Food Appraisal: Discussing Healthy Diet and Eating in Elementary Science

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Abstract

Food constitutes an important pedagogical component of elementary science, yet research on how to approach this topic is scarce. The present study attends to this issue by exploring *food appraisal* (dialogic sense-making wherein elementary teachers and students orally evaluate particular types of foods and eating habits) during science read-alouds. Our discourse analysis revealed varied forms of food appraisal across different elementary grade levels. In two primary classrooms (grades K-1), discussions entailed qualitative forms of food appraisal, namely affective appreciation (evaluation of food in terms of gustatory pleasure) and cultural appreciation (evaluation of food in terms of American traditions such as making jack-o'-lanterns). In contrast, food discussion at a fourth-grade classroom involved nutritional appreciation (quantitative evaluation of food on nutritional grounds and calorimetric needs). Our findings underscore the many pedagogical benefits and potential challenges of engaging students in talk about food in the science classroom. Classroom discussion about food provides elementary teachers with a unique opportunity to engage children in science but can also disempower students and reinforce problematic cultural ideologies. Awareness of such potential complications can help elementary teachers more effectively promote student health and empowerment through science.

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Keywords: elementary science, healthy eating, science read-alouds, food socialization

Introduction

Food constitutes an important pedagogical component of elementary science teaching and learning. This is particularly evident in the pervasiveness of food activities in science

classrooms. Among the most common types of food-related science activities implemented by school teachers are food talk, food writing, food growing, food preparation and eating, and food manipulation (e.g., Christie-Blick, 2006; Hernandez, 2010; Phillips, Duffrin & Geist, 2004; Royce, 2010; Rubstein, Calabrese Barton, Koch & Contento, 2006; Weiland, 2011; Wolfinger, 2005). Food is also recurrently mentioned in national science learning standards. For instance, the Benchmarks for Science Literacy (AAAS, 2009) state that students should learn that "eating a variety of healthful *foods*… help people stay healthy; vitamins and minerals, present in small amounts in *foods*, are essential to everything working well;" and, that, "the amount of *food* energy (calories) a person requires varies" (p.144). And more recently, the Next Generation Science Standards (NGSS Lead States, 2013) state that elementary students need to learn that "all animals need food in order to live and grow" and that **"**food provides animals with the materials they need for body repair and growth and is digested to release the energy they need to maintain body warmth and for motion" (5-PS3-1). Students are expected to grasp the biological significance of food to living beings, and develop an understanding of what constitutes healthy food (i.e., be able to distinguish between "good" and "bad" food based on nutritional composition) as well as healthy eating (i.e., distinguish between healthy and unhealthy diets based on consideration of personal well-being) (Shepherd, et al., 2001).

Nonetheless, research on how science teachers approach topics such as food and eating is surprisingly scarce (Harrison, 2005; Weaver-Hightower, 2011). This is particularly problematic given the multifaceted nature of food-related issues. As an instructional topic, food can potentially serve as a source of conceptual knowledge for science learners as well as personal empowerment (Calabrese-Barton, Koch, Contento & Hagiwara, 2005) and increased awareness of social inequities (Hilmers, Hilmers & Dave, 2012; Hinrichs, 2010). Fully realizing this potential is contingent upon a more sophisticated, theory-based understanding of food discourse. To this end, the present study systematically examination of *food appraisal* (dialogic sense-making wherein elementary teachers and students orally evaluate particular types of foods and eating habits) while engaging in a whole-class read aloud of a science trade book. More specifically, we seek to address the question: What evaluative meaning-making processes take place in elementary classroom discussions about food?

Learning about Food

Food instruction can involve many complex scientific concepts across a range of science disciplines, including ecology, biology, chemistry, agriculture, and even technology. For instance, the science concept of *energy balance* is central to nutritional notions such as unhealthy diet (e.g., high-fat, high-sugar, or high-calorie diet), fitness, and obesity. As a result of this interdisciplinarity, elementary teachers are in a unique position to promote healthier student diets while promoting science learning and student engagement. This is evident in recent research showing that integration of science, health, and nutrition "significantly increases students' knowledge and awareness of science concepts related to energy in living systems, metabolism, nutrients, and diet" (Moreno et al., 2004, p. 122).

Science instructors who set out to foster student learning about food have adopted a wide variety of instructional strategies. One common approach is to engage students in hands-on, food-based science activities (Hovland et al., 2013) such as food lab/kitchen experiments and

inquiry-based educational kits that integrate food science with physics, biology, and chemistry (Schaich-Rogers, 2007). Consistent with Grace and Bay's (2011) call for school teacher adoption of transformative pedagogical models of "science for health literacy" (interdisciplinary teaching approaches that can bridge science literacy and health literacy), food-based science instruction has been shown to enhance students' performance and attitude toward science, particularly among culturally diverse students (Fraser-Abder, Doria, Yang & De Jesus, 2010).

Gardening, another common strategy, allows science teachers to integrate environmental science and nutrition education. In addition to connecting nutrition instruction to relevant science topics (e.g., life sciences and agriculture) (Graham, Beall, Lussier, McLaughlin & Zidenberg-Cherr, 2005), gardening has also been shown to effectively increase students' consumption of fruit and vegetables and reinforce their nutrition knowledge (Bagdonis, Hinrichs & Schafft, 2009; Joshi, Azuma & Feenstra, 2008; McAleese & Rankin, 2007; Morris & Zidenberg-Cherr, 2002). Furthermore, gardening has been shown to produce many positive benefits and learning outcomes, including improved student achievement, daily attendance, and classroom participation and healthier eating habits (Gleason, 1995; National Governors Association, 2000; Snyder, Story & Trenkner, 1992; Templeton, Marlette & Panemangalore, 2005). Combined, these studies provide ample evidence of the pedagogical value of incorporating food activities into science instruction. Beyond science education, a growing number of social scientists have also conducted research on food.

Food Socialization

Research examining the intersection between language and food is vast and can be found in varied fields of scholarship, including culinary linguistics (Gerhardt, Frobenious & Ley, 2013; Newman, 2009) and the anthropology of food and eating (Mintz & Du Bois, 2002). Language and food are emphasized in much of this literature as fundamentally interconnected aspects of the human experience. Arguing that eating and talking are universal and closely related human social acts, Gerhardt (2013) writes,

> Every healthy human being eats and talks…both food and language are used to main and create human relationships… while food enters the body through the mouth, language leaves the body through the same cavity…both food and language are fabricated by building larger units out of smaller entities: ingredients make dishes make meals; sounds make words make utterances make texts (p. 3-4).

