portion selections of unhealthy foods and higher conformity to peers' portion selections of healthy foods. This study provides support for social modeling of food portion selection among young children, but the extent of social modeling may be contingent on characteristics of the food.

Introduction

Prior research on social modeling has demonstrated that both adults' and children's eating behaviors are susceptible to influences from the mere presence of others as well as food selection and intake patterns of others⁽¹⁻⁹⁾. For example, 10-12 year olds have been shown to consume more healthy foods in the presence of unfamiliar peers than when eating alone⁽¹⁰⁾. Even children as young as 2 years old have been found to change their food preferences based on peer presence^(11,12). Peers do not need to be physically present to have an influence. For example, remote or fictitious peers led 6-11 year olds to adjust their vegetable intake^(13,14). These findings suggest that children may be especially sensitive to signals of others' eating behaviors and that conformity to others' normative food-related behavior is a robust phenomenon.

Several limitations, however, exist in the previous research. First, there has been little work examining conformity in food portion selection behavior, especially with young children. A limited number of studies have examined older children's food intake patterns, revealing that the amount of (unhealthy) snacks consumed by 6-12 year olds⁽¹⁵⁻¹⁷⁾ and 7-9 year olds^(18,19) was guided by the snack consumption behavior of their peers. A similar result of conformity was observed for healthy foods in a study of 6-11 year olds⁽¹⁴⁾. Yet, thus far, this line of research has not been extended to younger children (3-6 year olds). Importantly, this would be a seminal developmental period to study given that portion size is a predictor of energy intake for 2-5 years olds⁽²⁰⁾ and that for 4-6 year olds, exposure to larger food portions has been found to promote greater food intake^(21,22). Furthermore, food preferences and consumption patterns acquired during early childhood^(23,24) are highly predictive of eating habits in adulthood⁽²⁵⁻²⁸⁾. Unhealthy eating habits such as excessive energy intake from large portions may eventually lead to diet-related metabolic diseases^(29,30). Consequently, it is important to examine how young children navigate peer influence when making food portion selections.

Second, existing studies on children's modeling of others' food intake have mainly focused on peer influence on consumption of unfamiliar, foods with low-energy-density (ED) such as novel vegetables and fruits^(7,12,31). Examining whether peer influence can be used to also promote smaller portions of palatable high-ED foods, instead of solely focusing on encouraging greater intake of low-ED (and potentially healthier) foods^(32,33) could not only provide insight into factors that influence children's social learning of food portions, but also have implications for the promotion of healthy eating habits.

The first aim of the current study was to explore whether and under what conditions

preschoolers would change their food portion selections based on exposure to remote peers' food portion selections. The conditions we explored included type of food (high v. low-ED) and type of peer influence (healthy v. unhealthy). Specifically, we tested whether young children changed their food portion selections after seeing remote peers either choose larger amounts of low-ED foods and smaller amounts of high-ED foods (i.e., healthy peers condition) or choose larger amounts of high-ED foods and smaller amounts of low-ED foods (i.e., unhealthy peers condition). Based on social modeling and conformity research demonstrating sensitivity to group influence by preschoolers, we predicted that young children would adjust their portion sizes accordingly (i.e., their portion sizes would be more similar to what they saw peers selected compared to their baseline portion sizes) after seeing their peers choose larger or smaller portions of foods under all four conditions (type of foods by type of peers).

The second aim of this study was to examine how parenting behaviors (feeding styles and food environment provided to children) might influence children's tendency to conform to others' food portions. Previous research has shown that parents differ in the degree to which they permit children autonomy in eating^(34,35) and that more restrictive parenting has been linked to lower compliance in children⁽³⁶⁻³⁸⁾. Family food environment is also an important determinant of children's healthy food intake, such that availability of healthy foods throughout the day and greater food variety at home have been associated with healthier eating⁽³⁹⁻⁴⁴⁾. Additionally, evidence suggests that parents' nutritional knowledge and concern for disease prevention are likely to influence the diets of children positively, such as increasing fruit intake⁽⁴⁵⁾. In particular, we focused on examining parents' restriction of food, teaching nutrition, pressure to eat, and food environment. As such, we hypothesized that children with more restrictive and controlling parents would show lower levels of conformity to peers' portion selection patterns and that teaching nutrition and food environment would be positively related to conformity to low-ED foods.

