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How information about what is “healthy” versus “unhealthy” impacts children’s consumption of otherwise identical foods

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Abstract

Can brief messages about health influence children’s consumption of identical foods? Across a series of studies, we manipulated children’s consumption of identical foods (fruit sauces) by pairing those foods with brief messages about each food’s health status. What initially appeared to be a preference for foods described as healthy among 5–6-year-old children (Studies 1–2) actually reflected a preference for alternatives to foods described as unhealthy (Studies 3–5), including comparison foods that were described with negative or neutral content. Although the two foods on each trial were identical, children consistently ate more of the alternative to a food described as unhealthy. Similar effects were observed among 8–9-year-old children (Study 6). These results demonstrate that children’s eating behavior is affected by messages they receive from other people, including messages about health. Further, these studies reveal basic psychological mechanisms that contribute to children’s choices among foods, which could lead to effective interventions in the food domain.

Keywords: Food; Social Cognition; Cognitive Development; Health Messages; Eating

How information about what is “healthy” versus “unhealthy” impacts children’s food consumption

Learning what to eat is a critical problem of development. Several human food preferences are observed early in life and across cultures. From infancy, humans prefer sweet and salty flavors (which signal that foods are calorically dense) and avoid bitter flavors (which signal that foods could be toxic) (Birch, 1990, 1999; Coldwell, Oswald, & Reed, 2009; Mennella, Finkbeiner, Lipchock, Hwang, & Reed, 2014; Mennella, Lukasewycz, Griffith, & Beauchamp, 2011; Ventura & Mennella, 2011). Children and adults also prefer foods they have eaten before and avoid things they have not tried or that they associate with sickness (Aldridge, Dovey, & Halford, 2009; Bernstein, 1978, 1994; Birch & Marlin, 1982; Garb & Stunkard, 1974; Hausner, Nicklaus, Issanchou, Mølgaard, & Møller, 2009; Mennella, Jagnow, & Beauchamp, 2001). Although these early preferences shape human eating behavior in important ways, they do not explain the rich cultural diversity and social meaning that characterizes human food selection (Rozin, 2005; Rozin & Schiller, 1980). Moreover, in the modern food environment, humans cannot rely exclusively on early flavor and familiarity preferences to develop a healthy diet (Gearhardt, Grilo, DiLeone, Brownell, & Potenza, 2011; Mennella, Bobowski, & Reed, 2016). Fortunately, people do not need to choose foods in isolation. Children can determine which foods comprise a healthy, culturally appropriate diet by learning from other people (DeJesus, Kinzler, & Shutts, 2019; Nguyen, 2012; Shutts, Kinzler, & DeJesus, 2013; Wertz & Wynn, 2014). The current paper investigates whether brief messages about health impact children’s food intake, particularly when the foods only differ in the way they are described by another person (e.g., as “healthy” or “unhealthy”).

Health messages provide an interesting case study for social learning because the literature is relatively mixed regarding the influence of different types of health messages on children's eating behavior. Some past efforts to increase children's acceptance of healthy foods have even backfired: In one study with 9- to 11-year-old children, participants rated a drink labeled as "healthy" more negatively than a drink labeled as "new" and reported that they would be less likely to ask their parents to purchase the "healthy" drink (Wardle & Huon, 2000). Similarly, 3–5-year-old children presented with a food described as "healthy" chose to eat less of it than a control food, suggesting an early association between "healthy" and "not tasting good" (Maimaran & Fishbach, 2014). In contrast, interventions that build on young children's early intuitions that food serves important health functions (Inagaki & Hatano, 2004; Wellman & Johnson, 1982)—for example, by providing a theory-driven, causal framework to understand nutrition or by giving lessons about the connection between food and the body—have been shown to increase preschool-age children's nutrition knowledge (Gripshover & Markman, 2013; Nguyen, McCullough, & Noble, 2011; Sigman-Grant et al., 2014) and their vegetable consumption (Gripshover & Markman, 2013). The success of interventions that teach about nutrition and the body suggest that children are capable of conceptually rich thinking about food, that such thinking is related to children's food choices, and that children are capable of classifying foods as healthy vs. "junk" at as early as 3 years (Nguyen, 2007). However, such interventions are also highly resource-intensive, unfold over long periods of time, and would be difficult for most parents, schools, and clinicians to implement.

Developing brief, inexpensive interventions that could promote healthy eating in childhood, as well as understanding the psychological mechanisms underlying children's responses to these interventions, are important contributions to efforts to promote children's

health and reduce childhood obesity (Cunningham, Kramer, & Narayan, 2014; Ebbeling, Pawlak, & Ludwig, 2002; Freedman et al., 2005; Levi, Segal, Rayburn, & Martin, 2015; Nader et al., 2006; Ogden, Carroll, Kit, & Flegal, 2014; Wang & Beydoun, 2007). The potential for social learning to encourage healthier food choices is especially important given that, on average, children in the United States are not meeting recommendations for fruit and vegetable intake (Kim et al., 2014; Muñoz, Krebs-Smith, Ballard-Barbash, & Cleveland, 1997). Further, the modern food environment is replete with misleading signals such as nonnutritive sweeteners and easily accessible foods that are high in sugar, fat, and salt (Gearhardt et al., 2011; Mennella et al., 2016). In addition to the high prevalence of clearly unhealthy foods, the health status of many foods is ambiguous. For example, lay opinion is that that yogurt is healthy; yet, yogurts (especially yogurts with child-friendly marketing) are often very high in sugar (Moore, Horti, & Fielding, 2018). Therefore, discovering strategies that promote healthier food choices – especially early in development – is critical.

Across a series of studies employing a common method, we presented children with pairs of identical foods, each described using a different message. We aimed to better understand the early psychological impact of brief health messages on children's eating behavior. Describing identical foods using different messages allowed us to isolate the effect of message content (compared to a food's flavor, ingredients, packaging, or appearance). Message content was manipulated across studies. We primarily recruited 5- and 6-year-old children in the present studies based on past studies showing that children are capable of reasoning about food and health by this age (Gripshover & Markman, 2013; Nguyen, 2007; Sigman-Grant et al., 2014), but that children do not necessarily select healthy foods at this age or later in childhood (Maimaran & Fishbach, 2014; Wardle & Huon, 2000). We measured actual consumption to

obtain an ecologically valid assessment of the effect of message content on children’s choices. In addition to our primary measure of consumption, children were subsequently asked to evaluate the foods (and these evaluation data are presented in the Supplemental Materials, available on the Open Science Framework).

In Studies 1 and 2, we examined 5- and 6-year-old children’s intake of otherwise identical foods that were described with messages about their healthiness versus unhealthiness. After observing a general preference for “healthy” over “unhealthy” foods, we next examined the mechanisms underlying children’s differential consumption of foods: Does children’s consumption reflect a preference for healthy foods, a desire to avoid unhealthy foods, or both (Studies 3, 4, and 5)? Finally, in Studies 6 and 7, we examined the scope of our observed effects by including older children (8–9-year-old children; Study 6) and by testing 5–6-year-old children with pared-down messages about the foods (Study 7). All studies presented a variant of a common method, which is described in detail in Study 1. Together, these studies provide a deeper understanding of the early psychology of food selection.

Study 1: Healthy vs. Unhealthy

In Study 1, an adult informant presented children in a university lab setting with one food described as healthy (“This food is very healthy. It has a lot of healthy ingredients. It will make your bones and muscles get strong”) and an identical food described as unhealthy (“This food is not very healthy. It does not have healthy ingredients. It won’t make your bones and muscles get strong”). Children’s consumption of the two foods was measured. We reasoned that children might eat more of the healthy food given that it was described more positively. Alternatively, past research suggests that children sometimes avoid eating a food described as

"healthy" because they infer that it does not taste as good. (Maimaran & Fishbach, 2014; Wardle & Huon, 2000).

Method

Participants. Participants included 32 5- and 6-year-old children. Children participated in a laboratory located in a city in the Midwestern region of the United States. See Table 1 for additional details on demographics and exclusions.

Materials. Children were presented with two identical foods on each trial and each child participated in two trials. One trial used a single-serving package of Gerber® 2nd Foods Pear Blueberry sauce, while the other used a single-serving package of Motts® Natural Applesauce. For each trial, foods were prepared by dividing the single-serving cup of fruit sauce into two smaller plastic cups. Each small plastic cup was placed inside a larger bowl (yellow, green, red, or blue) with a white plastic spoon. Both foods in each trial were served on one tray for ease of movement.

These foods were selected because they are typically familiar to children of this age, so we expected that children would be generally willing to try this food in an unusual setting (i.e., the laboratory) and that parents would approve of children eating it. Neither food contained added sugars or artificial sweeteners. We have used these foods in related studies and found that children's consumption and evaluation of these foods, despite their familiarity, can be influenced by context (DeJesus, Shutts, & Kinzler, 2015; DeJesus, Shutts, & Kinzler, 2018). These fruit sauces are referred to as "food" throughout for brevity, but we return to the issue of generalizability to a broader range of foods in the General Discussion.