Not only does the language use shape foodways (e.g., food-related behaviors such as eating habits) but food consumption also shapes the language use (e.g., promotes verbal interaction and language acquisition among young eaters). For example, research shows that food talk at the dinner table (Ochs, Pontecorvo & Fasulo, 1996; Paugh & Izquierdo, 2009) and during school lunchtime (Karrebæk, 2012) plays a central role in children's socialization to traditional foods, culturally appropriate ways of eating, and understandings of healthy food. And, while gathered around food, eaters have a chance to develop interpersonal and linguistic skills and have a chance to negotiate their personal identities (i.e., their sense of self as members of sociocultural groups who eat in particular ways).

An important distinction commonly made in the literature on food discourse is between the socialization of taste (pleasurable eating) and the socialization of nutrition (healthy eating) through language use and verbal negotiation (Ochs et al., 1996; Paugh & Izquierdo, 2009). Socialization of taste prioritizes food as a source of pleasure for the eater, whereas socialization of nutrition emphasizes food as a source of health. The former is often characterized by the usage of taste words (Ankestein & Pereira, 2013), vocabulary that describes one gustatory sensation or perception when crushing and chewing particular types of food (e.g., sweet, sour, bitter, salty, tangy, spicy). These two distinct and often competing ways of talking about food and verbally depicting eating are reflective of what has been previously described as the *dual aspects of ingestion* (Newman, 2009). Acts of ingestion have two closely related yet distinct aspects: the consumer's sensation while ingesting food (the sensorial aspect) and the disappearance of the entity consumed (the digestive aspect). When engaged in food-centered discourse, speakers often use language in ways that emphasize one aspect more than the other, hence fostering different types of socialization.

Central to the processes of socialization of eating is *food morality* (Aronsson & Gottzén, 2011), the language-mediated negotiation of "good food" and "bad food." Fuller, Briggs, and Dillon-Sumner (2013) describe how health magazines construct "good food" differently for men and for women (i.e., contain gender-biased moral messages). Good food for men improves physical performance (builds muscles), whereas good food for women improves physical appearance (leads to weight loss). These studies show how food morality is accomplished in discourse through a process of *linguistic evaluation* – explicit and implicit communication of particular food items and eating habits as being either good or bad for consumers. Informed by this literature, the present study examines *food interactions* (Karrebæk, 2012; Paugh & Izquierdo, 2009) in science classrooms.

Theoretical Framework

Our theoretical perspective on linguistic evaluation is informed by the work of language scholars like Hunston (1994) who writes that,

> To evaluate something is to have an opinion about it, particularly in terms of how good or bad it is. The terms of reference for the judgment may be essentially personal… or they may occur within an institutionalized framework (p. 191).

From this stance, evaluation refers to the language-mediated processes of value ascription that take place in face-to-face interaction. Evaluation can be explicitly expressed by means of deployment of particular evaluative resources available to speakers (e.g., critical commentary) or implicitly conveyed through word choices and constructions designed to evoke judgmental responses from receivers. Further, evaluation simultaneously entails multiple parameters (right-wrong, good-bad, important-unimportant, factual-tentative, etc.) and varied foci (ideas exchanged, references made, participants addressed, etc.).

Drawing upon appraisal theory (Martin & White, 2003), a theory about the communicative resources used by speakers to express evaluation through discourse, we conceive of food discussions as communicative events in which science teachers and students exchange utterances with varied appraisal systems – word choices and constructions that communicate particular types of evaluative meanings. Like Martin (2000), we use *appraisal* in reference to

"the semantic resources used to negotiate emotions, judgments, and valuations, alongside resources for amplifying and engaging with these evaluations" (p. 145). From this perspective, when teachers and students advance an opinion or express an attitude about food, they have the option of choosing among a range of evaluative options and, as a result, communicate different types of appraisal such as appreciation and judgment (see Figure 1 below).