To test these hypotheses, we employed a remote-confederate conformity paradigm to study young children's conformity to peers' portion selection patterns. The majority of developmental studies on social modeling of others' eating behavior have used live confederates^(12,31,46-49). However, prior studies on eating behavior using a 'remote-confederate' design with adults have shown that a confederate does not have to be present for social modeling effects to work. For example, using various types of norms by remote confederates (ranging from evidence of what non-present others consumed^(50,51) to messages on what foods non-present others approved of⁽⁵²⁾) have resulted in corresponding consumption patterns by participants. Similarly, a few prior studies have also used

remote confederates to influence eating behaviors of older children (ranging from 5- to 12-year olds)^(15, 24,53). Our study is the first to our knowledge that examined the role of remote social influence on portion selection patterns on a younger preschool age sample (3-6 year-olds).

Methods

Participants & Recruitment

Participants of this study included 75 3-6 year old Singaporean children (33 girls, $M = 62 \pm .72$ months, range [yr; month] = 3;9–6;7) from diverse local neighborhood preschools. Fifty-one Singaporean children were of Chinese descent, 10 of Malay descent, 8 identified as “Other,” and 6 children’s ethnic identities were not indicated in parent surveys. Given that English is the common language used in education, business, and government, Singaporean preschool children were recruited using English language materials and telephone/email procedures. The researcher obtained permission from principals of all schools and written informed consent from parents for preschoolers to participate in the experiment. A meta-analysis by Vartanian and colleagues⁽⁵⁴⁾ revealed a correlational effect size of $r = .47$ (a “large” effect size, equivalent to Cohen’s d of 1.06) between the food intake behavior of social models and child participants. Given that their meta-analysis did not include portion selection behavior as an outcome, we used a more conservative effect size of Cohen’s $d = 0.7$ with a desired statistical power level of 0.8 and a probability level of 0.05 (two-tailed) for the following power analyses: a one-sample t -test, an independent samples t -test, and a repeated measures ANOVA (with effect size $f = .25$ and correlation between repeated measures of .50). Analyses using G*Power⁽⁵⁵⁾ sample size calculation estimated that for the one-sample t -test, 19 participants were needed; for the independent samples t -test, 68 participants (34 per group) were needed; and for the repeated measures ANOVA, 34 (17 per group) participants were needed.

Study design

The present study was an experimental, 2 x 2 design with the independent variables being food type (low vs. high-ED) as the within-subject factor and peer condition (healthy vs. unhealthy peers) as the between-subject factor. The main dependent variable assessed was the amount of change in child’s food portion selection from before to after viewing remote peers’ selections. This experiment was part of a larger battery of assessments involving other cognitive tasks (i.e. executive functioning, theory of mind, prosociality). Each child was randomly assigned to one of the two (between-subject)

experimental conditions (healthy vs. unhealthy peers). Participants in the 'unhealthy' peers condition viewed peers selecting large portions of high-ED foods and small portions of low-ED foods. Participants in the 'healthy' peers condition viewed peers selecting small portions of high-ED foods and large portions of low-ED foods.

Procedures

First, children underwent an initial screening in which they were asked to identify six different unhealthy and healthy food images (which would be presented later for portion selection) that varied in high/low-ED. If they mistakenly identified the food, they were immediately corrected. Participants were then asked about their hunger status using the hunger status assessment, which was used as a control variable in analyses. Next, participants were asked to play a game where they would be shown some foods and asked some questions about how much food they would want to consume. They were then introduced to the practice trial to familiarize them with the food portion selection task (PST). After participants completed the practice trial, they began the pretest trials followed by the manipulation, and then finally test trials. Participants made food portion choices for both low and high-ED food types (within subjects) twice (at pretest trial, and test trial), with all foods presented in a randomized order. Participants completed a total of 12 trials: 6 consecutive pretest trials and 6 consecutive test trials for each condition (between-subjects).

Following the test trial, participants were debriefed that everyone likes different kinds of foods. Any questions by the participants about the tasks were clarified at this time, and they were offered a sticker as a token of appreciation for participating.

