

What Role Does Taste Play in School Meal Studies? A Narrative Review of the Literature

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ABSTRACT

School meals play an important role in student well-being. However, studies have given evidence that school meals may not be satisfactory to students. Evidence suggests that taste plays an influential role in students' food decisions and eating experiences. This review of current research finds that studies around improving school meals mainly focus on increasing intake of target foods or food groups, and few studies exist that examine other outcomes such as food enjoyment or student well-being. Future studies could explore the impact of increasing student engagement and dialogue around school meals on factors such as physical and psychological well-being, empowerment, school enjoyment, and academic outcomes. These efforts may help researchers and school professionals accurately evaluate and improve the enjoyment of school food, which can play an important role in promoting the well-being of students.

Keywords: taste, school meals, student engagement, eating experience, well-being, food palatability

INTRODUCTION

School lunch plays an important role in the overall well-being of students (Belot & James, 2011; Florence, Asbridge, & Veugelers, 2008). Results from various studies suggest school meals may not yet be satisfactory to students; recent research presents data that suggests food waste is common in elementary and middle school lunchrooms, particularly waste of fruits and vegetables (Amin, Yon, Taylor, & Johnson, 2015; Cohen, Richardson, Austin, Economos, & Rimm, 2013; Just & Price, 2013). Survey research has reported a commonly held belief that tasty food and healthful food are incompatible (Cho & Nadow, 2004; Freeland-Graves & Nitzke, 2002), which may be discouraging for school meal providers that must conform their offerings to fit specific nutrient guidelines (Food and Nutrition Service [FNS], USDA, 2012).

It has been argued that the palatability of food should be prioritized as an important part of school meals (Story, 2009). Palatability is used to describe the ability of food to appeal to multiple senses (e.g. taste, smell, mouth feel) and make it acceptable to the consumer. Multiple studies suggest palatability is one of the most important factors influencing children's eating habits (Horne et al., 2004; Jonsson, Ekström, & Gustafsson, 2005; Lakkakula et al., 2011; Lowe, Horne, Tapper, Bowdery, & Egerton, 2004; Wardle et al., 2003). By the time children typically begin attending school (around age six), strong taste preferences may already be formed (Skinner, Carruth, Bounds, & Ziegler, 2002).

A focus on increasing palatability of healthy food may help dismantle the negative association between "healthiness" and "tastiness", a mindset that has been illustrated in a number of studies (Cho & Nadow, 2004; Freeland-Graves & Nitzke, 2002; Raghunathan, Naylor, & Hoyer, 2006). For example, in a series of experimental trials, it was found that when food is portrayed as less healthy, participants were more likely to report higher expectations for the food to taste good,

had higher enjoyment while eating the food, and were more likely to choose that food over others (Raghunathan et al., 2006). Furthermore, high food enjoyment has been inversely associated with picky eating behaviors (van der Horst, 2012). Increasing the nutritional quality of food without taking measures to ensure the food is enjoyed by students may further reinforce this negative association between health and palatability.

Given the evidence that food palatability plays an influential role in students' food decisions and eating experiences, the purpose of this review is to examine the role of food palatability in school-based meal studies. Specifically, we sought to answer the questions of "What are the approaches being used to encourage healthy eating during school meals?"; "Are the quantitative and qualitative assessments used in these studies sufficient to elucidate overall food enjoyment?" and "What have been the outcomes of these studies?"

METHODS

A bibliographical search of articles published prior to February 2017 in peer-reviewed journals was conducted using the following databases: PubMed, ScienceDirect, and Web of Science. The criteria for inclusion were studies that focused on healthy eating in the school lunch context and involved participants enrolled in elementary or middle school. While studies were not limited to a specific country, only those published in English were reviewed. Descriptions of study samples, interventional strategies, findings, and forms of assessment from each study were categorized and placed into a comparative table. Emergent themes around findings and interventional strategies used in each study were identified by the first author and subsequently discussed and approved by all authors. An overview of the studies, along with descriptions for each assessment, is provided in Table 1.