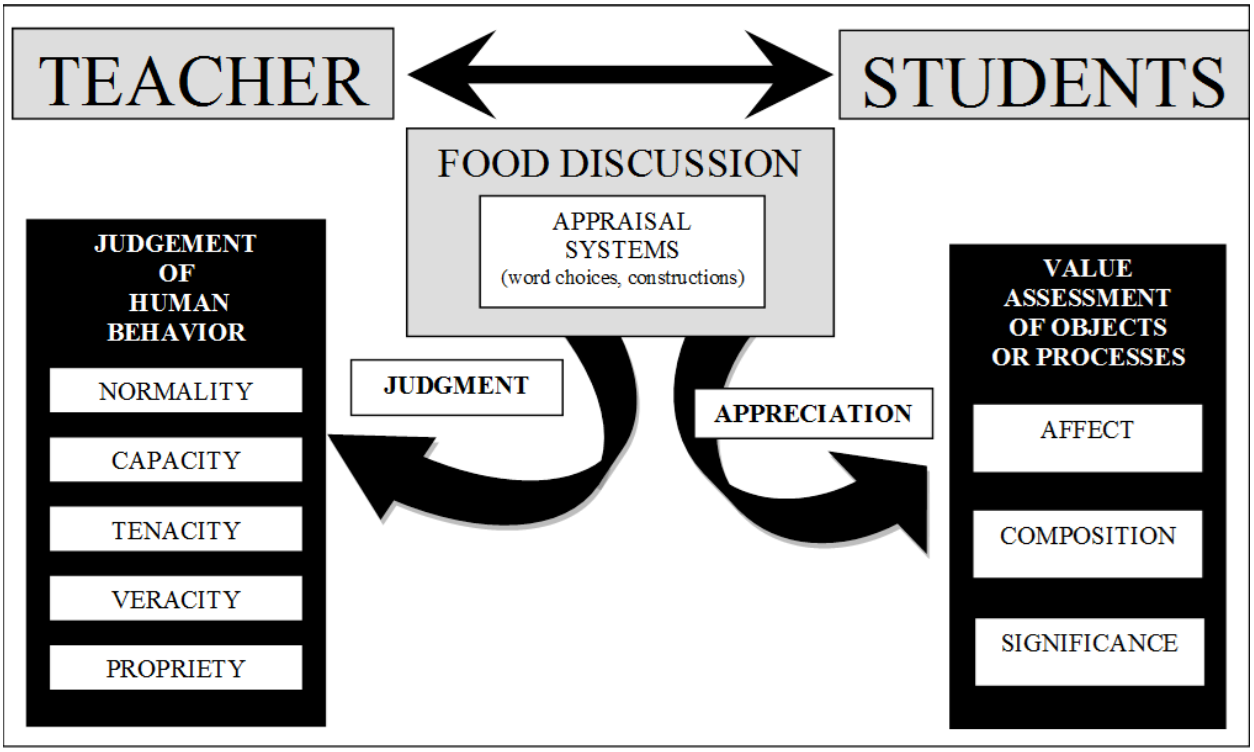


Figure 1. Oral Evaluation in Food Discussion.

In our theoretical framework, *appreciation* deals with the evaluation of objects, products, or processes. When appreciating something, speakers evaluate nonhuman entities either positively or negatively based on criteria such as affect (e.g., affective responses or references to emotions), composition (e.g., qualities such as balance, unbalanced, simplistic, complex), and significance (e.g., identifying impact or implications). By contrast, *judgment* is a type of appraisal concerned specifically with human behavior. When passing judgment on behavior, speakers evaluate the acts and dispositions of human beings, either positively or negatively, based on criteria such as normality (custom or tradition), capacity (capability), tenacity (resolve), veracity (truth), or propriety (ethics). Judgmental meanings include behavioral assessments such as normal or abnormal, moral or immoral, legal or illegal, acceptable or unacceptable, and/or laudable or deplorable. In the present study, we examine how science teachers and students deploy these different appraisal systems to make sense of certain types of food and eating habits discussed in the course of science read-alouds.

Methodology

Our methodological approach centered on the use of technological media (video and audio) for making a naturalistic record (Lincoln & Guba, 1985) and getting access to a particular type of pedagogical activity, namely teacher-student discursive appraisal of foods in the specific context of science read-alouds. Selection of such pedagogical context was informed by recent research showing a growing presence of teacher aloud readings of children's picture books in elementary science (Braun, 2010; Heisey & Kucan, 2010; McCormick & McTigue, 2011). Such a trend suggests that science read-alouds constitutes an important pedagogical strategy for teaching the topic of food in elementary school settings.

Conducted within a qualitative and interpretive paradigm of educational research (Bogdan & Biklen, 2003; Creswell, 2003), our design relies on discourse-centered methodology concerned with the moment-by-moment, real-time unfolding of speech (Farnell & Graham, 1998). Classroom videography (Hall, 2000) is combined with semi-structured interview (Robson, 2002) for the purpose of providing a phenomenological account (Merriam, 1998) of teachers' and students' experiences talking about food in elementary science, and effectively supporting our emergent analytical approach (Roschelle, 2000). This methodological approach allowed us to conduct an in-depth exploration without interfering with teachers' pedagogical practices.

Data Collection

Our data set consisted of digitally captured video-recordings of teacher-led science read-alouds immediately followed by audio-recorded interviews with the teachers. These methodological choices were strategically made to create a technical arrangement in which teachers were first positioned as action-takers interacting with learners in the pursuit of particular pedagogical goals, and then as respondents commenting on their own actions. Recorded by an operator with a stationary digital camcorder located in the back of the room, the videos focused mainly on the book being held by the teacher. During video data collection, an effort was made to produce "teaching dioramas" (Hall, 2000) – video representations similar to museum exhibits with a wide-angle format that offered a glimpse of the larger classroom landscape (i.e., extended beyond the teacher's body) and also captured teachers' interactional work in the immediate surroundings (e.g., local students' voices, backs, and body movements). Although asymmetrically focused on the teacher, this positioning of the camera was consistent with Stigler's (1995) recommendation for educational researchers to "point the camera toward that which should be the focus of the ideal student at any given time" (p. 15). In the case of read-alouds, this ideal student perspective or vantage point is typically that of a child looking at the science book being held by the teacher in front of the classroom while facing the students. This allowed us to examine the data from the perspective a student engaged in discursive interaction with the teacher and his/her peers, thus providing critical information about how a student may experience the discussions of food.

Our video dataset was supplemented by curricular data (the children's science books selected by the teacher to be read aloud) and semi-structured interviews with the participating elementary teachers. The children's books allowed us access to the original textual information and pictorial representations taken up and elaborated by teachers and students during the video-

recorded food discussions. Immediately after reading their selected book aloud, each teacher participated in a semi-structured interview in which she was asked to comment upon on various aspects of the read-aloud session, including book selections, teaching objectives for the lesson, and students' learning and participation. As Bernard (2002) points out, semi-structured interviews are based on the use of a general script or interview guide containing a list of topics that need to be covered and questions to be asked. This type of interview is open-ended, that is, although there is a list of predetermined questions, the interviewer has the freedom to modify the sequence and wording of questions, omit or add questions depending on their appropriateness to particular interviewees, and determine the amount of time and attention given to different questions or topics (Robson, 2002). Our interview protocol included the following questions: (1) Why did you select that particular science book? (2) What was your overall impression about the read-aloud? (3) What specific strategies did you adopt while reading the science book aloud? (4) Were they effective? (5) What was your purpose of employing these read-aloud strategies? (6) Was your science read-aloud integrated to other activities, topics or lessons? In this study, deviations from the protocol occurred in instances when (provide example scenario) in order to (provide reason why). This interview data provided us with important information regarding the classroom context wherein every read-aloud was performed.

Participants

Participants in this exploratory study included three elementary teachers from different public schools in upstate New York who were assigned the following pseudonyms: Martha, Megan, and Sue. These teachers were recruited and selected for various reasons through an announcement on local listserv to which teachers voluntarily subscribed. First, they regularly read children's science books aloud to their students. Second, they approached aloud reading dialogically (Pappas, Varelas, Barry & Rife, 2002) by interspersing oral text delivery with whole-class discussions that enabled students to actively make sense of book contents, express their understandings, and share personal experiences. Third, all three teachers identified food and/or eating as instructional topics they were about to cover in science. While participation in this study was voluntary, we sought to select teachers with a wide range of teaching experiences (novices and veterans) and taught in a variety of instructional settings (urban, suburban, and rural areas) and grade levels (1 through 6) in order to understand food discourse in a variety of contexts. The books were selected by the participating teachers without the researchers' input. All teacher names were changed for this study to ensure confidentiality.