Materials

Hunger status assessment

Participants' hunger and fullness was measured on a 3-point scale⁽⁵⁶⁾ using images of three figures with (1) an empty stomach, (2) a half empty/full stomach, and (3) a full stomach. The experimenter asked, "Do you see these three kids? I'm going to tell you about how much food they've eaten and how hungry they are." Experimenter then said, "[Pointing to the empty stomach figure] This kid has not eaten at all, so his/her [matching it to the participant's gender] stomach is empty and he/she is hungry. [Pointing to the full stomach figure] This kid ate a lot, so his/her stomach is full and he/she is not hungry. [Pointing to the half full stomach figure] This kid has eaten a little bit, so his/her stomach is

half full.” *Hunger status question*: How do you feel right now? [Pointing to empty stomach figure] Are you hungry like this child? [Points to full stomach figure] or full like this child? [Pointing to half-full stomach figure] or half-full like this child?”

Food portion selection task

Children began with a practice trial in which they were presented with a slide show similar to the format of the food PST (see below). The practice trial had a plate of blue circles. The experimenter explained, “See this plate? There are little circles on the plate. Well in this game when you press this button [point to right arrow →] you get to add more circles onto your plate. When you press this button [point to left arrow ←], you get to take away circles from your plate. Let’s try! Press this button and see what happens.” The participant was instructed to press the right arrow button by the instructor, “See you can add more and more circles on your plate. Okay, you can keep pressing. See, the plate is now full of circles.” The participant was allowed to press the right arrow until maximum full portion on a plate was presented. Then the experimenter instructed, “Now try pressing this button [left arrow button ←] and see what happens. See you can take away more and more circles off your plate. Now, there are only few circles left on the plate. [At this point, participants could press the button until the minimum portion was presented]. So when you press this button [right arrow button →], you add more circles on your plate, and when you press this button [left arrow button], you take away circles from your plate.”

After the practice trial, children were introduced to the actual food PST: “So in this game you will see some foods. Choose how much you want to eat by pressing the buttons. You can add or take away food from your plate just like how you did with the circles.” Participants completed a computerized PST that was modeled on prior computerized assessments of portion selection and intended food consumption⁽⁵⁷⁻⁵⁹⁾. The PST was designed to show high-resolution images of foods individually served on one dinner plate with user-controlled portion sizes that were controlled by the left and right arrow keys on the computer keyboard. Participants were asked to select their desired portion of the six different food items individually in a randomized order for both the pretest and test trials, and were allowed to increase or decrease the portion size of the foods displayed in equicaloric steps ranging from 20 to 500 kcal in approximately* 20 kcal increments by pressing the corresponding

* Based on a goal to avoid displaying images of foods broken into pieces (e.g. broken chips, broken M&M’s), some images did not reflect exact 20 kcal increments.

arrows (See Figure 1). Past research with adults has suggested that computerized PSTs can reliably predict actual self-served and consumed portions for a given food presented in the task ^(59,60).

The healthy and unhealthy foods were selected from a list of 61 candidate foods commonly eaten by Singaporeans and ranked by the food energy density (kcal/100g) ⁽⁵⁸⁻⁶⁰⁾. Three relatively low-ED foods ($M = 102$ kcal/100g; range: 54-145 kcal/100g) were selected from the lower end of the ED list (tomato pasta, fruit salad, vegetarian Eefu noodle) and 3 relatively high-ED foods ($M = 428$ kcal/100g; range: 228-550 kcal/100g) were selected from the higher end of the list (potato chips, French fries, and M&Ms). Pilot-testing ($N = 11$) showed that some children of this age (20-40%) had trouble labeling foods precisely (e.g., labeling French fries as chips or labeling them as fish sticks). To reduce confusion (confusing French fries with potato chips, which is another item included in the test) and to ensure that children use the correct labels, we designed follow-up verbal corrections for foods that were not immediately recognizable by children in this age range, so they knew what foods the pictures represented. For each pretest and test trial, the participant was asked for each food, "Choose how much [food] you want to eat by pressing the buttons." Participants were not told that they would receive the foods they were choosing in the task. No participants asked about whether they would receive the foods at the end of the game, suggesting that they understood they were asked a hypothetical question. To minimize undue influences or demands for children to expect that they should change their initially selected portion sizes, these instructions were delivered in an identical tone for pretest and test trials. Overall, the session was conducted in a neutral and non-judgmental tone and expression by the experimenter.