RESULTS

A total of sixteen studies was included in the review. Following review, the studies were grouped into the following categories according to interventional strategies used: Rewards-based studies, taste exposure, multicomponent, and chef collaboration. Of the studies reviewed, ten focused specifically on FV consumption, one focused on whole grain consumption, while the remainder focused on consumption of the entire meal. Common assessments included consumption, selection, knowledge, willingness to try, and liking. No studies formally evaluated qualitative participant data. See Table 1.

Rewards-based studies

Certain studies have employed methods that essentially attempt to teach children to like specific foods. These incentive-based studies rewarded children for eating the target foods (usually fruits or vegetables) in an effort to foster a positive association with the taste of the food, increase acceptance of the food through repeated exposure, and guide habit formation (Cooke et al., 2011). Several studies were identified that implemented rewards for foods eaten during school lunch. All studies measured consumption as a primary outcome, while three studies assessed one or more additional outcomes of likeability, selection, and knowledge (Hoffman et al., 2010); Lowe et al., 2004; Belot, James, & Nolen, 2016).

In one rewards-based study, school staff rewarded children with verbal praise and stickers when they were seen eating fruits and vegetables (FV) (Hoffman et al., 2010). At two-year follow-up, plate waste data indicated no change in vegetable consumption and modestly greater fruit consumption. Questionnaire data from students indicated no change in FV preference at any time point. In another study in elementary schools, consumption of FV was incentivized for two to

three weeks (Just & Price, 2013). There was a significant increase in FV consumption in intervention groups; however, these effects were not sustained after a four-week follow up, indicating that consumption of the school-offered FV was not rewarding in itself. A follow up study incentivized consumption of FV for a longer amount of time of up to five weeks (Loewenstein, Price, & Volpp, 2016). Consumption of FV increased in the intervention group and remained higher after a two-month follow up, particularly in the schools where the intervention was in place for five weeks. The authors attributed these effects to habit formation guided by the incentive period, which was hypothesized to work by overriding intrinsic motivations (Loewenstein et al., 2016). In a recent study, students from thirty-one schools received stickers or a larger prize for selecting FV during the meal time (Belot et al., 2016). Selection and consumption of FV increased significantly, in particular for students competing against their classmates. However, effects were not sustained at a six-month reassessment once the incentives were removed.

Overall, results for the efficacy of rewards-based studies have been mixed and, in some cases, have even produced negative feelings toward the target food. As mentioned in the study by Belot et al. (2016), students who missed school or who failed to select FV early in the week, and thus lost an opportunity to earn a large prize at the end of the week, may have experienced loss of intrinsic motivation to select FV. Furthermore, many of the studies reported loss of effect post-intervention, suggesting that the experience of eating FV was not intrinsically rewarding in itself. In a review by Cooke et al. (2011), it was noted that in previous rewards-based trials where *consumption* of foods was the goal, the study was successful. However, in studies that aimed to increase *liking*, incentives were not successful, according to hedonic ratings. This highlights a need to examine multiple factors beyond consumption in order to more effectively assess the eating experience in children.

Taste exposure

Two empirical studies that examined the effects of sampling a food item that is part of the school meal were found in the literature. In one study, students standing in line for lunch were offered a small serving of fresh red or yellow bell peppers (Elsbernd et al., 2016). Students then had the option of selecting the same bell peppers, a different vegetable, or no vegetable as part of the reimbursable school meal. Assessments included percent of students who selected a vegetable serving and consumption. There was no significant difference in percentage of students consuming the vegetable post-intervention, suggesting acceptability of the vegetable was not improved by the taste sample.

Another cafeteria-based study explored the effects of offering eight different FV samples during lunchtime on reported FV liking (Lakkakula et al., 2011). Students were offered samples of four different fruits and four different vegetables every other week for eight weeks, then again at four months and ten months. A brief survey was used to assess willingness to try and likeability. Reported liking for the target FV was significantly increased at four- and ten-month follow-ups. Consumption on non-intervention days was not assessed. Overall, neither of these two studies closely evaluated students' perceptions of the foods beyond behavioral outcomes during intervention days and data collected from short likeability scales, which limits conclusions that can be made about food palatability.