The first teacher was Martha who taught kindergarten and had twenty five years of teaching experience at the time of this study. She taught at a rural school and chose to read the book *You Are What You Eat* (Berger, 1994). A description of this and other books can be found on Table 1. She self-reported regularly using a combination of fiction and nonfiction read-alouds to provide background knowledge on each science topic, introduce new concepts, and review ideas. During her interview, Martha stated that this particular read-aloud was part of a larger instructional unit:

> We are doing [a unit on] nutrition… we do a lot of cutting out of magazines, and yesterday we were cutting out foods they had never tried and then they put that on a plate and they had to write what they would like to try… and then today we're talking about, just trying to get that concept of eating a balanced meal, I know like

> the food pyramid is passé now [laughs], first it was stacked and then it was sliced, but the plate concept, I think they really click with that one.

Our second participant was Megan who was a first-grade teacher with six years of experience at the time. She taught at a suburban school and was video-recorded while reading the book *From Seed to Pumpkin* (Pfeffer & Hale, 2004). Immediately following her read-aloud, Megan explained why she selected this particular book and how it fit into ongoing classroom activities:

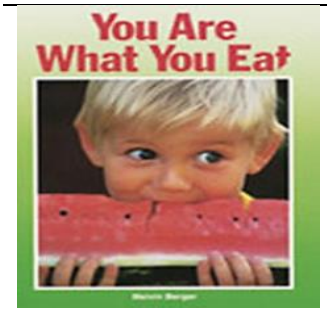
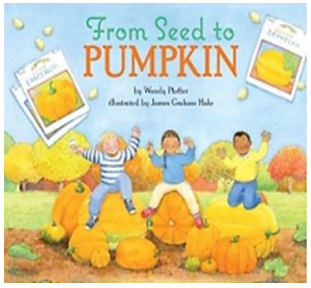
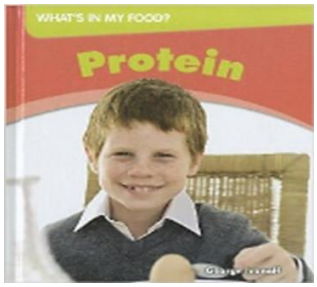
> We just introduced our Organisms unit, so yesterday we planted seeds [peas, pumpkins], and several students planted pumpkin seeds. I thought this would be a good link to what we've done in the past and scaffolding it into what we've actually learned, and actually incorporating it with the hands-on. So we talked about pumpkins and apples in the fall, and now we are talking about the seeds and actually the lifecycles, so it was a quick overview on giving them more in-depth, so it's two weeks until it's going to sprout, four into that, so some pre-setting, some background knowledge, just a little mishmash of everything.

The last participating teacher was Sue who taught fifth grade and had twenty years of teaching experience. In her urban classroom, Sue read the book *Protein* (Ivanoff, 2012) aloud. While articulating her rationale for selecting this specific book for her read aloud, Sue stated:

> We are in the middle of a food chemistry unit where we are looking at nutrition and what nutrients are in which food… we read an article on nutrients in general that talked a little bit about proteins but this is much more in-depth than anything we've done before… it went into a little more detail in terms of amino acids, what they do, what amino acids are and how they work…the food chemistry unit has a lot of hands-on, tomorrow we will talk about reading nutrition labels and read about vitamins and minerals.

The above instructional activities were part of these teachers' efforts to meet the state's science learning content standards. In New York, K-4 students are expected to understand that "humans need a variety of healthy foods… to maintain good health" and that "good health habits include… eating a balanced diet (NYSED, 2013a, p. 21)." Similarly, 5-8 students are required to learn that "food provides molecules that serve as fuel and building material for all organisms"; "foods contain a variety of substances, which include carbohydrates, fats, vitamins, proteins, minerals, and water"; "energy in foods is measured in calories"; and, "to maintain a balanced state, all organisms have a minimum daily intake of each type of nutrient (NYSED, 2013b, p. 18)."

Table 1. Video-recorded science read-alouds.

Book	Video
	*Teacher*: Martha *Grade*: Kindergarten *Duration*: 17 minutes *Book Title*: You Are What You Eat (Berger, 1994) *Genre and Stylistic Features*: Very large, non-fictional poster book that provides an expository description of wide variety of foods (fruits, vegetables, meats, pastas, sweets, etc.), children's activities (playing, exercising, studying, seeing a dentist, etc.), and the food pyramid. Illustrated with colorful pictures of children of varied ages and cultural backgrounds eating, the book's layout follows a traditional textbook format with a table of contents and a word index at the end.
	*Teacher*: Megan *Grade*: First *Duration*: 23 minutes *Book Title*: From Seed to Pumpkin (Pfeffer & Hale, 2004) *Genre and Stylistic Features*: Hybrid storybook written in the form of an informational narrative wherein fictional characters (a farmer, three kids, and a dog) set out to grow pumpkins in a rural setting. The book is illustrated with very colorful cartoonish drawings and informs readers about the process whereby pumpkins are grown from seed, nurtured in a garden, and eventually cooked into pies and carved into jack-o'-lanterns during Halloween. The unseen narrator describes several gardening tasks (preparing the soil, digging holes for the seeds, watering, weeding and picking) and stages in the pumpkin lifecycle (seeds, seedlings, adult plants, blooming, pollination by bees, and fruit maturation).
	*Teacher*: Sue *Grade*: Fifth *Duration*: 20 minutes *Book Title*: Protein (Ivanoff, 2012) *Genre and Stylistic Features*: Non-fictional picture book that provides an expository description of several aspects of the macro-nutrient protein. The author addresses questions such as: What is protein? What does protein do? What foods contain protein? What happens if I don't eat protein? Illustrated with large and colorful photographs of a variety of protein-rich foods (meats, grain, dairy foods, legumes, etc.) and physical activities (children and professional athletes running, riding bicycles, playing basketball, lifting weights, etc.), this book provides descriptive information regarding the amount of proteins that humans need and how to meet these nutritional needs, identifies the benefits of healthy eating habits and the potential consequences of failing to eat enough proteins, and introduces readers to the notion of a balanced diet (defined as "a healthy selection of food that you eat").