After personal selection of the initial six food portions, the experimenter introduced the manipulation. For the manipulation, a 8 x 11 inch display featuring 3 girls/boys whose ethnicities were representative of Singaporean society (Chinese, Malay, Indian) and whose gender was matched to the participant was shown with each child's portion displayed below each child's photo (See Figure 2). This display was presented to participants as an example of portion selection decisions made by other ostensible children who previously participated in the experiment. The experimenter said: "Ok, well now I am going to show you some little boys/girls who also chose how much food they wanted to eat. Let's see." Next, the experimenter showed the participant a picture of three gender-matched kids with 3 plates of food. While pointing to each child's face and food, the experimenter said, "Oh look! This boy/girl chose this much [food], this boy/girl chose this much [food] and this boy/girl chose this much [food]." The experimenter then informed the participant the

reason for why the food portion selection task had to be repeated for the test trials, “Oh no, the computer forgot how much food you picked last time. Let’s try again.” The participant was reminded on the instructions on how to make their responses and was asked to choose how much food he/she wanted to eat (the task was reset after the manipulation).

Figure 1. *Example of food portion-size images (presented individually) displayed on the portion selection computer program. Keyboard commands to increase (right arrow key) or decrease (left arrow key) food portion images correspondingly changed the portion size of the displayed image in approximately 20 kcal increments ranging from 20 to 500 kcal; 25 images total per food.*

Figure 2. *Example of experimental manipulation. Three boys/girls (Chinese-Singaporean, Malay-Singaporean, Indian-Singaporean) were presented with their food portion selection shown below (ex. Fruit salad).*

Healthy peers condition

Unhealthy peers condition

Evaluation of food portion conformity

The conformity index was created by calculating the participants' average change in portion size from pretest trial to test trial for all 6 foods. This was further categorized into the average change in portion size from pretest trials to test trials for 3 low-ED foods and 3 high-ED foods.

Questionnaires

A survey was distributed to parents to examine potential associations between parents' feeding styles and children's conformity to peers' food portion selections. The survey included 4 subscales (15 items in total) of the Comprehensive Feeding Practices Questionnaire (CFPQ)⁽⁶¹⁾ to measure the extent to which parents controlled their children's eating environment and endorsed autonomous displays by their children in eating: child's food environment (Cronbach $\alpha = .68$),

parental pressure to eat (Cronbach $\alpha = .60$), parental restriction for health (Cronbach $\alpha = .54$), and parental teaching about nutrition (Cronbach $\alpha = .80$). These specific subscales were chosen because past research suggests that parents' nutritional knowledge and concern for disease prevention may be linked to positive eating behavior for children, such as increasing fruit intake⁽⁴⁵⁾. Food environment scale was included because availability and exposure to healthy foods have also been important predictors of children's food consumption patterns^(34,62,63). Parental restriction for health subscale was selected because of the association between parents' restrictive control of their child's eating and excessive eating/poor self-regulation of energy intake among preschoolers⁽⁶²⁾. Given a high correlation between parental restriction for health and parental restriction for weight⁽⁶¹⁾, we only selected one of the two restriction subscales to reduce redundancy and to minimize parents' participant burden. The following 4 items were removed in order to refine the scales for higher reliability (final Cronbach α 's provided above): *Most of the food I keep in the house is healthy; My child should always eat all of the food on his/her plate; If I did not guide or regulate my child's eating, he/she would eat too many junk foods; I tell my child what to eat and what not to eat without explanation*. All items were rated using a seven-point Likert-type scale; responses ranged from 'disagree' to 'agree.' Finally, parents were asked to fill out a short survey about demographic information: parent and child ethnicity (racial and cultural heritage; generation status).

Strategy of Analysis

To examine the extent of conformity under different conditions, a mixed ANOVA with peer type (healthy or unhealthy) as the between-subject variable and food type (healthy or unhealthy) as within-subject variable was conducted. In addition, one-sample t-tests were conducted to examine whether conformity under each condition was significantly different from zero [i.e., no change in portion size, and thus no conformity]). To examine potential correlates of conformity, we ran partial correlation analyses between the magnitude of conformity and the parenting variables from the CFPQ after controlling for hunger status.