Procedure. An experimenter brought the child into the testing room and introduced the child to a "teacher." Children sat facing the teacher at a rectangular table containing one set of

bowls and foods. The experimenter then left the room. A second experiment, the teacher, introduced herself to the child by saying, “I’m a teacher at a school right near here. I know a lot about the foods at my school. I’m going to tell you about some foods today.” The teacher then described each food to the child. For the healthy food, the teacher said, “This food is very healthy. It has a lot of healthy ingredients. It will make your bones and muscles get strong.” For the unhealthy food, the teacher said, “This food is not very healthy. It does not have healthy ingredients. It won’t make your bones and muscles get strong.” These messages were designed to ensure that all children had access to the same information about the meaning of “healthy” and “unhealthy” without providing any additional information about the food’s flavor, ingredients, or brand. We refer to these foods throughout the paper as “healthy” and “unhealthy” for brevity. (Though to note, in Study 7, we specifically examine whether simply labeling foods as “healthy” and “unhealthy” without additional descriptions influenced children’s eating behavior.)

After the teacher described each food, the first experimenter returned to the testing room and said that the teacher was needed elsewhere. The teacher told the child, “you can eat whatever you want,” pushed the foods towards the child, and left the room. The experimenter remained in the room and appeared to read a magazine in the corner of the testing room while timing for 60 seconds, during which children could freely eat or not eat the provided foods. This parameter was set so there would be a clear end to each trial and so that all children would have an equal amount of time with the foods (whether they ate or not).

A research assistant sat behind a screen in the testing room and triggered a light placed outside the testing room to alert the experimenter to enter the room after the teacher completed the messages so that the experimenter would be unaware of the message content paired with each food. The research assistant triggered the light again to alert the teacher to enter the room for the

second trial so that the teacher would be unaware of children's eating behavior in the first trial. To reduce any overt social pressure children might feel to eat a particular food (or to eat at all), the teacher left the room while children ate and the experimenter unobtrusively supervised the study by appearing to read a magazine.

Food consumption was our primary measure of interest in this study and was measured as the number of bites of food children took in the study. Foods were also weighed before and after the test session. In addition, after participants had the opportunity to eat the foods, children were asked to evaluate each food on a 5-point Likert scale that ranged from "not yummy at all" to "really really yummy." Children's evaluations largely followed similar patterns to their consumption data (see Supplemental Materials).

All procedures were approved by our Institutional Review Board. Parents of participating children provided written consent and completed demographic questionnaires and questionnaires asking about children's food allergies. Children were tested between 2012 and 2017 and each child participated in only one of the studies reported here.

Design and Analyses. The pairing of message to bowl (e.g., the red bowl to the healthy vs. unhealthy message) was counterbalanced across participants. Half of children heard a positive (healthy) message first on the first trial, whereas half of children heard a negative (unhealthy) message first on the first trial. Children who heard a positive message first on the first trial heard a negative message first on the second trial, and vice versa.

In Study 1, as well as in all subsequent studies, we conducted a repeated-measures Poisson regression model with number of bites eaten as the outcome and food type (healthy, unhealthy; reference category = unhealthy) and gender (male, female; reference category = female) entered as predictors. For significant predictors, we report exponential effect sizes with

95% confidence intervals for significant predictors (Coxe, 2018). Bites (rather than grams) were analyzed in this manner after inspection of the data revealed that responses were not normally distributed. Bites eaten provides a count variable that differentiates between true 0s and very small bites. Across studies, bites and grams for each child were highly correlated, $r(312) = 0.89$, $p < .001$ (grams data are presented in the Supplemental Table 1). Means and bootstrapped 95% confidence intervals are presented as descriptive statistics of children's food intake.

We included gender in our analyses based on research showing that children prefer foods eaten by same-gender models (Frazier, Gelman, Kaciroti, Russell, & Lumeng, 2012; Shutts, Banaji, & Spelke, 2010), as well as a previous study showing that girls (but not boys) ate more foods offered by peers than by teachers (Hendy & Raudenbush, 2000). Additional analyses are described where relevant. The data and analysis code for all studies are available on the Open Science Framework.

Results and Discussion

Children ate more of the food described as healthy ($M = 6.28$, $CI = 4.37, 8.47$) than the food described as unhealthy ($M = 2.03$, $CI = 1.31, 2.81$), $b = 1.13$, $SE = 0.14$, $z = 7.91$, $p < .001$, exponential effect size = 3.09 ($CI = 2.31, 4.10$). No significant effect of gender was observed, $b = -0.08$, $SE = 0.12$, $z = -0.61$, $p = .54$. See Supplemental Materials for children's evaluations and Table 2 for the number of participants who ate all foods, just one food type, or no foods across studies.

Given that children ate more of the healthy food, we next examined whether this finding was primarily driven by valence (i.e., children interpreting "healthy" as generally good and "unhealthy" as generally bad) or more specifically by the particular messages presented here, as well as the generalizability of this finding across contexts. Accordingly, in Study 2, each food

was described using one positive and one negative attribute.

Study 2: Healthy/Unpopular vs. Popular/Unhealthy

In Study 2, an adult described one food as healthy but not popular and described the other food as popular but not healthy (including explanatory details) in a laboratory context. If children interpret healthy and unhealthy messages as meaning generally "good" and "bad" (respectively), then they might not differentiate between the foods in Study 2, as each food had one positive and one negative attribute. If children do consider the described health status of foods, then they might eat more of the healthy/unpopular food than the popular/unhealthy food. Social messages were selected as the comparison because previous research reveals that children at this age prefer foods that have been endorsed by other children and people who match their social group membership (Birch, 1980; DeJesus et al., 2018; Frazier et al., 2012; Hendy & Raudenbush, 2000; Shutts et al., 2010). Therefore, children may alternatively be inclined to eat a food described as popular among other children, compared to a food described as healthy.

Method

Participants. Participants included 32 5- and 6-year-old children. Children participated in a laboratory in a Midwestern U. S. city (see Table 1).

Procedure. The procedure was identical to Study 1, except for the messages provided. For the healthy/unpopular food, children heard, "This food is very healthy but it is not very popular. It has a lot of healthy ingredients. It will make your bones and muscles get strong. But kids don't think this food is a cool food to eat. No one eats it at school with their friends." For the popular/unhealthy food, they heard, "This food is very popular but it is not very healthy. All the kids think it's a cool food to eat. Everyone eats it at school with their friends. But this food does not have healthy ingredients. It won't make your bones and muscles get strong." The

popular and unpopular messages were taken from a related study (DeJesus et al., 2018), in which 5- and 6-year-old children ate more food described as popular than food described as unpopular and reported that the popular food tasted better than the unpopular food.

In addition to the counterbalancing structure reported in Study 1, the presentation order for positive and negative components of each message was counterbalanced across participants.

Results and Discussion

Children ate more of the food described as healthy but not popular (M = 5.75, CI = 3.47, 8.53) than the food described as popular but not healthy (M = 2.16, CI = 1.31, 3.13), b = 0.98, SE = 0.14, z = 6.95, $p < .001$, exponential effect size = 2.67 (CI = 2.03, 3.52; see Figure 1, left). No significant effect of gender was observed, b = 0.09, SE = 0.13, z = 0.69, p = .49. See Supplemental Materials for children’s evaluations.

Children’s preference for “healthy but not popular” foods could be considered somewhat surprising, particularly given past research showing that children like and consume more of foods that they think other children like to eat (Birch, 1980; DeJesus et al., 2018; Frazier et al., 2012; Hendy & Raudenbush, 2000; Shutts et al., 2010), as well as studies finding that health messages can backfire (Maimaran & Fishbach, 2014). Yet, this finding seems to be robust: We replicated and extended this basic finding in two different contexts, which are reported in full in the Supplemental Materials. In Supplemental Study 1, we presented children with the messages from Study 2 in a school setting. In Supplemental Study 2, a child informant presented children with the messages from Study 2 in a lab setting. Participants tested in both contexts (a school setting with an adult informant and in a lab setting with a child informant) similarly ate more of the food described as healthy but not popular than the food described as popular but not healthy. Overall, these studies provide striking evidence of children’s responses to health messages in

guiding their consumption, even when choosing between otherwise identical foods.

One possibility is that children really do recognize the value of healthy eating, and our studies could provide evidence of this. American diets and nutrition knowledge have improved in recent years (Guthrie, Derby, & Levy, 1999; Rehm, Peñalvo, Afshin, & Mozaffarian, 2016). Moreover, children are capable of learning about nutrition in the preschool years (Gripshover & Markman, 2013; Nguyen, 2007). If so, simply telling children that foods are healthy could serve as a successful intervention to promote healthy eating. Alternatively, a different interpretation of the results from Studies 1 and 2 is that children's behavior does not reflect an affinity for foods described as healthy. Instead, children's performance may reflect a tendency to selectively avoid foods described as unhealthy. Our results might indicate that children preferentially consume alternatives to foods described as unhealthy, rather than seeking out healthy foods per se. In past studies demonstrating that children ate less of foods described as healthy (Maimaran & Fishbach, 2014; Wardle & Huon, 2000), the alternative options presented were foods described as tasting good or foods described neutrally, but not foods described as unhealthy. Thus, children's early and robust attention to the unhealthy component of the messages in Studies 1 and 2 could account for children's differential food consumption. Studies 3–5 tested this possibility.

Studies 3–5: Do Children Prefer Healthy Foods or Avoid Unhealthy Foods?

Studies 3–5 examined whether children in previous studies were attracted to healthy foods or repelled by unhealthy foods (or both). In Studies 3 and 4, we compared children's consumption of foods described using a neutral message to foods described as unhealthy (Study 3) and as healthy (Study 4). In Study 5, we compared children's consumption of unhealthy vs. unpopular foods.

Study 3: Unhealthy vs. Neutral

Children in Study 3 were presented with a food described as unhealthy and a food described neutrally (including explanatory details). If children were motivated to select the alternative to an unhealthy food in previous studies, we would expect children to eat more of the neutral food than the unhealthy food.