Data Analysis

Our choice of a discursive and qualitative analytical approach was motivated in part by recent research showing that, in addition to providing sustenance and nourishment to the body,

food has an extraordinary symbolic potential as medium for conveying a wide variety of meanings (personal, societal, cultural, scientific, etc.), hence its study requires the adoption a meaning-centered interpretative approach. As Counihan and Van Esterik (1997) emphasize, "food marks social differences, boundaries, bonds, and contradictions. Eating is an endlessly evolving enactment of gender, family, and community relationships" (p.1). Put differently, selecting and eating food are complex acts of signification whose meanings extend beyond scientific sphere and conceptual issues related to nutritional quantification and body health. Through food, people construct certain types of identities and position themselves and others socially and culturally in the world.

We conducted discourse analysis of the video transcripts (see appendix for transcription conventions). Like discourse theorists such as Jaworski and Coupleland (1999), we define discourse analysis as "a committedly qualitative orientation to linguistic and social understanding" whose aim is "to demonstrate meaning-making processes and to build rich interpretations of local discourse events" (p. 36-37). Further, our approach to food discourse analysis is aligned with the research tradition of interactional sociolinguistics. Concerned primarily with micro-level communication in face-to-face interaction, this particular strand of discourse analysis deals with signaling mechanisms or *contextualization cues* (Gumperz, 1982) in unfolding talk. Its main premise is that the seemingly irrelevant details, such as the particular words that speakers choose to use (i.e., lexical choices), can reveal important information about how members of a social group relate to each other and their world, share meanings, and interpret what is being said (the message exchanged). Because such subtle discursive information can potentially illuminate "what really goes on" in a verbal exchange or communicative event, it plays a central role in the empirical process of theory genesis (Levinson, 1983).

We read transcripts inductively through iterative cycles in which we sought to understand and describe emergent patterns in teacher-student oral evaluation of food and eating in each read-aloud session. Guided by the theoretical framework, we conducted an in-depth and up-close analysis of evaluative word choices (appraisal systems) in teacher-student oral food discourse. From our theoretical perspective, classroom discussion provided teachers and students with a shared discursive space for evaluative work (i.e., appraisal), enabling them to convey and negotiate particular edible ideologies, attitudes toward eating, and relationships with food. Further, an analytical distinction was made to two different foci of appraisal: food itself and acts of eating. In the former, attention was given primarily to the object of ingestion (e.g., appreciating a particular type of food such as sugar as being unhealthy). By contrast, in the latter, the ingestion act itself becomes the main focal point (e.g., judging a particularly eating behavior or habit such as the consumption of sugar as being unhealthy). Put differently, when judging, evaluation of one's foodways (eating behaviors) took precedence over evaluation of what was consumed. Due to their pervasiveness in our transcripts, these two alternative forms of appraisal (appreciative and judgmental) became the main focus of our analysis.

Various measures were taken to ensure the validity and trustworthiness of our analysis. First, we combined systematic examination of transcribed recordings and sequential analysis and playback of video-recorded interaction. Second, we held peer debriefing sessions where we worked to triangulate our individual interpretations of the data. As emphasized by Lesh and

Lehrer (2000), the cross-checking of particular episodes is of paramount importance to videotape analysis. And third, we reflectively considered our emergent pattern in light the contextual information disclosed by the teachers during the semi-structured interviews.

Findings

Our discourse analysis revealed the predominance of varied types of food appraisal across different elementary grade levels (see Figure 2). In the two primary classrooms (grades K-1), discussions entailed qualitative forms of food appraisal, namely *affective appreciation* (evaluation of food in terms of gustatory pleasure) and *cultural appreciation* (evaluation of food in terms of American traditions such as making jack-o'-lanterns). In contrast, food discussion at the fourth-grade classroom involved *nutritional appreciation* (quantitative evaluation of food on nutritional grounds and calorimetric needs). The pedagogical practices underlying these different types of food appraisal are presented in Figure 2 in ascending order of grade level.

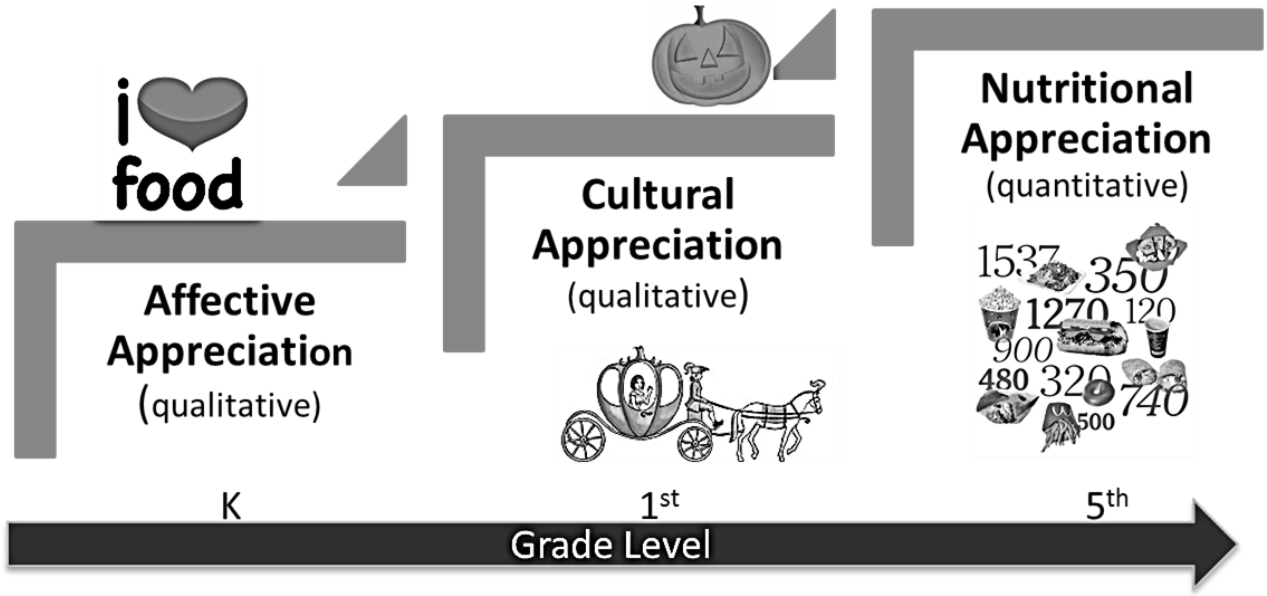
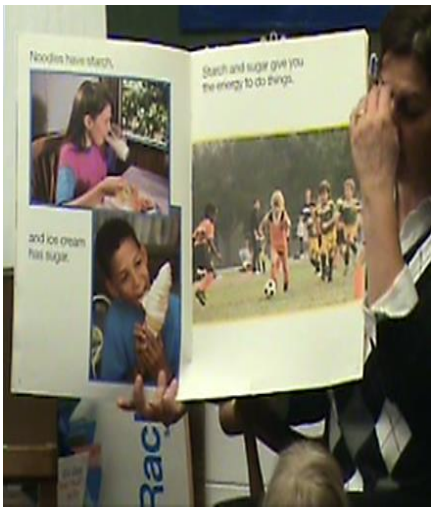