Results

First, we examined whether there were statistically significant differences in pre-manipulation variables between the healthy and unhealthy peers conditions. For pretest trials, there were no differences in children's baseline portion selections between peer conditions, with the exception of

potato chips' portions (healthy peers condition: 215.2 kcal, unhealthy peers condition: 293.4 kcal, $t(60.19) = 2.49, p = .016, d = .60$). Pearson Chi-Square tests showed that the two conditions did not differ in terms of gender composition and baseline hunger status ($p > .20$), suggesting that randomization to each condition was successful for gender, initial hunger status, and all pretest food items except potato chips.

The 2 (peer condition: healthy or unhealthy) x 2 (food type: high-ED or low-ED) repeated measures ANOVA showed a food type x peer condition interaction, $F(1, 72) = 16.11, p < .001, \eta^2 = .183$ (See Figure 3), but no main effects of either factor ($p > .10$). In the healthy peers condition (peers choosing large portions of low-ED foods and small portions of high-ED foods), participants demonstrated conformity by increasing their portion sizes of low-ED food by an average of 60.33 kcal, $SD = 146.04$ kcal, when tested against 0 (no conformity), $t(40) = 2.65, p = .012, d = 0.41$, two-tailed (hereafter), and decreasing high-ED foods' portion sizes by an average of 40.65 kcal, $SD = 117.49$ kcal, $t(40) = -2.22, p = .032, d = -0.35$. In the unhealthy peers condition (peers choosing large portions of high-ED foods and small portions of low-ED foods), participants showed a marginally significant change to portions of high-ED foods, $M = 38.99$ kcal, $SD = 131.37$ kcal, $t(32) = 1.71, p = .098, d = 0.30$, but did not change in conformity to portions of low-ED foods, $M = -3.23$ kcal, $SD = 100.86$ kcal, $t(32) = -.18, p = .855, d = -0.032$. To control for the potential effect of hunger status on the above results, a 2 (peer condition: healthy or unhealthy) x 2 (food type: high energy or low energy) ANCOVA with hunger included as a covariate was run. The results remained the same with a significant interaction, $F(1, 70) = 15.54, p < .001, \eta^2 = .182$, but no significant main effects.

Figure 3. Average change in participants' portion size based on high-ED and low-ED foods and peer conditions.

Note. Healthy condition= peers choose large portions of low-ED foods and small portions of high-ED foods, Unhealthy condition = peers choose large portions of high-ED foods and small portions of low-ED foods.

Correlates of children's eating behavior

Of 75 parents' surveys distributed, 54 parent surveys were returned. The items from each subscale of the Child Feeding Practices Questionnaire (CFPQ) were averaged to create a composite score for each subscale. For any missing items, the subscale was computed without that item. To establish mean conformity rates for each type of food (high-ED and low-ED), we aggregated participants' change in portion size from pretest to test trials across the two conditions (healthy and unhealthy peers). Given that greater conformity for healthy (unhealthy) peers would be represented by negative values for changes in selected portion sizes for high-ED (low-ED) foods, negative values were reversed to positive values (vice-versa for positive values) for these conditions. Partial correlation coefficients were computed to assess the relationship between the magnitude of conformity and the

parenting variables from the CFPQ (child's food environment, parental pressure to eat, parental restriction for health, and parental teaching about nutrition), controlling for initial hunger status. As shown in Table 1, marginally significant correlations were found between parental restriction for health and the two indices of conformity ($r = -.24, p = .076$, for high-ED foods, and $r = .26, p = .051$, for low-ED foods). In other words, children of parents who rated higher in restriction for their child's health conformed less to peers' portions of higher ED food and conformed more to peers' portions of lower ED food. There were no statistically significant correlations between conformity variables and the measures of child's food environment, parental pressure to eat, and parental teaching about nutrition (see Table 1 for details).

Table 1. Partial correlations controlling for hunger status.

Variable	1	2	3	4	5	6	7
1. Magnitude of Conformity to high-ED foods (kcal)	–	-.20	-.11	-.10	-.09	-.24 [†]	-.06
2. Magnitude of Conformity to low-ED foods (kcal)		–	-.12	-.15	-.10	.26 [†]	-.01
3. Gender			–	.19	-.07	.09	-.03
4. Child's food environment				–	-.19	-.31 [*]	.28 [*]
5. Parental pressure to eat					–	.38 ^{**}	-.12
6. Parental restriction for health						–	-.05
7. Parental teaching about nutrition							–

[†] $p < .10$ ^{*} $p < .05$ ^{**} $p < .01$

Note. Gender: 1= female, 2= male; Hunger status: 0=hungry, 1=half-full, 3=full; Parenting variables (6-9): higher values indicate greater endorsement of behavior by parents