Multicomponent approach

Due to the complex nature of eating behavior and food choice, many studies have implemented multifaceted approaches to improving school meals. These often include education, cafeteria modifications, menu changes, and food-focused activities. A review of multicomponent studies

that included efforts around modifying the cafeteria environment suggests that the primary assessment is food consumption, particularly FV (Burgess-Champoux, Chan, Rosen, Marquart, & Reicks, 2008; Hoffman et al., 2010; Siega-Riz et al., 2011; Struempfer, Parmer, Mastropietro, Arsiwalla, & Bubb, 2014; Williamson, Han, Johnson, Martin, & Newton Jr., 2013), while some studies assessed additional factors, such as liking (Hoffman et al., 2010) and selection (Williamson et al., 2013).

In a study that involved classroom nutrition education and FV tasting, FV consumption increased by one serving per week, with no follow-up data to report (Struempfer et al., 2014). In a larger multicomponent study by Siega-Riz et al. (2011), nutrition education and communication strategies were paired with healthy menu substitutions. After the two-and-a-half year intervention, fruit intake increased by 10% in the treatment group. Consumption was self-reported and no data on liking of the school meal was recorded. In a recent review of two large multicomponent studies of similar design, menu modifications similar to the ones implemented by Siega-Riz et al. (2011) were made in conjunction with cafeteria health displays (Williamson et al., 2013). Consumption of foods was measured by self-report. Both studies reported improved nutritional intake; however, both studies also noted large amounts of plate waste. Overall, the focus of these multicomponent studies has centered on methods to increase the quantity of certain foods eaten with little exploration into the students' experiences of the modified school meal.

Chef collaboration

Since 2012, various studies have been published about chef-based interventions that focus on increasing palatability of food to fit children's tastes while adhering to mandatory nutritional school meal guidelines (Cohen et al., 2012; Cohen et al., 2015; Thorsen et al., 2015; Zellner & Cobuzzi, 2017). These studies involved collaboration between culinary professionals and school food service staff to modify components of the menu. In every study, multiple outcomes were measured, including consumption (either of the entire meal or of specific foods), likeability, selection, and/or knowledge.

Results indicated that consumption of the chef-enhanced food was greater in all four of the studies. All trials lasted six months or longer. Interestingly, one study implemented an additional choice architecture component, where half of the chef-enhanced schools and half of the standard meal schools also received cafeteria modification to promote selection of fruits and vegetables (Cohen et al., 2015). After the four-month period, all groups exposed to choice architecture increased fruit and vegetable *selection*; however, only students in the chef-enhanced schools increased *consumption* of fruits and vegetables, highlighting the importance of the taste of the food. While the chef-based studies were unique from other studies in this review because of their focus on reformulating food to be more acceptable to students, there remained areas where food enjoyment and palatability could have been further explored, such as by collecting qualitative data regarding the food experience (e.g. focus groups or qualitative surveys).

Table 1. Description of school meal intervention research.