Method

Participants. Participants included 32 5- and 6-year-old children. Children participated in a laboratory study in a Midwestern U. S. city (see Table 1).

Procedure. One food was described as unhealthy and one food was described neutrally. For the unhealthy food, the teacher again said, "This food is not very healthy. It does not have healthy ingredients. It won't make your bones and muscles get strong." For the neutral food, the teacher said, "This food is right here. It has a lot of ingredients. You can buy this food at the store." Other than the change in message content, the method was identical to Study 1.

Results and Discussion

Children ate more of the neutral food (M = 7.62, CI = 5.41, 10.06) than the unhealthy food (M = 3.72, CI = 2.44, 5.25), b = 0.72, SE = 0.11, z = 6.42, p < .001, exponential effect size = 2.05 (CI = 1.66, 2.57; see Figure 2, left). No significant effect of gender was observed, b = -0.08, SE = 0.11, z = -0.72, p = .47. See Supplemental Materials for children's evaluations.

Children's eating in Study 3 suggests that children prefer the alternative to an unhealthy food (rather than seeking out healthy foods). In Study 4, we further examined this possibility by comparing children's consumption of a healthy food and a neutral food.

Study 4: Healthy vs. Neutral

Children in Study 4 were presented with one food described as healthy and one food described neutrally (including explanatory details). If children are motivated to eat healthy foods

directly, as opposed to the alternative to an unhealthy food, we would expect children to eat more of the healthy food compared to the neutral food. Alternatively, children might not differentiate between healthy and neutral foods, or might eat more of the neutral foods if they assume that healthy foods do not taste good.

Method

Participants. Participants included 32 5- and 6-year-old children. Children participated in a laboratory study in a Midwestern U. S. city (see Table 1).

Procedure. One food was described as healthy and one food was described neutrally. For the healthy food, the teacher again said, “This food is very healthy. It has a lot of healthy ingredients. It will make your bones and muscles get strong.” For the neutral food, as in Study 3, the teacher said, “This food is right here. It has a lot of ingredients. You can buy this food at the store.” Other than the change in message content, the method was identical to Study 1.

Results

We observed no significant effect of food type, b = -0.05, SE = 0.11, z = -0.40, p = .69 (see Figure 2, right). Children ate similar amounts of the healthy food (M = 4.75, CI = 3.25, 6.34) and the neutral food (M = 4.97, CI = 3.41, 6.53). No significant gender effect was observed, b = 0.15, SE = 0.11, z = 1.30, p = .19. See Supplemental Materials for children’s evaluations.

Comparing across Studies 3 and 4, children ate more of the food described as healthier (M = 6.19, CI = 4.78, 7.63) than as less healthy (M = 4.34, CI = 3.28, 5.52), b = 0.72, SE = 0.11, z = 6.42, p < .001, exponential effect size = 2.05 (CI = 1.65, 2.57). Children also ate more in Study 3 (M = 11.34, CI = 8.16, 14.9 than in Study 4 (M = 9.72, CI = 6.88, 12.44), b = 0.29, SE = 0.12, z = 2.39, p = .017, exponential effect size = 1.34 (CI = 1.05, 1.68). A significant

interaction between food and study was also observed, b = -0.76, SE = 0.16, z = -4.79, $p < .001$, exponential effect size = 0.47 (CI = 0.34, 0.63). To examine this interaction, we compared the difference in children's bites of healthier vs. less healthy foods in Study 3 (M = 3.91) to Study 4 (M = -0.22) and found that this difference was significantly larger in Study 3 than Study 4, $t(57.69) = 3.61$, $p < .001$.

These studies provide evidence that even young children consider the health status of a food when deciding what to eat. At the same time, the mechanisms underlying children's choices may be different from those that adults would assume at first glance: Choices of healthy foods could reflect a selection among alternatives, rather than a specific interest in healthfulness. Children's eating behavior also demonstrated variability across the presented foods, as shown in Figure 2. Rather than reducing their intake of the unhealthy food (and potentially eating similar amounts of healthy and neutral food), children ate more neutral food. One possibility is that children view the "neutral" food differently depending on the alternative to which it is compared. Children may view the neutral food as a smart or desirable choice compared to the unhealthy food (and therefore eat more), but they may view the neutral food slightly less positively when compared with a healthy food. Another possibility is that children's existing health knowledge does not necessarily translate into a useful health strategy at this stage. Children seem to respond based on a conceptualization of unhealthy foods as relatively less desirable, but they might not realize that a better health strategy would be to reduce their intake of unhealthy food (rather than increasing their intake of the alternative). These possibilities may operate in tandem to boost children's intake of the neutral food (relative to unhealthy), rather than a pattern of eating in which healthy foods were maximized and unhealthy foods were minimized.

Study 5 provides an additional test of children's willingness to eat the alternative to an

unhealthy food – here, children were presented with one food described as unhealthy and one food described as unpopular. Given that children could reject both foods, Study 5 provides an especially stringent test of children's tendency to eat the alternative to an unhealthy food. We hypothesized that children might eat more of the unpopular food than the unhealthy food, even though both foods were described negatively.

Study 5: Unhealthy vs. Unpopular

Children in Study 5 were presented with one food described as unhealthy and one food described as unpopular. If children primarily prefer healthy foods, we might not expect children to differentiate between these two foods, given that they were both described negatively. In contrast, if children's responses in previous studies were primarily driven by a desire to avoid the unhealthy food, we would expect children to eat more of the unpopular food than the unhealthy food.

Method

Participants. Participants included 32 5- and 6-year-old children. Children participated in a laboratory study in a Midwestern U. S. city (see Table 1).

Procedure. Foods were described as either unhealthy or unpopular. For the unhealthy food, the teacher said, "This food is not very healthy. It does not have healthy ingredients. It won't make your bones and muscles get strong." For the unpopular food, the teacher said, "This food is not very popular. Kids don't think this food is a cool food to eat. No one eats it at school with their friends." The procedure and design were otherwise identical to Study 1.

Results and Discussion

Children ate more of the food described as unpopular (M = 5.25, CI = 3.31, 7.56) than the food described as unhealthy (M = 2.75, CI = 1.53, 4.38), b = 0.65, SE = 0.13, z = 4.91, p <

.001, exponential effect size = 1.91 (*CI* = 1.47, 2.46). No significant effect of gender was observed, $b = -0.03$, $SE = 0.13$, $z = -0.25$, $p = .80$. See Supplemental Materials for children's evaluations.

Taken together, Studies 3, 4, and 5 suggest that children's patterns of eating are best characterized as consuming the alternative to an unhealthy food, rather than seeking out healthy foods. Children ate more of the neutral food compared to the unhealthy food (Study 3), yet they did not distinguish between a healthy food and a neutral food (Study 4). Study 5 provided additional evidence that children eat more of the alternative to an unhealthy food: Both foods were described negatively and children could have rejected both foods. Yet, children ate more of the food described as unpopular than the food described as unhealthy.

Studies 6 & 7: Scope of the Effect

In two final studies, we examined the scope and generalizability of children's consumption of the alternative to an unhealthy food. We replicated our basic finding with 8- and 9-year-old children (Study 6) and presented 5- and 6-year-old children with simpler messages about health and popularity without explanatory details about those concepts (Study 7).

Study 6: Healthy/Unpopular vs. Popular/Unhealthy (Older Children)

In Study 6, we recruited older children (8- and 9-year-olds) to participate in the same procedure as Study 2: Children were presented with one food described as healthy but not popular and one food described as popular but not healthy (including explanatory details). We tested older children to explore the possibility that children's consideration of messages about health versus popularity may shift with age. In particular, research suggests that as children age, popularity and social status become more important to them, and children's peer networks become structured around friendship-based social groups (Bukowski, Hoza, & Boivin, 2006;

Putallaz & Gottman, 1981; Rubin, Bukowski, & Bowker, 2015). By adolescence, interventions that align with social values, including those designed to decrease unhealthy eating, are more effective than interventions that demonstrated success among younger children (Yeager, Dahl, & Dweck, 2017). For instance, adolescents selected healthier snacks after writing about the manipulative practices of the food industry (Bryan et al., 2016), suggesting that different messages or values may be persuasive at different ages. Thus, we recruited 8- and 9-year-old children, who had been in school for more time but were still at an age at which our method would be appropriate, to test whether older children would be persuaded by information about popularity or whether their responses would mirror those of younger children. The latter result would suggest some degree of developmental continuity in the effects observed thusfar.

Method

Participants. Participants included 33 8- and 9-year-old children. Children participated in a laboratory study in a Midwestern U. S. city (see Table 1).

Procedure. Study 6 was identical to Study 2, except that it included older children.

Results and Discussion

As in previous studies, children ate more of the food described as healthy but not popular (M = 10.36, CI = 7.67, 13.15) than the food described as popular but not healthy (M = 4.52, CI = 3.18, 5.88), b = 0.83, SE = 0.10, z = 8.46, $p < .001$, exponential effect size = 2.30 (CI = 1.89, 2.79). No effect of gender was observed, b = -0.02, SE = 0.09, z = -0.19, p = .85. See Supplemental Materials for children’s evaluations.