Discussion

The current study examined whether preschool age children conformed to the social influence of remote peers' portion selection patterns and whether this effect differed by type of food (high vs. low energy density) and/or type of peer behavior (healthy vs. unhealthy). Methodologically, this study builds upon previous studies on social influence on portion selection behavior by using a computerized

portion selection task that realistically simulates intended energy intake across a range of foods. Additionally, this method allowed participants to directly select their desired personal portion sizes at pretest trials as opposed to researchers inferring personal portion size preferences from the amount participants consumed from a predetermined fixed quantity of food served to participants⁽¹⁵⁻¹⁹⁾, and thereby, reducing uncertainty in the source of modeling effects (i.e. experimenter bias). Instead of live peers, the current study also used remote peers. Conceptually, this study expands past research by exploring relatively healthy as well as unhealthy peer influence on food portions when different types of food are offered.

We found conformity effects in children's food portion selections, for both low and high-ED foods under the healthy peers condition, and a marginal effect for high-ED foods under the unhealthy peers condition. Results are consistent with previous studies on food modeling and also similar paradigms on conformity in non-food domains⁽⁶⁷⁻⁷¹⁾ showing that young children will change their judgments after viewing remote peers choose alternative responses. These findings complement prior studies⁽³²⁾ focusing on food choices, by adding that children are not just susceptible to social pressure to conform to peers' food preferences, but they are also sensitive and conform to portion selection patterns of others at this age. Some exceptions to this were the portion selections of high-ED and low-ED foods in the unhealthy peers condition, suggesting that healthier portion selection patterns of peers may elicit more conformity than unhealthy ones. Specifically, children did not reduce their portion of healthy low-ED foods when their unhealthy peers did, and only marginally increased their portions of unhealthy high-ED foods when their unhealthy peers did. One possible explanation for this finding is that it may be easier for young children to choose larger portions of foods that they are naturally more inclined to prefer. Children have innate, sensory preferences for sweet and salty tastes⁽⁷²⁾, which are typical to the palatable high-ED foods presented in the study. Seeing peers selecting larger portions for these palatable foods may signal the appropriateness or permissibility of consuming these foods. Conversely, children may require more social influence or incentives to change their initial portion selection of the low-ED foods. Another possibility is that children may already be aware of norms of these low-ED foods as being relatively healthier, and may be relatively more resistant to reducing or removing the consumption of foods considered to be healthy compared to engaging in extra indulgence of desired foods based on corresponding peer behavior. To further test this possibility, future studies should assess children's initial knowledge of health norms around different types of food.

In addition to filling the developmental gap in the literature, the current study also addressed a common limitation in the experimental design of prior research studies. The majority of experimental studies on peer modeling with adults and children have used baseline conditions (i.e. pretests) which can unintentionally communicate social expectations for how much to eat⁽³²⁾. For example, participants often receive common instructions such as eating as much as they would like from a fixed portion of food. If the portion sizes are large, for instance^(52,64,65), this experimental setup may provide unintentional normative information that encourages larger food intake than the experimental manipulation. Therefore, it remains unclear whether social models truly inhibit or promote eating behaviors based on experimental demand. The current study addressed this limitation⁽³²⁾ by using a computerized portion selection task with realistic images of familiar foods (representing specific amounts of energy) presented in random order to measure children's own precise food portions presented to them before and after the manipulation. Furthermore, early childhood interventions are primarily designed to increase healthy eating^(53,73-76). However, healthy eating is not exclusively a product of selecting healthier foods, but also avoiding excessive portion sizes, especially for energy-dense foods. More research is needed to understand both positive and negative peer influence on food consumption behaviors when different foods are offered⁽³³⁾. The current study addressed this by investigating both directions of peer influence using healthy and unhealthy peer groups.