Figure 2. Food Appraisal across Elementary Grade Levels.

Martha: Kindergarten

This read-aloud was characterized by the predominance of affective appreciation of food. Particularly noticeable was the deployment of two competing appraisal systems (taste appreciation and behavioral judgment) by Martha and the students. For instance, halfway into the session, students expressed affective appreciation of sugar while evaluating verbal and visual references to sweet food items such as sugar and ice cream on the book *You Are What You Eat*:



Martha: NOODLES HAVE STARCH, AND ICE CREAM HAS SUGAR. STARCH AND SUGAR GIVE YOU THE ENERGY TO DO THINGS.

Students: I like sugar! I like sugar a lot! I love sugar! Me too! [students begin calling out with excitement]

Martha: Uh, Jacob says that he thought sugar made you slow, well it's all about getting the right amount, you wouldn't want to just have sugar, just like you wouldn't want to just have protein, you want to have the right amount.

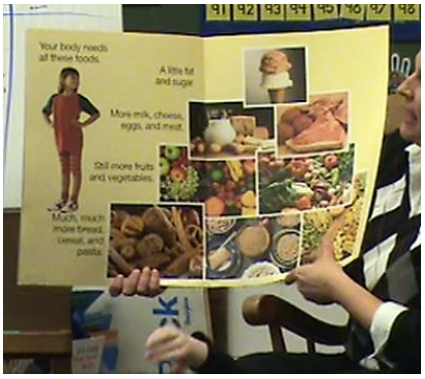
John: Or salt, like, if you uh…

Martha: Right, you wouldn't want to have too much salt, but by eating certain foods that have starch and sugar in them, it gives you energy to do things.*

*See Appendix for coding

The discussion began with students affectively appraising sugar by resorting to the two emotion verbs *to like* and *to love*. Through their spontaneous and unprompted expression of affective appreciation of this particular substance ("I like sugar! I like sugar a lot! I love sugar!"), students collaboratively ascribed a positive value to sugary foods. This positive evaluation of sugar was then met with evaluative comments from the teacher who immediately shifted to a judgmental mode of appraisal. Rather than continuing to evaluate the food itself (sugar), Martha focused her appraisal on the act of eating sugar. Further, she repeatedly resorted to directives with the verb *to want* ("you wouldn't want to just have sugar…you want to have the right amount") that emphasized personal desire rather than necessity; no directives such as "you need to have the right amount" were provided. As a result, a contrast was made between desirable eating habits ("you want to have the right amount") and undesirable eating habits ("you wouldn't want to just have sugar"). Rather than categorizing sugar itself as being a good or bad type of food based on gustatory sensation (taste), Martha made a distinction between right and wrong based on consideration of normality (i.e., eating habits considered to be consistent with normative principles). Rightness or wrongness was contingent upon consumption of what is considered to be normal amounts of sugar, not food selection (sugar itself is not necessarily a bad food choice). Throughout this collective negotiation of the value of sugar, students were socialized into appraising food through judgment of what constitutes normal eating activity rather than mere affective appreciation of food items.

Similar patterns recurred a few minutes later during discussion of a book page that contained pictures of several different types of food arranged into a pyramid outline:



Martha: YOUR BODY NEEDS ALL THESE FOODS. A LITTLE FAT AND SUGAR. MORE MILK, CHEESE, EGGS, AND MEAT. STILL MORE FRUITS AND VEGETABLES.
Students: And ice cream!
Martha: MUCH, MUCH MORE BREAD, CEREAL, AND PASTA.
Students: And ice cream!
Martha: Just a little bit of that…

Martha: On this page here, they show us, you said it looked like the food tower or pyramid, well scientists are always figuring out new information and they figured some new information about the food pyramid… and what they thought was that the food pyramid is, when you looked at this, I heard some of you say "there is ice cream, there is ice cream!" Well, what was happening is, when they saw pictures of the food pyramid, kids looked and saw the things that they really liked like ice cream and cookies, and they are like "oh, some kids are getting too much of that."

As can be seen above, students interrupted Martha's aloud reading to reinforce their previously expressed appreciation of sweet food items. Their comments ("And ice cream, and ice cream") communicated a personal preference for ice cream over other items on the food pyramid. This persistent expression of affective appreciation indicates that students continued to evaluate food primarily in terms of their sensorial experiences (previously experienced sensations of taste), appraising each item according to its perceived degree of gustatory pleasure. Once again, Martha reacted by judging students' expressed fondness for sweets ("just a little bit of that [ice cream]… some kids are getting too much of that [ice cream and cookies]"). By doing so, Martha continued to reinforce the need for students to appraise food in terms of what constitutes normal eating ("just a little bit") and abnormal eating ("getting too much") rather than simply relying on their personal perceptions of pleasurable taste.