We also compared Studies 2 and 6, as both studies used the same procedure with different age groups. Overall, children ate more of the healthy/unpopular food (M = 8.09, CI = 6.12, 10.26) than the popular/unhealthy food (M = 3.35, CI = 2.48, 4.28), b = 0.98, SE = 0.14, z =

6.95, $p < .001$, exponential effect size = 2.67 (*CI* = 2.03, 3.53), and older children in Study 6 (*M* = 14.88, *CI* = 11.54, 18.06) ate more food than younger children in Study 2 (*M* = 7.91, *CI* = 4.97, 10.94), $b = 0.74$, $SE = 0.15$, $z = 5.08$, $p < .001$, exponential effect size = 2.09 (*CI* = 1.56, 2.82). No significant interaction between food and age group was observed, $b = -0.15$, $SE = 0.17$, $z = -0.87$, $p = .38$.

Children's eating behavior in Study 6 was particularly interesting given the possibility that older children might have placed more value on information about a food's popularity (compared to younger children). Instead, just like younger children in Study 2, older children in Study 6 ate more healthy/unpopular food compared to popular/unhealthy food, suggesting some degree of continuity in children's responses (although the possibility remains that this pattern would shift as children enter adolescence). In Study 7, we provide a final extension of this effect by recruiting 5- and 6-year-old children and just labeling foods as healthy/unpopular and popular/unhealthy, without the explanatory details provided in previous studies.

Study 7: Healthy/Unpopular vs. Popular/Unhealthy (Short Messages)

Five- and 6-year-old children in Study 7 were presented with foods labeled as healthy but not popular and popular but not healthy, without any additional details describing what those labels meant. We aimed to examine whether simple labels (without supporting content) would be sufficient to guide children's differential food consumption.

Method

Participants. Participants included 32 5- and 6-year-old children. Children participated in a laboratory study in a Midwestern U. S. city (see Table 1).

Procedure. Study 7 was identical to Study 2 (foods were described as healthy but not popular or popular but not healthy), except that children only heard labels; we eliminated the

other message details. Thus, children were only told that, “This food is very popular but it is not very healthy” and “This food is very healthy but it is not very popular.”

At the very end of the study, children were also asked what “it means for a food to be very healthy” and what “it means for a food to be not very healthy.” Two coders categorized the content of each explanation as one of three mutually exclusive codes: General health (e.g., “good for you” or “bad for you”), content resembling messages from prior studies (such as “makes your bones and muscles get strong,” “will make you sick” or mentioning ingredients/composition), or other/don’t know. Both coders coded all explanations; reliability was high (kappa = 0.83) and disagreements were resolved by discussion.

Results and Discussion

Children ate more of the food labeled as healthy but not popular (M = 8.12, CI = 5.69, 10.53) than the food labeled as popular but not healthy (M = 5.25, CI = 3.69, 7.34), b = 0.43, SE = 0.13, z = 3.43, $p < .001$, exponential effect size = 1.54 (CI = 1.20, 1.99). Boys took fewer bites (M = 2.59) than girls (M = 4.09), b = -0.46, SE = 0.16, z = -2.91, p = .004, exponential effect size = 0.63 (CI = 0.46, 0.85), but no significant interaction between food type and gender was observed, $b < 0.01$, SE = 0.20, z = 0.03, p = .97. See Supplemental Materials for children’s evaluations.

Children’s explanations of what it means to be healthy and unhealthy revealed some health knowledge related to the messages delivered in previous studies, but most children did not provide a detailed explanation. Roughly 50% of children’s explanations were coded as general (“good for you”, “bad for you”), 36% of children mentioned a feature of the detailed message content from previous studies (e.g., referring to growth, strength, or ingredients), and 14% of children either did not provide an explanation or named a food (e.g., apple, candy). No

significant difference in explanation code was observed based on whether children were asked what it means to be healthy vs. unhealthy, χ^2 (2) = 0.74, p = .691.

Study 7 replicated the finding that children eat more of a healthy/unpopular food compared to a popular/unhealthy food. This study also demonstrated that although most children’s explanations conveyed some idea of what it means to be healthy or unhealthy (though see Sigman-Grant et al., 2014, for evidence that children may associate "good for you" with taste, rather than health), far fewer explanations included detailed information about the consequences of eating healthy and unhealthy foods (as was provided in our messages in all other studies). Such category labels, in addition to being an efficient shorthand for communication, can serve as messages themselves and provide opportunities to both invite and impede conceptual change by linking to deeper explanatory content and reifying categorical boundaries (Gelman & DeJesus, 2018). Children’s health explanations reveal some insight into the meaning of health in a food context – most explanations included an indication that healthy foods are good for the body and unhealthy foods are not, but most children did not spontaneously offer more complex details. Nevertheless, even without the supporting information provided to them, children ate the alternative to the unhealthy food.

General Discussion

The present research reveals the power of brief messages about health to influence children’s consumption of otherwise identical foods (in this case, fruit sauces). In Studies 1 and 2, children ate more of foods described as healthy (or healthy but not popular) compared to foods described as unhealthy (or unhealthy but popular). Studies 3, 4, and 5 revealed that this effect was primarily driven by children’s attention to the “unhealthy” message – children ate more of the alternative to an unhealthy food, but they did not differentiate between healthy foods and

foods described neutrally. Studies 6 and 7 demonstrated the scope of this effect: 8- and 9-year-olds similarly ate more of the healthy but unpopular food than the popular but unhealthy food, and simply labeling foods was sufficient to elicit this effect among younger children. Children's evaluations largely mirrored their food intake, providing converging evidence for these results (see Supplemental Materials).

What are the practical consequences of these findings? One might wonder what the value is of changing children's intake of fruit sauce by a just a few bites in a laboratory setting. We view this series of studies as having two important practical consequences. First, these studies reveal a potential new strategy for guiding children's food choices: Focusing on what is unhealthy, rather than exclusively encouraging children to eat healthy foods. Strategies that provide rewards for eating healthy foods, such as desserts or additional television time (Birch, Marlin, & Rotter, 1984; Newman & Taylor, 1992; Wardle, Herrera, Cooke, & Gibson, 2003), have been largely ineffective. Despite some successes (Gripshover & Markman, 2013; Sigman-Grant et al., 2014), many interventions focused on delivering verbal lessons to children in classroom settings have had modest beneficial effects at best (Colquitt et al., 2016; Wolfenden et al., 2012). The present results suggest that a more effective strategy might be to focus on the unhealthy side of the equation. Related strategies have been examined with adults: In studies that provide adults with information about what is healthy and what is not (such as calorie labels with recommended daily intake or warning labels about high sugar beverages), adults make healthier choices for themselves and their children (Donnelly, Zatz, Svirsky, & John, 2018; Moran & Roberto, 2018; Roberto, Larsen, Agnew, Baik, & Brownell, 2010). The present studies are the first to provide converging evidence that messages about what is unhealthy can influence young children's own food choices. Second, understanding how to change people's attitudes

towards foods that are familiar and well-liked (such as the fruit sauce presented to children in this study) is an important endeavor in a food environment where many well-liked foods, including those that are often considered to be healthy by consumers, actually include unhealthy ingredients or lack in nutritional value. For instance, the American Academic of Pediatrics recently changed its guidance on fruit juice intake to discourage parents from offering it to children due to its high sugar content and lack of protein and fiber; nevertheless, many people think of juice as a healthy choice (Heyman & Abrams, 2017). The area in which there is most disagreement lies not in foods such as cookies, ice cream, and soda (which both laypeople and nutritionists agree are unhealthy), but rather in foods such as fruit juice, frozen yogurt, and granola, which laypeople tend to think are somewhat healthy but nutritionists view as unhealthy (Quealy & Sanger-Katz, 2016). Messages that alter the intake of otherwise identical foods points to a possible strategy to change attitudes towards these pseudo-health foods, which could ultimately encourage healthier eating across the lifespan. Among adults, small cumulative changes in health-related behaviors have been shown to add up to meaningful differences in outcomes (Damschroder et al., 2014; Lutes et al., 2008), but additional research is needed to assess the effectiveness of similar strategies in children, including those that use messages such as those developed in these studies.

From a broader perspective, the present research sheds light on the mechanisms that guide children's differential intake of otherwise identical foods and can help reconcile conflicting evidence over whether messages about health are attractive to children. At first blush, our initial findings suggested that children prefer foods described as "healthy." Children's apparent affinity for foods described as "healthy" was at odds with previous findings suggesting that children discount foods described as "healthy" as not being appealing to eat (Maimaran &

Fishbach, 2014; Wardle & Huon, 2000) and the everyday experience of many parents and caregivers. Nevertheless, further investigation revealed that children's responses were not driven by a preference for healthy foods per se but instead by a preference for eating the alternative to foods described as unhealthy. Taken together, our results and these previous findings suggest that describing a food as *healthy* is unlikely to make that food appealing to children. Nevertheless, these results also suggest that children's food choices are malleable from an early age and that children are engaging in somewhat consistent strategies to avoid *unhealthy* foods. Across development, children have an increasing conceptual understanding of health, nutrition, and growth (Gripshover & Markman, 2013; Inagaki & Hatano, 2004; Nguyen, 2007; Nguyen et al., 2011; Schultz & Danford, 2016; Sigman-Grant et al., 2014; Wellman & Johnson, 1982) and future research could examine how children view the immediate and long-term consequences of healthy vs. unhealthy eating and how that conceptualization may shift with age.