Parent-child interactions can have a strong influence on a child's physical development, development of food preferences, the quality and quantity of their meals and knowledge of nutrition⁽³⁵⁾. Examining how different levels of parental control in children's feeding are related to children's sensitivity to others' choices will contribute to our understanding of how parenting and environment factors may be related to children's portion selections. The current study observed limited associations between parental practices and child conformity. Regardless of child's hunger status, parental restriction for food was found to be marginally negatively correlated with conformity to food portions for unhealthy foods, and marginally positively correlated with conformity to healthy foods. This finding provides partial support for our prediction that the more restrictive of food that parents reported to be for health reasons, the less compliant their children would be to peers' decisions. The fact that this correlation between parental restriction and conformity differed by food type suggests that it is possible that children may already have a rudimentary understanding of what foods are healthy and unhealthy before developing knowledge about healthy and unhealthy portion sizes. Thus, it is possible that regardless of whether peers are demonstrating healthy or unhealthy sized food portion selections,

children may simply be following social norms based on the healthy labels associated with the food itself. Although prior studies have looked at young children's nutrition knowledge (i.e. preschoolers have selected more fruits and vegetables as healthy and more desserts as unhealthy in a meal creation task, indicating an early understanding of food nutrition⁽⁷⁷⁾), future research should examine children's early understandings of healthy and unhealthy portion sizes. Another possibility is that parents' feeding practices may be a response to child characteristics (e.g. large appetite, self-control or impulsivity) that may also be associated with tendency to conform to others' food portion choices. In either case, the correlations were relatively weak so the finding and potential interpretations should be treated with caution.

There was no association between parental pressure to eat and conformity, which suggests that unlike parental restriction, parental pressure may not undermine compliance, or broadly interfere with social learning for peers' eating behaviors. Future studies should explore parents' expectations of children's independent or autonomous behavior to determine whether other parenting variables may be moderating this behavior or whether restrictive parenting is exclusively associated with low conformity to positive and negative peer influence.

We also found no evidence of associations between children's conformity to others' food portions and teaching of nutrition. One possible explanation is that parental teaching about nutrition may not necessarily include portion control, and may instead be more focused on food choice and selection (consuming healthy foods and avoiding unhealthy ones). Consistent with this notion, no items in the subscale measuring parents' teaching of nutrition explicitly mentioned portion control.

One limitation of the present study was that children's body mass index (BMI) was not collected or measured. Some studies have shown that body weight of participants moderated the degree of modeling. Normal-weight children were more likely to restrict their eating in no-eating norm condition compared to overweight children, whereas overweight children were more likely to overeat in the high norm condition compared to normal-weight children. However, these effects were not found to persist overtime⁽¹⁸⁾. Participants in the current study were randomly assigned into the different peer conditions, so that unmeasured individual differences, such as BMI should be randomly distributed across conditions. Nevertheless, future studies should include BMI to explore whether conformity effects are moderated by body weight of the participant. Another limitation is that actual food intake was not measured in the present study; thus, it remains unclear whether participants who increased or decreased their initially selected portions after exposure to social influence would actually continue to consume

an amount of energy that matches their portion. Given that adults typically consume most of the food they self-serve themselves^(64,78), it may be reasonable to expect that intake would match portion selection patterns after social influence, but this will require further investigation in the context of young children.

Another limitation is the parental feeding practices and low reliability of the scales. The low reliabilities observed in the current studies may be due to the use of the measures within a Singaporean context. Future studies should consider potential modifications to the scales to fit the cultural context of Singapore. The use of a more elaborate cover story for the manipulation, though not applied in previous conformity studies^(67,68,70,71), for greater ecological validity and minimization of participant suspicion. Finally, another limitation may be unintentional demand characteristics, despite experimenters' efforts to minimize pressure to the participant. Our results seem to suggest, however, that children did not seem to change their portion selections randomly or just because they were asked twice by the experimenter. Nonetheless, future studies should systematically examine the effects of experimenter's influence on conformity interviews.

Understanding children's food portion selections, especially in response to normative influences from others, must be studied more carefully to maximize health benefits and to prevent diseases such as obesity and diet-related chronic disease⁽⁷⁹⁻⁸²⁾. As children grow older, they develop important health habits and lifestyle choices that define their future well-being. Exploring the effects that conforming tendencies have on young children's food portion selections will not only advance our knowledge about the role of peers in learning about food and eating behavior, but also will allow us to continue developing controls of food choice, intake, and healthy portion sizes to better inform healthy-promotion interventions. Furthermore, the fact that remote peers in this experiment were effective in eliciting positive peer influence to help young children make healthier food choices suggests that coordination of live peers or confederates may not be necessary to successfully execute interventions that encourage healthy eating.

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522

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530 **Conflict of interest**

531 None

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