Megan: Grade 1

Aloud reading of the book *From Seed to Pumpkin* was characterized by cultural appraisal. Pumpkin was evaluated on cultural grounds (in terms of its association with a traditional American holiday). This appraisal was observed at the onset of the read-aloud:

Megan: When do we usually see pumpkins?
Students: When it's the farm.
Megan: In the farm. But what time of year do we usually see pumpkins?
Students: Halloween!
Megan: Halloween, so in the fall.

Rather than being evaluated with respect to eating habits or consumption, the pumpkin was initially evaluated in terms of its role as a seasonal/holiday icon. Such a form of evaluation is consistent with historical food studies showing that the pumpkin has a unique status in American history as a cultural symbol of rural nostalgia and a source of national identity that sets it apart from other fruits and edible items. This symbolism is evident in countless forms of cultural manifestations ranging from harvest festivals (e.g., giant pumpkins, carving contests, etc.) to children's fables (e.g., Cinderella's carriage) and legends (Sleepy Hollow). As Ott (2012) writes, "unlike most people around the world, who eat pumpkin unceremoniously throughout the year… [Americans] set them in front of their houses as decoration every autumn and carve them into jack-o'-lanterns for Halloween night" (p. 3). In other words, in contemporary American society, the cultural celebratory value of the pumpkin surpasses its culinary value as a food ingredient.

Appraisal of pumpkins as a potential source of food was taken up later in the discussion when attention shifted to the appreciation of pumpkin ripeness:

Megan: "LEAVES ON THE TREES TURN RED, BROWN, AND YELLOW. AND THE PUMPKINS START TO CHANGE COLOR TOO. AS THEY RIPEN, THEY CHANGE FROM GREEN TO YELLOW AND THEN TO ORANGE." Ripen means they get ready. You know how you guys can eat fruit? It's got to get ripe; it has to be ready to eat.
Student: Like apples.
Megan: Like apples, yeah. They turn colors.
Student: And bananas.
Megan: And bananas! When bananas aren't ripe, they're green; they're not ready to eat. When they are ready to eat what color are they?
Student: Yellow!
Megan: Yellow.
Student: And then if we don't eat them they turn black.
Megan: Excellent. That means they start to rot. So they're not ready, then they get ripe, and then they rot.

In this passage, pumpkins were appraised in terms of readiness for human consumption (ripeness). More specifically, the discussion centered on the appreciation of the significance of pumpkins' external appearance (outer coloration) based on prevalent cultural norms. Through comparisons to fruits likely familiar to the children such as apples and bananas, multiple associations were made between particular colors and maturation stages (green = unripe, yellow = ripe, black = rotten). As a result, fruits were ascribed different values along an unripe-to-rotten evaluative continuum. Underlying this appraisal system is social construction of behavioral normality and propriety. Eating yellow fruits was constituted as the "normal" and "proper" behavior (culturally acceptable diet).

Sue: Grade 5

Nutritional appraisal pervaded the aloud reading of *Protein*. Rather than relying on qualitative assessment of "normal" eating habits and healthy foods, Sue and her students resorted

to a quantitative appraisal system wherein particular patterns of food intake was evaluated as constituting a "balanced diet" based on considerations of biological necessity and nutrient composition. This was particular evident in Sue's comments early in the read-aloud session:

> MOST PEOPLE NEED ABOUT ONE HUNDRED AND TWENTY EIGHT TEN-THOUSANDTHS OUNCES PROTEIN PER POUND OF THEIR WEIGHT. So, you'll have to take your weight and multiply it by a little over a hundredth of ounces. This young boy [photograph] is eight. He weighs 55 pounds, so he needs to eat around seven tenths of ounces of protein every day in order for his body to work at his best to survive. DIFFERENT TYPES OF FOOD HAVE DIFFERENT AMOUNT OF PROTEIN… close to 3 ounces of chicken will give you seven tenths of ounces of protein… PROTEIN IS A MACRO-NUTRIENT. Does anybody know what macro-nutrient is? Macro-nutrient is a nutrient that you need a lot of.

Unlike Martha's read-aloud which was focused on personal desire (what one *wants* when selecting and consuming food), Sue's nutritional appraisal was centered on biological necessity (what one *needs* when selecting and consuming food). Further, biological necessity was conceptualized qualitatively in terms of macro-nutrient/micro-nutrient dichotomy (high versus low biological needs) as well as quantitatively in terms of the mathematical ratio (0.0128 ounces of protein per pound in the eater's body weight). As a result, an appraisal system was created wherein one's eating habits could be judged quantitatively as producing the necessary amount of protein intake. In addition to being introduced to a more abstract and quantitative conception of food, students were socialized into what Mudry (2011) refers to as the *discourse of food enumeration and eating quantification* which, she argues, has remained the predominant framework for conceptualizing what constitutes a "good" diet or eating in modern society since with the invention of the calorimeter at the turn of the twentieth century. This is consistent with Mudry's (2011) argument that "scientists used a calorimeter to quantify food and human activity, and they used scientific data to construct numeric boundaries for 'good' and 'bad' foods and eaters… calorimetry could determine how much [food] you should put into your body based on how much [energy] you put out" (p. 236-238). Calories have been seen metaphorically as "fuel" for the "human machine."

Subsequent to the quantification of protein needs based on body weight, consideration was given to eating situations wherein such needs remained unmet, that is, eating habits that could potentially lead to dietary imbalance as well as the consequences of such lack of balance:

Sue: Many of foods we eat provide multiple nutrients, so it gets pretty complicated try to figure out how much what you need to eat keeps in a balanced diet… vegetarians eat a lot of legumes because they don't eat meat, so they need to make sure to get enough protein in their diets… what happens if I don't eat protein?
Troy: You can't live without protein, like hair may not grow?
Sue: Well, it might grow, but it won't grow very well. You need protein for your hair to grow and keep your skin healthy. Sam?
Sam: You can get sick.
Sue: Right, your body cannot stay strong without protein.

The above discussion centered on the harmful effects of insufficient consumption of protein to one's health. As part of this appraisal system, protein-rich items such as meat and legumes were constructed as *foods of necessity* (Ochs et al., 1996), that is, a type of "food that is good for you" (i.e., needed for the attainment of physical health) rather than simply "good food" (i.e., having a pleasurable taste). Put differently, "good" was a judgment value assigned to eating habits that produce a physiological state (body strength, hair growth, and skin health) rather than a sensorial experience (e.g., gustatory feelings of gratification and satisfaction).