These studies raise several important questions for future research. First, how might children react to a broader set of foods and messages? Children ate less of the "unhealthy" option when presented with two identical fruit sauces, but to what extent would this generalize to foods that are more obviously healthy but less typically liked by children (such as broccoli) and unhealthy foods that children typically enjoy eating (such as brownies)? Fruit sauce was selected in these studies because it is familiar to children (so we expected few children to completely reject it) and it strikes a balance between being relatively sweet, given that children prefer sweet foods (Birch, 1990, 1999; Ventura & Mennella, 2011), but not obviously unhealthy. It is unknown whether the messages used in the present studies would be similarly effective in increasing children's acceptance of bitter foods, which children tend to dislike but is a common flavor in vegetables (Ventura & Mennella, 2011), or overcoming the assumption that healthy

foods do not taste good (Maimaran & Fishbach, 2014; Raghunathan, Naylor, & Hoyer, 2006). Testing the limits of the messages used in the present studies is an important direction for future research. Changing children's attitudes towards unfamiliar or new foods might be helpful as well, as children may assume that foods that have been modified to be healthier are necessarily less tasty (Harris, Hyary, & Schwartz, 2016). The finding that children's evaluations of these foods largely aligned with their patterns of eating suggests that presenting these messages could be a promising avenue – in addition to eating more of the alternative to an unhealthy food, children reported liking it more too (see Supplemental Materials). Considering the content of the messages designed for the present studies, we chose not to directly pit "healthy" and "tasty" messages against each other to avoid reinforcing the perception that healthy foods do not taste good, but the development of this impression and methods to overcome it are important directions for future studies.

Second, how might the explicit messages provided in this study differ from or complement the language that parents use at home when talking about food or health? Several studies have examined parental talk about food, often focusing on patterns of restriction and encouragement (e.g., Pesch, Miller, Appugliese, Rosenblum, & Lumeng, 2018; Stark et al., 2000). In one study, mothers of obese children used more direct imperatives when their child was presented with a familiar dessert compared to mothers whose children were not obese (Pesch et al., 2018). Prior studies have also found that parents report modeling healthy eating at home and discussing the taste and health of foods (Hendy, Williams, Camise, Eckman, & Hedemann, 2009; Musher-Eizenman & Holub, 2007; Tibbs et al., 2001), but relatively few studies have examined how parents spontaneously talk about health. In one study that provided parents with picture books about vegetables to encourage children to be more receptive to those foods, two-

year-old children were more likely to eat vegetables and rate vegetables more positively (compared to baseline) at a 3-month follow-up (Owen, Kennedy, Hill, & Houston-Price, 2018). However, it is unclear if these effects were due to exposure from the book, more offers of those foods from parents (since the foods were delivered to families as part of the study and parents were encouraged to offer them daily), or from other conversations that parents and children had in response to the picture books (including conversations about health). Future research is needed to understand how the messages designed for the present research compare to or could supplement everyday conversations between parents and children.

Third, how does the current pattern of results inform an understanding of a potential negativity bias in the food domain? A negativity bias – in which negative information is more salient and influential than positive information – has been observed across domains and across the lifespan (Baltazar, Shutts, & Kinzler, 2012; Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Ito, Larsen, Smith, & Cacioppo, 1998; Mumme, Fernald, & Herrera, 1996; Vaish, Grossmann, & Woodward, 2008). Infants are highly sensitive to information about disgust that has been paired with foods (Liberman, Woodward, Sullivan, & Kinzler, 2016), even though children's own avoidance of contaminated foods develops over a more protracted developmental period (DeJesus et al., 2015; Rozin, Hammer, Oster, Horowitz, & Marmora, 1986). The observation that children eat the alternative to an unhealthy food, rather than specifically preferring a healthy food, fits well within a more domain-general theory about negative information conveying more strong information than positive information. Nonetheless, we note that children did not treat all negative information equally in this study – "not popular" did not do the same work as "not healthy." Future studies could more purposefully probe children's sensitivity to different types of negative information about food. One possibility is that negative

information that is specifically about disgust, safety, and health may be especially impactful in the food domain.

Finally, the present studies emphasize the importance of developmental science for designing interventions that promote healthy eating in childhood and may ultimately contribute to efforts to prevent childhood obesity (Cunningham et al., 2014; Ebbeling et al., 2002; Freedman et al., 2005; Levi et al., 2015; Nader et al., 2006; Ogden et al., 2014; Wang & Beydoun, 2007). Carefully controlled laboratory studies can illuminate which manipulations are effective, which may then be applied to broader field settings. Understanding how to guide children away from unhealthy foods (rather than solely focusing on promoting the consumption of healthy foods) is critical in a food environment in which young children have so much access to sugary foods: From the age of 2, children in the U. S. are more likely to eat a processed sweet food than a fruit or vegetable (Saavedra, Deming, Dattilo, & Reidy, 2013; Siega-Riz, Kinlaw, Deming, & Reidy, 2011). By age 3, most children drink at least one sugar-sweetened beverage per day (Nickelson, Lawrence, Parton, Knowlden, & McDermott, 2014), and more than 15% of children’s daily calories comes from added sugars (McGuire, 2011; World Health Organization, 2015). These statistics highlight the need for evidence-based recommendations to encourage healthier eating, both by replacing unhealthy foods with healthier ones and by reducing children’s intake of foods with unhealthy levels of sugar, fat, and sodium. Future research is needed to better understand how influencing children’s tendency to avoid unhealthy foods fits into the constellation of factors that influence children’s obesity risk and obesity risks across the lifespan, including genetics, individual differences in food preferences and attitudes, psychosocial stress, messages from parents, peers, and the media, and broader social policy

(Giskes, Patterson, Turrell, & Newman, 2005; Gracey, Stanley, Burke, Corti, & Beilin, 1996; Lott, Schwartz, Story, & Brownell, 2018; Pesch & Lumeng, 2018).

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References

Aldridge, V., Dovey, T. M., & Halford, J. C. G. (2009). The role of familiarity in dietary development. *Developmental Review, 29*(1), 32-44. doi:10.1016/j.dr.2008.11.001

Baltazar, N. C., Shutts, K., & Kinzler, K. D. (2012). Children show heightened memory for threatening social actions. *Journal of Experimental Child Psychology, 112*(1), 102-110. doi:10.1016/j.jecp.2011.11.003

Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. *Review of General Psychology, 5*(4), 323-370. doi:10.1037/1089-2680.5.4.323

Bernstein, I. L. (1978). Learned taste aversions in children receiving chemotherapy. *Science, 200*(4347), 1302. doi:10.1126/science.663613

Bernstein, I. L. (1994). Development of food aversions during illness. *Proceedings of the Nutrition Society, 53,* 131-137. doi:10.1079/ PNS19940016

Birch, L. L. (1980). Effects of peer models' food choices and eating behaviors on preschoolers' food preferences. *Child Development,* 489-496. doi:10.2307/1129283

Birch, L. L. (1990). Development of food acceptance patterns. *Developmental Psychology, 26*(4), 515-519. doi:10.1037/0012-1649.26.4.515

Birch, L. L. (1999). Development of food preferences. *Annual Review of Nutrition, 19*(1), 41-62. doi:10.1146/annurev.nutr.19.1.41

Birch, L. L., & Marlin, D. W. (1982). I don't like it; I never tried it: Effects of exposure on two-year-old children's food preferences. *Appetite, 3*(4), 353-360. doi:10.1037/0012-1649.26.4.515

Birch, L. L., Marlin, D. W., & Rotter, J. (1984). Eating as the" means" activity in a contingency: effects on young children's food preference. *Child Development*, 55(2), 431-439. doi: 10.2307/1129954

Bryan, C. J., Yeager, D. S., Hinojosa, C. P., Chabot, A., Bergen, H., Kawamura, M., & Steubing, F. (2016). Harnessing adolescent values to motivate healthier eating. *Proceedings of the National Academy of Sciences, 113(39), 10830-10835*. doi:10.1073/pnas.1604586113

Bukowski, W., M., Hoza, B., & Boivin, M. (2006). Popularity, friendship, and emotional adjustment during early adolescence. *New Directions for Child and Adolescent Development, 1993*(60), 23-37. doi:10.1002/cd.23219936004

Coldwell, S. E., Oswald, T. K., & Reed, D. R. (2009). A marker of growth differs between adolescents with high vs. low sugar preference. *Physiology & Behavior*, *96*(4), 574-580. doi:10.1016/j.physbeh.2008.12.010

Colquitt, J. L., Loveman, E., O'Malley, C., Azevedo, L. B., Mead, E., Al-Khudairy, L., . . . Rees, K. (2016). Diet, physical activity, and behavioural interventions for the treatment of overweight or obesity in preschool children up to the age of 6 years. *Cochrane Database of Systematic Reviews*(3). doi:10.1002/14651858.CD012105

Coxe, S. (2018, February). Effect size measures for nonlinear count regression models. Poster presented at the American Statistical Association Conference on Statistical Practice. Portland, OR. February 15 – 17, 2018. https://stefany.shinyapps.io/RcountD/

Cunningham, S. A., Kramer, M. R., & Narayan, K. V. (2014). Incidence of childhood obesity in the United States. *New England Journal of Medicine, 370*(5), 403-411. doi:10.1056/NEJMoa1309753

Damschroder, L. J., Lutes, L. D., Kirsh, S., Kim, H. M., Gillon, L., Holleman, R. G., . . . Richardson, C. R. (2014). Small-Changes Obesity Treatment Among Veterans: 12-Month Outcomes. *American Journal of Preventive Medicine, 47*(5), 541-553. doi: 10.1016/j.amepre.2014.06.016

DeJesus, J. M., Kinzler, K. D., & Shutts, K. (2019). Food Cognition and Nutrition Knowledge. In J. O. Fisher & J. C. Lumeng (Eds.), *Pediatric Food Preferences and Eating Behaviors* (pp. 271-288). New York, NY: Elsevier.