Author (Year), Location	Approach	Sample^a	Participants	Intervention	Results	Form of assessment^b
Thorsen et al. (2014), Denmark	Chef collaboration	3rd and 4th grade children (aged 8-11 years old) from 9 municipal schools	187	For 2 separate 3-month periods, children received either the New Nordic Diet (NND) or their usual packed lunch in random order. NND: palatable, environmental, nutritious, culturally appropriate, ad libitum meal served buffet style in cafeteria. 2 of the 9 schools were randomly assigned to measure food intake and plate waste. Measured for 5 consecutive days near end of intervention period.	<ul style="list-style-type: none"> • Food intake and plate waste higher for NND schools • Packed lunches rated higher for control • Food intake average: 230g NND; 198g control • Edible plate waste: 29% NND; 16% control • Food intake-plate waste highly significant correlates with likability. 	C L
Zellner & Cobuzzi (2017), USA	Chef collaboration	3 rd and 4 th grade students (aged 8-10 years old) from 2 urban schools	n/a	School A (intervention) 1x/week received chef- prepared meal from scratch, ate family style with non- disposable dishware, separate dessert course, description of meal prior to eating. School B (control) 5x/week received traditional school lunch, also sat family-style with non-disposable dishes,	<ul style="list-style-type: none"> • Significant increase in consumption, liking, and preference cauliflower intervention group • No increase in liking or preference found control (consumption not measured). • Consumption sweet potatoes higher intervention at beginning 	C L P K

				received dessert with meal. Both meals 30 minutes, met USDA nutritional requirements. Trial lasted 9 months.	than control, no change consumption end of year for either <ul style="list-style-type: none"> • Liking and preference did not change. 	
Cohen et al. (2012), USA	Chef collaboration	4 public middle schools in Boston, MA	3,049 students in plate waste study	Chef Initiative schools (intervention) received meals similar to standard Boston Public school menus, but chef-enhanced for increased palatability and nutrition. Control matched for race, ethnicity, and reduced/free meal eligibility. Received standard Boston Public school menus. Trial lasted 2 years.	<ul style="list-style-type: none"> • Each group consumed similar amounts of entrees. • Intervention consumed more side dishes (significantly greater whole grain consumption). • Each group selected similar amounts of V, intervention had significantly higher V consumption (average of 2 servings/week). 	C S
Cohen et al. (2015), USA	Chef collaboration	Students in grades 1-8 attending one of 2 urban, low-income school districts	9,511 (968 students included in statistical analysis -only those with active consents and data for all study days)	For 3 months, 4 schools received chef-enhanced meals (increased nutrition and palatability), 10 received standard meals. For the next 4 months, 2 of the chef-enhanced schools received choice architecture while 4 of the standard-lunch schools received choice architecture. Trial lasted 7 months.	<ul style="list-style-type: none"> • Short-term exposure: Intervention more likely to select V, percent consumed unchanged. • Long-term exposure: Students in choice architecture schools more likely to select FV, but consumption only increased in chef-enhanced schools (+0.75c V/wk). 	C S

Horne et al. (2004), UK	Rewards	Children aged 5-11 years old from 2 schools in London	749	16 day Food Dudes intervention program where students watched videos of heroic figures promoting vegetables, had letters from the heroic figures read to the class, received sticker for tasting FV, and received prize for consuming entire portion.	<ul style="list-style-type: none"> • Significant increase in FV consumption in treatment group, no increase in control. • Average F increase from 36% to 79%. • Average V increase from 44% to 66%. • Largest increase seen in students who ate least FV during baseline. • Intake remained significantly higher at 4 month follow up. 	C
Lowe et al. (2004), UK	Rewards	Children aged 4-11 years old from three schools	402	16 day Food Dudes intervention program where students watched videos of heroic figures promoting vegetables, had letters from the heroic figures read to the class, received sticker for tasting FV, and received prize for consuming entire portion.	<ul style="list-style-type: none"> • Significant increase in FV consumption in all groups. For 4-7 yo, average increase of 2.54 portions/day. For 7-11 yo, average increase of 2.18 portions/day. • Liking significantly higher at intervention. • F liking increased from 3.81 (s.d.=0.79) to 4.22 (s.d.=0.78) • V liking increased from 3.31 (s.d.=0.99) to 3.65 (s.d.=0.99). 	C L