DeJesus, J. M., Shutts, K., & Kinzler, K. D. (2015). Eww she sneezed! Contamination context affects children's food preferences and consumption. *Appetite, 87*, 303-309. doi:10.1016/j.appet.2014.12.222

DeJesus, J. M., Shutts, K., & Kinzler, K. D. (2018). Mere social knowledge impacts children's consumption and categorization of foods. *Developmental Science, 21*(5), e12627. doi:doi:10.1111/desc.12627

Donnelly, G. E., Zatz, L. Y., Svirsky, D., & John, L. K. (2018). The effect of graphic warnings on sugary-drink purchasing. *Psychological Science, 29*(8), 1321-1333. doi:10.1177/0956797618766361

Ebbeling, C. B., Pawlak, D. B., & Ludwig, D. S. (2002). Childhood obesity: public-health crisis, common sense cure. *The Lancet, 360*(9331), 473-482. doi:10.1016/S0140-6736(02)09678-2

Frazier, B. N., Gelman, S. A., Kaciroti, N., Russell, J. W., & Lumeng, J. C. (2012). I’ll have what she’s having: The impact of model characteristics on children’s food choices. *Developmental Science, 15*(1), 87-98. doi:10.1111/j.1467-7687.2011.01106.x

Freedman, D. S., K., K. L., K., S. M., H., D. W., R., S. S., & S., B. G. (2005). The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. *Pediatrics, 115*(1), 22-27. doi:10.1542/peds.2004-0220

Garb, J. L., & Stunkard, A. J. (1974). Taste aversions in man. *American Journal of Psychiatry, 131*(11), 1204-1207. doi:10.1176/ajp.131.11.1204

Gearhardt, A. N., Grilo, C. M., DiLeone, R. J., Brownell, K. D., & Potenza, M. N. (2011). Can food be addictive? Public health and policy implications. *Addiction, 106*(7), 1208-1212. doi:10.1111/j.1360-0443.2010.03301.x

Gelman, S. A., & DeJesus, J. M. (2018). The language paradox: Words invite and impede conceptual change. In T. Amin & O. Levrini (Eds.), *Converging and Complementary Perspectives on Conceptual Change.* (pp. 89-96). New York, NY: Routledge.

Giskes, K., Patterson, C., Turrell, G., & Newman, B. (2005). Health and nutrition beliefs and perceptions of Brisbane adolescents. *Nutrition & Dietetics, 62*(2-3), 69-75. doi:10.1111/j.1747-0080.2005.00002.x

Gracey, D., Stanley, N., Burke, V., Corti, B., & Beilin, L. J. (1996). Nutritional knowledge, beliefs and behaviours in teenage school students. *Health Education Research, 11*(2), 187-204. doi:10.1093/her/11.2.187

Gripshover, S. J., & Markman, E. M. (2013). Teaching young children a theory of nutrition conceptual change and the potential for increased vegetable consumption. *Psychological science, 24*(8), 1541-1553. doi:10.1177/0956797612474827

Guthrie, J. F., Derby, B. M., & Levy, A. S. (1999). What people know and do not know about nutrition. In B. H. Lin, J. F. Guthrie, & A. S. Levy (Eds.), *America's eating habits:*

Changes and consequences (pp. 243-290). Washington, DC: U.S. Department of Agriculture.

Harris, J. L., Hyary, M., & Schwartz, M. B. (2016). Effects of Offering Look-Alike Products as Smart Snacks in Schools. *Childhood Obesity, 12*(6), 432-439. doi:10.1089/chi.2016.0080

Hausner, H., Nicklaus, S., Issanchou, S., Mølgaard, C., & Møller, P. (2009). Breastfeeding facilitates acceptance of a novel dietary flavour compound. *European e-Journal of Clinical Nutrition and Metabolism, 4*(5), e231-e238. doi:10.1016/j.eclnm.2009.06.024

Hendy, H. M., & Raudenbush, B. (2000). Effectiveness of teacher modeling to encourage food acceptance in preschool children. *Appetite, 34*(1), 61-76. doi:10.1006/appe.1999.0286

Hendy, H. M., Williams, K. E., Camise, T. S., Eckman, N., & Hedemann, A. (2009). The Parent Mealtime Action Scale (PMAS). Development and association with children's diet and weight. *Appetite, 52*(2), 328-339. doi: 10.1016/j.appet.2008.11.003

Heyman, M. B., & Abrams, S. A. (2017). Fruit Juice in Infants, Children, and Adolescents: Current Recommendations. *Pediatrics, 139*(6), e20170967. doi:10.1542/peds.2017-0967

Inagaki, K., & Hatano, G. (2004). Vitalistic causality in young children's naive biology. *Trends in Cognitive Sciences, 8*(8), 356-362. doi:10.1016/j.tics.2004.06.004

Ito, T. A., Larsen, J. T., Smith, N. K., & Cacioppo, J. T. (1998). Negative information weighs more heavily on the brain: The negativity bias in evaluative categorizations. Journal of Personality and Social Psychology, 75(4), 887-900. doi:10.1037/0022-3514.75.4.887

Kim, S. A., Moore, L. V., Galuska, D., Wright, A. P., Harris, D., Grummer-Strawn, L. M., . . . Rhodes, D. G. (2014). Vital signs: Fruit and vegetable intake among children — United States, 2003–2010. *Morbidity and Mortality Weekly Report, 63*(31), 671-676.

Levi, J., Segal, L. M., Rayburn, J., & Martin, A. (2015). *State of Obesity: Better Policies for a Healthier America: 2015*. Retrieved from http://stateofobesity.org/files/stateofobesity2015.pdf

Liberman, Z., Woodward, A. L., Sullivan, K. R., & Kinzler, K. D. (2016). Early emerging system for reasoning about the social nature of food. *Proceedings of the National Academy of Sciences, 113*(34), 9480-9485. doi:10.1073/pnas.1605456113

Lott, M., Schwartz, M., Story, M., & Brownell, K. D. (2018). Why we need local, state, and national policy-based approaches to improve children’s nutrition in the United States. In M. S. Freemark (Ed.), *Pediatric Obesity: Etiology, Pathogenesis and Treatment* (pp. 731-755). Cham: Springer International Publishing.

Lutes, L. D., Winett, R. A., Barger, S. D., Wojcik, J. R., Herbert, W. G., Nickols-Richardson, S. M., & Anderson, E. S. (2008). Small changes in nutrition and physical activity promote weight loss and maintenance: 3-month evidence from the ASPIRE randomized trial. *Annals of Behavioral Medicine, 35*(3), 351-357.

Maimaran, M., & Fishbach, A. (2014). If it's useful and you know it, do you eat? Preschoolers refrain from instrumental food. *Journal of Consumer Research, 41*(3), 642-655. doi:10.1086/677224

McGuire, S. (2011). U.S. Department of Agriculture and U.S. Department of Health and Human Services, Dietary Guidelines for Americans, 2010. 7th Edition, Washington, DC: U.S. Government Printing Office, January 2011. *Advances in Nutrition: An International Review Journal, 2*(3), 293-294. doi:10.3945/an.111.000430

Mennella, J. A., Bobowski, N. K., & Reed, D. R. (2016). The development of sweet taste: From biology to hedonics. *Reviews in Endocrine and Metabolic Disorders, 17*(2), 171-178. doi:10.1007/s11154-016-9360-5

Mennella, J. A., Finkbeiner, S., Lipchock, S. V., Hwang, L.-D., & Reed, D. R. (2014). Preferences for salty and sweet tastes are elevated and related to each other during childhood. *PloS one, 9*(3), e92201. doi:10.1371/journal.pone.0092201

Mennella, J. A., Jagnow, C. P., & Beauchamp, G. K. (2001). Prenatal and postnatal flavor learning by human infants. *Pediatrics, 107*(6), e88-e88. doi:10.1542/peds.107.6.e88

Mennella, J. A., Lukasewycz, L. D., Griffith, J. W., & Beauchamp, G. K. (2011). Evaluation of the Monell forced-choice, paired-comparison tracking procedure for determining sweet taste preferences across the lifespan. *Chemical Senses*, 345-355. doi:10.1093/chemse/bjq134

Moore, J. B., Horti, A., & Fielding, B. A. (2018). Evaluation of the nutrient content of yogurts: a comprehensive survey of yogurt products in the major UK supermarkets. *BMJ Open, 8*(8). doi:10.1136/bmjopen-2017-021387

Moran, A. J., & Roberto, C. A. (2018). Health warning labels correct parents’ misperceptions about sugary drink options. *American journal of preventive medicine, 55*(2), e19-e27. doi: 10.1016/j.amepre.2018.04.018

Mumme, D. L., Fernald, A., & Herrera, C. (1996). Infants' responses to facial and vocal emotional signals in a social referencing paradigm. *Child Development, 67*(6), 3219-3237. doi:10.1111/j.1467-8624.1996.tb01910.x

Muñoz, K. A., Krebs-Smith, S. M., Ballard-Barbash, R., & Cleveland, L. E. (1997). Food intakes of US children and adolescents compared with recommendations. *Pediatrics, 100*(3), 323-329. doi:10.1542/peds.100.3.323

Musher-Eizenman, D., & Holub, S. (2007). Comprehensive Feeding Practices Questionnaire: Validation of a New Measure of Parental Feeding Practices. *Journal of Pediatric Psychology, 32*(8), 960-972. doi:10.1093/jpepsy/jsm037

Nader, P. R., O'Brien, M., Houts, R., Bradley, R., Belsky, J., Crosnoe, R., . . . Susman, E. J. (2006). Identifying risk for obesity in early childhood. *Pediatrics, 118*(3), e594-e601. doi:10.1542/peds.2005-2801

Newman, J., & Taylor, A. (1992). Effect of a means-end contingency on young children's food preferences. *Journal of Experimental Child Psychology, 53*(2), 200-216.