Just & Price (2013), USA	Rewards	Students from 18 elementary schools	n/a (41,374 observations)	Incentivized FV consumption during lunch for 2-3 weeks.	<ul style="list-style-type: none"> • Significant increase in FV consumption during intervention; not sustained after 4 weeks. 	C
Loewenstein et al. (2016), USA	Rewards	Children attending 1 of 40 elementary schools	8,000	Follow up on Just & Price (2013) study, kept incentive (25 cent token) in place for 3-5 weeks.	<ul style="list-style-type: none"> • Increased consumption of FV after 2 months. • Consumption higher in schools intervention lasted 5 weeks. 	C
Belot, James, & Nolen (2016), England	Rewards	Children aged 6-7 and 9-10 from 31 schools in England	638	Kids received stickers based on FV choice. Larger prize at end of week according to week's choices.	<ul style="list-style-type: none"> • No change knowledge of FV either group. • Selection and consumption of FV increased significantly treatment group; mostly those in competition with classmates. • No significant change in FV consumption at follow up. 	C K S
Hoffman et al. (2010), USA	Rewards	Kindergarten and 1 st grade students from 4 public schools	297	<p>2 year intervention with lunchroom, classroom, school, and family components.</p> <p>No changes made to menu. Loudspeaker announcements giving FV fact of the day, classroom videos, posters in cafeteria, lunch staff giving verbal praise and sticker when</p>	<ul style="list-style-type: none"> • Lunch consumption and plate waste showed slightly more FV intake in treatment; only F more after 2 years. • FV preferences, as rated by questionnaire, remained stable in all groups all time periods. 	C L

they see students take a bite of FV.

Struempler et al. (2014), USA	Multi-component	3rd graders	2477	17 week Body Quest program, nutrition education, FV tastings. Measured FV consumption over lunch.	<ul style="list-style-type: none"> • Increased FV consumption by 1 serving per week, significant but modest. 	C
Burgess-Champoux et al. (2008), USA	Multi-component	4th-5th grade students from 2 Minneapolis schools	150	Menu modification (replaced refined-grain products at lunch with whole-grain products), 5 classroom lessons, family oriented activities.	<ul style="list-style-type: none"> • Whole-grain consumption increased 1 serving/day; refined grains decreased same • No change in control school. 	C K
Siega-Riz et al. (2011), USA	Multi-component	Students from 42 public middle schools	3908	2.5 year intervention with nutrition, physical education, and social communication strategies. For nutrition component, study staff revised school menus to have lower fat, higher whole grain, fiber, taste tests, cafeteria enhancements, training of school staff 2x year, and messages about healthy eating.	<ul style="list-style-type: none"> • 10% higher fruit intake • 2 fl. Oz. greater water intake. 	C
Williamson et al. (2013), USA	Multi-component	4 th -6 th grade students	578 (Wise Mind Study) and 2097 (LA Health Study)	Evaluated the cafeteria modification of the Wise Mind study and LA health study. Modification included subbing in “healthier”	<ul style="list-style-type: none"> • Significant improvements in HEI in treatment groups compared to control after 28 months, particularly 	C S

				ingredients (i.e. low-fat cheese for regular, fruit canned in juice vs syrup, lean meat instead of high fat meat), hanging health posters, and health displays. Measured food selection, intake, plate waste, and healthy eating index.	with reduced fat intake. <ul style="list-style-type: none"> • Strong relationship between food intake and food selection (positive correlation) and plate waste (negative correlation). • Authors conclude that cafeteria modification can improve nutritional intake. 	
Elsbernd et al. (2016), USA	Sampling	K-5 th grade students	500-575	Served red and yellow bell peppers to students while they waited in line. Measured selection and consumption of vegetables at lunch (peppers, a different vegetable, or no vegetable).	<ul style="list-style-type: none"> • Increased V intake due to eating peppers in line, but no change in amount of V option taken for lunch. 	C S
Lakkakula (2011), USA	Sampling	1 st , 3 rd , and 5 th grade students	307	Children offered to taste 4 different F and 4 different V every other week for 8 weeks, then offered again at 4 and 10 month follow ups. One-page tasting survey with faces, assessed willingness to taste (“I chewed it and swallowed it”, “I spit it into the napkin”, “I did not try it”) and likeability (“I like it a lot”, “I like it”, and “I did not like it”).	<ul style="list-style-type: none"> • Increased liking for FV in all groups, maintained at both follow ups. • No significant differences between age groups. 	L WTT

^aInclusion criteria for each study may contain assumptions around age and grade (e.g. a student age 11 enrolled in 3rd grade could be considered eligible for a study involving 3rd graders, even though the typical age for 3rd graders is 8-9 years old).