Nguyen, S. P. (2007). An apple a day keeps the doctor away: Children's evaluative categories of food. *Appetite, 48*(1), 114-118. doi: 10.1016/j.appet.2006.06.001

Nguyen, S. P. (2012). The role of external sources of information in children’s evaluative food categories. *Infant and Child Development, 21*(2), 216-235. doi:10.1002/icd.745

Nguyen, S. P., McCullough, M. B., & Noble, A. (2011). A theory-based approach to teaching young children about health: A recipe for understanding. *Journal of Educational Psychology, 103*(3), 594. doi:10.1037/a0023392

Nickelson, J., Lawrence, J. C., Parton, J. M., Knowlden, A. P., & McDermott, R. J. (2014). What Proportion of Preschool-Aged Children Consume Sweetened Beverages? *Journal of School Health, 84*(3), 185-194. doi:10.1111/josh.12136

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *Journal of the American Medical Association, 311*(8), 806-814. doi:10.1001/jama.2014.732

Owen, L. H., Kennedy, O. B., Hill, C., & Houston-Price, C. (2018). Peas, please! Food familiarization through picture books helps parents introduce vegetables into preschoolers’ diets. *Appetite, 128*, 32-43. doi: 10.1016/j.appet.2018.05.140

Pesch, M. H., & Lumeng, J. C. (2018). Early Feeding Practices and Development of Childhood Obesity. In M. S. Freemark (Ed.), *Pediatric Obesity: Etiology, Pathogenesis and Treatment* (pp. 257-270). Cham: Springer International Publishing.

Pesch, M. H., Miller, A. L., Appugliese, D. P., Rosenblum, K. L., & Lumeng, J. C. (2018). Mothers of Obese Children Use More Direct Imperatives to Restrict Eating. *Journal of Nutrition Education and Behavior*, *50*(4), 403-407.e401. doi:10.1016/j.jneb.2017.10.010

Putallaz, M., & Gottman, J. M. (1981). Social skills and group acceptance. In S. R. Asher & J. M. Gottman (Eds.), *The Development of Children's Friendships* (pp. 116-149). Cambridge, U.K.: Cambridge University Press.

Quealy, K., & Sanger-Katz, M. (2016, July 5, 2016). Is sushi ‘healthy’? What about granola? Where Americans and nutritionists disagree. *The New York Times*. Retrieved from https://www.nytimes.com/interactive/2016/07/05/upshot/is-sushi-healthy-what-about-granola-where-americans-and-nutritionists-disagree.html

Raghunathan, R., Naylor, R. W., & Hoyer, W. D. (2006). The unhealthy = tasty intuition and its effects on taste inferences, enjoyment, and choice of food products. *Journal of Marketing, 70*(4), 170-184. doi:10.1509/jmkg.70.4.170

Rehm, C. D., Peñalvo, J. L., Afshin, A., & Mozaffarian, D. (2016). Dietary intake among US adults, 1999-2012. *Journal of the American Medical Association, 315*(23), 2542-2553. doi:10.1001/jama.2016.7491

Roberto, C. A., Larsen, P. D., Agnew, H., Baik, J., & Brownell, K. D. (2010). Evaluating the impact of menu labeling on food choices and intake. *American Journal of Public Health, 100*(2), 312-318. doi:10.2105/ajph.2009.160226

Rozin, P. (2005). The meaning of food in our lives: A cross-cultural perspective on eating and well-being. *Journal of Nutrition Education and Behavior, 37*, S107-S112. doi:10.1016/S1499-4046(06)60209-1

Rozin, P., Hammer, L., Oster, H., Horowitz, T., & Marmora, V. (1986). The child's conception of food: differentiation of categories of rejected substances in the 16 months to 5 year age range. *Appetite, 7*(2), 141-151. doi: 10.1016/S0195-6663(86)80014-9

Rozin, P., & Schiller, D. (1980). The nature and acquisition of a preference for chili pepper by humans. *Motivation and Emotion, 4*(1), 77-101. doi:10.1007/BF00995932

Rubin, K., H., Bukowski, W., M., & Bowker, J., C. (2015). Children in Peer Groups. *Handbook of Child Psychology and Developmental Science*. doi: 10.1002/9781118963418.childpsy405

10.1002/9781118963418.childpsy405

Saavedra, J. M., Deming, D., Dattilo, A., & Reidy, K. (2013). Lessons from the feeding infants and toddlers study in North America: What children eat, and implications for obesity prevention. *Annals of Nutrition and Metabolism, 62(suppl 3)*(Suppl. 3), 27-36.

Schultz, C. M., & Danford, C. M. (2016). Children's knowledge of eating: An integrative review of the literature. *Appetite, 107*, 534-548. doi: 10.1016/j.appet.2016.08.120

Shutts, K., Banaji, M. R., & Spelke, E. S. (2010). Social categories guide young children’s preferences for novel objects. *Developmental Science, 13*(4), 599-610. doi:10.1111/j.1467-7687.2009.00913.x

Shutts, K., Kinzler, K. D., & DeJesus, J. M. (2013). Understanding infants' and children's social learning about foods: Previous research and new prospects. *Developmental Psychology, 49*(3), 419-425. doi:10.1037/a0027551

Siega-Riz, A. M., Kinlaw, A., Deming, D. M., & Reidy, K. C. (2011). New findings from the Feeding Infants and Toddlers Study 2008. *Nestlé Nutrition Workshop Ser Pediatric Program, 68*, 83-105. doi:10.1159/000325667

Sigman-Grant, M., Byington, T. A., Lindsay, A. R., Lu, M., Mobley, A. R., Fitzgerald, N., & Hildebrand, D. (2014). Preschoolers can distinguish between healthy and unhealthy foods: The All 4 Kids Study. *Journal of Nutrition Education and Behavior*, *46*(2), 121-127. doi:10.1016/j.jneb.2013.09.012

Stark, L. J., Jelalian, E., Powers, S. W., Mulvihill, M. M., Opipari, L. C., Bowen, A., . . . Hovell, M. F. (2000). Parent and child mealtime behavior in families of children with cystic fibrosis. *The Journal of Pediatrics*, *136*(2), 195-200. doi:10.1016/S0022-3476(00)70101-6

Tibbs, T., Haire-Joshu, D., Schechtman, K. B., Brownson, R. C., Nanney, M. S., Houston, C., & Auslander, W. (2001). The relationship between parental modeling, eating patterns, and dietary intake among African-American parents. *Journal of the American Dietetic Association, 101*(5), 535-541. doi: 10.1016/S0002-8223(01)00134-1

Vaish, A., Grossmann, T., & Woodward, A. (2008). Not all emotions are created equal: The negativity bias in social-emotional development. *Psychological Bulletin, 134*(3), 383-403. doi:10.1037/0033-2909.134.3.383

Ventura, A. K., & Mennella, J. A. (2011). Innate and learned preferences for sweet taste during childhood. *Current Opinion in Clinical Nutrition & Metabolic Care, 14*(4), 379-384. doi:10.1097/MCO.0b013e328346df65

Wang, Y., & Beydoun, M. A. (2007). The obesity epidemic in the United States—gender, age, socioeconomic, racial/ethnic, and geographic characteristics: A systematic review and meta-regression analysis. *Epidemiologic Reviews, 29*(1), 6-28. doi:10.1093/epirev/mxm007

Wardle, J., Herrera, M. L., Cooke, L., & Gibson, E. L. (2003). Modifying children's food preferences: The effects of exposure and reward on acceptance of an unfamiliar vegetable. *European Journal of Clinical Nutrition, 57*(2), 341-348.

Wardle, J., & Huon, G. (2000). An experimental investigation of the influence of health information on children's taste preferences. *Health Education Research, 15*(1), 39-44. doi:10.1093/her/15.1.39

Wellman, H. M., & Johnson, C. N. (1982). Children's understanding of food and its functions: A preliminary study of the development of concepts of nutrition. *Journal of Applied Developmental Psychology, 3*(2), 135-148. doi: 10.1016/0193-3973(82)90024-7

Wertz, A. E., & Wynn, K. (2014). Selective social learning of plant edibility in 6- and 18-month-old infants. *Psychological Science, 25*(4), 874-882. doi:10.1177/0956797613516145

Wolfenden, L., Wyse, R. J., Britton, B. I., Campbell, K. J., Hodder, R. K., Stacey, F. G., . . . James, E. L. (2012). Interventions for increasing fruit and vegetable consumption in

children aged 5 years and under. *Cochrane Database of Systematic Reviews*(11). doi:10.1002/14651858.CD008552.pub2

World Health Organization. (2015). *Guideline: sugars intake for adults and children*. Geneva: World Health Organization.