^bDescription of assessment:

C= Consumption (amount of food ingested, as indicated by self-report, observation, plate waste photo comparison, or post-consumption tray weight)

K= Knowledge (ability to identify or correctly answer questions around food and/or nutrition)

L= Likeability (hedonic scale or qualitative report of food liking)

P= Preference (feelings about one food item in comparison to another)

S= Selection (food items placed on plate/tray, not necessarily consumed)

WTT= Willingness to try (confidence in ability or act of placing food to lips, chewing, or swallowing)

DISCUSSION

In the sixteen published articles reviewed, the studies around school meals often focused primarily on strategies that encourage students to adjust to the school meal offerings, while few focused on adjusting the offerings to appeal to students' taste preferences. Quantitative measures of consumption and plate waste were shown to consistently improve and remain improved in the studies that focused on increasing palatability of food offered in school meals. However, limited assumptions can be made around overall food palatability for all studies in this review.

Most studies implemented measures to assess the quantity of targeted food items students are eating (primarily, FV) by evaluating consumption and, to a lesser extent, selection, knowledge, and likeability. While these measures provide some indication on acceptability of the food, they are inadequate in elucidating whether the food intake is providing a positive experience, which could impact future nutrition behaviors. This highlights a need for researchers to evaluate a variety of measures that provide a more comprehensive look into the extent to which students enjoy the food they are receiving. Combining qualitative methods (e.g. focus groups) with current quantitative measures (e.g. food wasted) may provide a more comprehensive evaluation of the multifaceted topic of eating behavior (Creswell & Plano Clark, 2007).

A focus on food palatability in school meals may provide a valuable medium for students to exert influence in the school environment and help foster a sense of meaningful contribution. In a meta-analysis of sixteen studies that explored effects of the school environment on students' health, it was found that the feeling of having no 'voice' contributed to the likelihood that students would engage in risky health behavior or feel detached from the school environment (Jamal et al., 2013). Enabling students to express their preferences on taste, perhaps through student panels or student-centered activities in which their values and voices are central elements, school meal providers may help foster a positive relationship between students and school communities.

In terms of opening a dialogue around taste and school meals with students, it is important to consider how some interventional models may be more relevant to implementing effective strategies than others. The primary aim of all studies included in this review was around nutrition. However, the collection of studies utilizing collaboration with culinary professionals integrated a unique approach that focused on adjusting the taste of food to be more amenable to students (Cohen et al., 2012; Cohen et al., 2015; Thorsen et al., 2015; Zellner & Cobuzzi, 2017). By working to reformulate school menus according to students' taste preferences, collaboration with culinary professionals creates an avenue for discussion around food palatability and fosters opportunities for students to exert influence in their school environments. Future research could explore the impact of student engagement in school meal programs and the school health environment.

In summary, future studies around meals in schools should integrate more measures to comprehensively assess students' eating experiences. These measures may include collecting qualitative data, such as student surveys, interviews, or focus groups, student-centered activities, or administering validated and age-appropriate hedonic scales. Psychometric development to measure the eating experience may also prove insightful.

CONCLUSION

Intervention research improving school meals has often focused on increasing intake of target foods. Few published studies have examined other outcomes associated with improving school meals such as food enjoyment or well-being. Future studies could include the impact of increasing student engagement around school meals on factors such as physical, social, and psychological well-being in the school environment, and academic outcomes.

ACKNOWLEDGEMENTS

Funding in support of this work was provided by Nordea-fonden through the Danish organization Smag for Livet. The organization had no involvement with the content of this work.

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