Yeager, D. S., Dahl, R. E., & Dweck, C. S. (2017). Why interventions to influence adolescent behavior often fail but could succeed. *Perspectives on Psychological Science, 13*(1), 101-122. doi:10.1177/1745691617722620

Figure 1

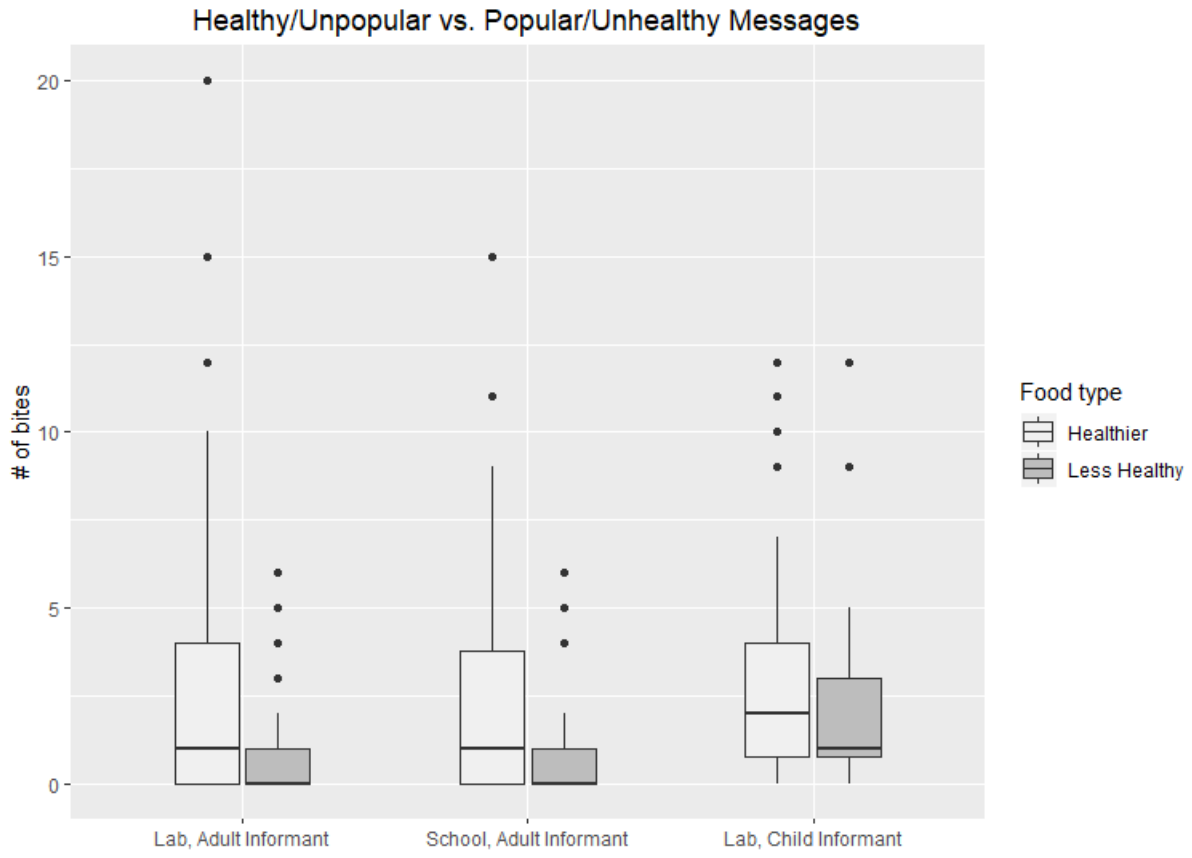

Figure 1. Box-and-whiskers plot of children’s consumption of foods described as healthy/unpopular and popular/unhealthy. The leftmost bars represent Study 2; the middle bars represent Supplemental Study 1; the rightmost bars represent Supplemental Study 2.

Figure 2

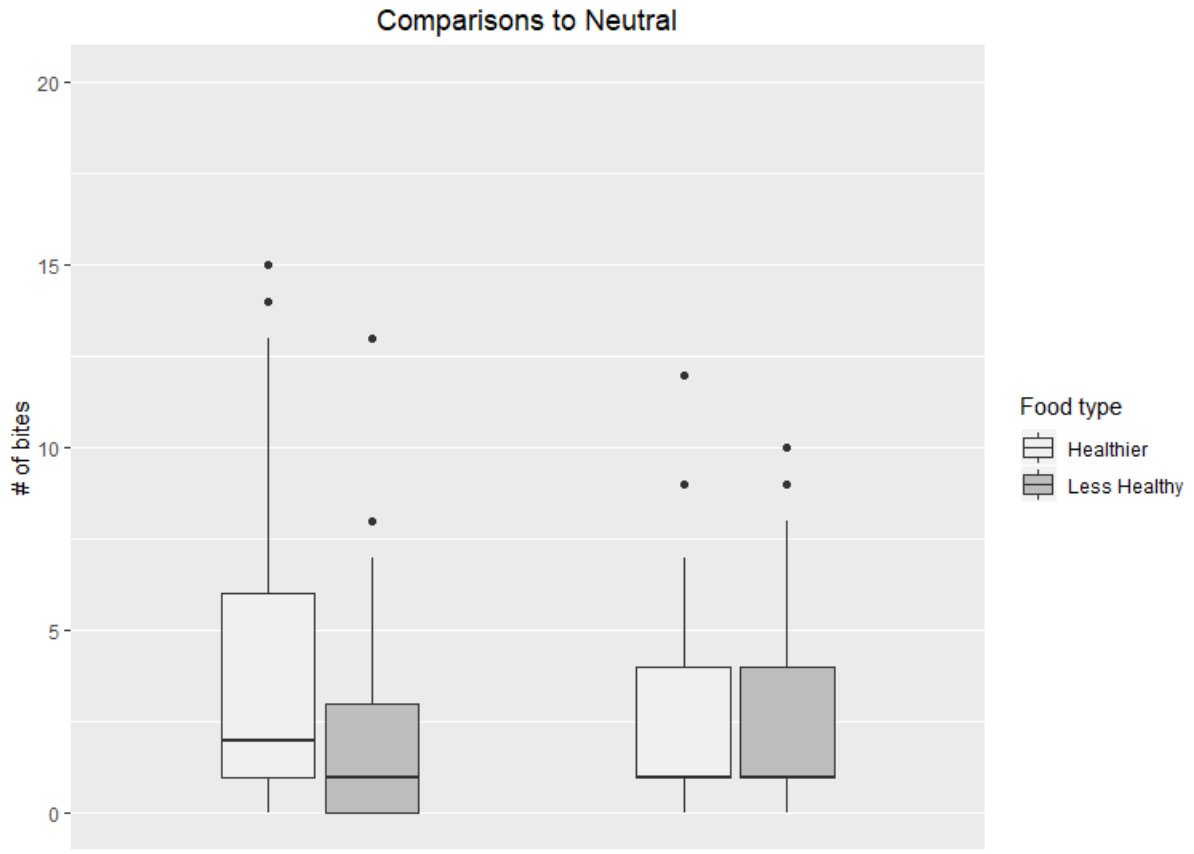

Figure 2. Box-and-whiskers plot of children’s consumption of a food described with a neutral message, compared to either a food described as unhealthy (Study 3, left bars) or healthy (Study 4, right bars).

Table 1

Participant characteristics in each study. Family income per year was rated on a 1 (< $15,000) to 9 (> $150,000) scale. In Study 1, 12 families did not report their income (of these families, 16 parents reportedly held a bachelor's degree or more). S1 and S2 refer to studies reported in supplemental materials.

Study:	**1**	**2**	**S1**	**S2**	**3**	**4**	**5**	**6**	**7**
N	32	32	29	32	32	32	32	33	32
Child age (years)									
Mean	5.93	5.95	6.48	6.07	5.96	5.98	5.94	8.98	6.16
Min	5.05	5.04	4.92	5.17	5.13	5.02	5.01	8.05	5.25
Max	6.87	7.01	7.68	7.26	6.97	7.00	7.07	9.92	6.97
Child gender (n)									
F	16	16	16	16	15	16	15	17	16
M	16	16	13	16	17	16	17	16	16
Race/ethnicity (n)									
White	22	10	15	13	16	16	5	29	25
African-American	8	9	1	6	5	8	13	0	0
Asian	1	0	1	1	1	0	0	1	0
Hispanic	0	6	5	4	4	4	7	0	1
Multiracial	1	3	6	7	5	4	7	3	2
Did not report	0	4	1	1	1	0	1	0	4
Income (mean)	6.80	6.75	3.82	6.42	6.75	6.23	5.75	7.16	7.74
Exclusions (n)									
Experimenter error	3	0	0	0	2	2	0	4	3
Didn't complete study	1	0	0	1	0	0	0	2	0
Parent interference	0	0	0	0	0	0	0	0	0
Developmental delay (parent report)	0	1	0	0	0	0	0	0	0

Table 2

Number of participants who ate both foods, just one food, or neither food in each study. "Mixed across trials" refers to children who demonstrated different behaviors across trials (e.g., ate both foods on trial 1 and the healthier food in trial 2; ate the healthier food in trial 1 and no food in trial 2). S1 and S2 refer to studies reported in supplemental materials.

Study	**Ate both foods**	**Ate healthier food only**	**Ate less healthy food only**	**Did not eat**	**Mixed across trials**
1	17	3	0	7	5
2	10	4	0	9	9
S1	11	3	0	7	6
S2	22	0	0	7	3
3	19	4	0	4	5
4	23	0	0	6	3
5	14	4	0	6	8
6	28	0	0	1	4
7	25	1	0	3	3