Later in the discussion, protein-rich foods were characterized as good for building muscles, with several allusions being made specifically to athletes and their commonly used dietary supplements:

Sue: ATHLETES NEED A LOT PROTEIN BECAUSE THEY USE THEIR MUSCLES MORE THAN MOST PEOPLE. A lot of people are on a big protein kick lately. You see protein drink; you see protein bars… because they need to have so much muscle mass in order for them to lift this heavy weight they need to have a lot of muscle.
Student: Teacher.
Sue: Yes.
Student: Have you ever heard of muscle milk?
Sue: Yes.
Student: Someone talked about that, he said it's like a shake.

The above discussion centered on evaluation of consumption of *functional foods* (Henderson & Johnson, 2012), food products manufactured within a medical paradigm through the use of biotechnology and that are marketed as having extra health-giving properties that go beyond basic nutrition such as the ability to enhance sport performances and active lifestyles. More specifically, Sue and the students positively judged the consumption of sports-related products such as bars and shakes as a means to meet the very high protein needs of professional athletes. The evaluative link made between protein consumption and muscle building is reflective of larger ideologies about foodways reinforced by mass media such as sports magazines wherein consuming large quantities of proteins with the goal of achieving muscularity is commonly depicted as "eating right" (Fuller et al., 2013). Similarly, in the above discussion

protein consumption was used as a standard for establishing a morally superior type of diet and for judging one's eating practices.

Discussion

Elementary teachers and students appraise food and eating in variety of ways when these topics are taken up as part of science discussions. In this specific social context, food can be appreciated as being either good or bad based on emotional, cultural, and nutritional grounds. Likewise, eating can be judged as either good or bad based on consideration of normality and propriety qualitative criteria (personal desire, biological necessity, cultural norms) or quantitative criteria (number of calories, grams of protein). Evaluative meaning-making about food in elementary science is both diverse and complex, thus deserving of further analytical and theoretical consideration.

Promoting Health through Science

As reported above, promotion of a healthy diet was prominent in food-centered science discussions in two elementary classrooms (Martha's and Sue's). Despite their similar efforts to discourage excessive food consumption, these teachers' evaluative approaches differed in important ways. Martha socialized her kindergarten students into appraising food through judgment of what constitutes normal eating activity (non-excessive consumption) rather than mere affective appreciation of food items (sensation of gustatory pleasure). In contrast, Sue socialized her fourth-graders to appreciate food on nutritional grounds (the extent to which it met one's calorimetric needs and provided eaters with a balanced diet). Excessive consumption was defined qualitatively by Martha as simply eating beyond a point of minimum sensorial satisfaction, and quantitatively by Sue as an unbalanced calorimetric state wherein energetic input superseded output.

Martha's appraisal of excessive food consumption was emotionally loaded. Students were encouraged to view indulging in tasty sweets (i.e., seeking gustatory pleasure) as a "bad" habit to be suppressed and replaced by food consumption based on informed consideration of biological necessity. Such affective appraisal of food consumption has been criticized by food scholars such as Fuller et al. (2013) who argue that "loading eating with a lot of emotional baggage" (p. 277) can be disempowering for eaters and ineffective in promoting healthy eating. Linking food consumption to affect can encourage eaters to see unhealthy eating as equivalent to failure to demonstrate self-discipline, determination, and control over one's appetite and cravings (i.e., not being a "good" person). As such, eaters can experience negative emotions such as remorse and guilt. A more effective approach is to associate healthy eating with positive emotions such as the enjoyment of being more in tune with one's appetite and body needs.

In contrast, appraisal of diet based on calorimetric calculations, as prevalent in Sue's classroom, is consistent with the "discourse of quantification" or "scientized eating" (Mudry, 2011), a new language of food enumeration and eating measurement that emerged in the US with the advent of the calorimetric technology and food science. Rather than simply relying on subjective considerations such as personal gastronomic preferences or culturally appropriate food choices, Sue's students were socialized into a more sophisticated epistemological framework wherein healthy eating was defined quantitatively in terms of calorimetric data and scientific

research. Students were encouraged to establish a more detached and rational relationship with food wherein eating habits were to be objectively calculated and measured against empirically established numeric standards (i.e., the "truths" about food). Irrational appetite was to be supplanted by calculated nutritional needs. As Mudry (2011) writes, "the introduction of quantity as an inherent quality of American food and the human act of eating normalized personal gastronomic preferences and allowed eaters, and their food, to be ranked, counted, and measured" (p. 250). Despite its epistemological sophistication, nutritional appreciation runs the risk of reducing eating and people to mere numbers which can also be a source of disempowerment for eaters and obstacle to the promotion of healthy diet, and is thus deserving of careful and critical consideration on the part of practitioners.

The above findings provide evidence that eating and emotionality are two closely linked aspects of the human experience. As Fuller et al. (2013) emphasize, "eating is just as much about pleasure as it is about guilt… very few people, if any, are able to entirely separate food from emotion" (p. 273). As such, it can be argued that efforts to socialize students into science-informed foodways should not overlook food emotionality in favor of detached transmission of food science facts in elementary school. How one feels about food is just as important as what one knows about food, and thus efforts to erase children's emotional links to food can potentially render science instruction meaningless and disempowering to students.

Food and Culture

Unlike the other two teachers, Megan appraised food culturally. Rather than focusing on nutritional or emotional aspects of pumpkin consumption, attention was given mainly to cultural meanings of pumpkins pervasive in American culture such as jack-o'-lanterns (food as symbolic or food for decoration and celebration). This cultural reading of pumpkin is consistent with Mudry's (2011) argument that "eating, tastes, and pleasure derived from food are largely cultural, experiential, and geographical" (p. 248). In addition to nourishing themselves, people also use food for a wide variety of sociocultural purposes such as creating social relationships with others (e.g., bonding), demonstrating social status, establishing group membership, and constructing national identities (Gerhard et al., 2013; Peckham, 1998). Not attending to these sociocultural facets of food and eating would be neglecting important aspects people's "food worlds" (Koustrup, Wittrup, Terkildsen & Nielsen, 2012). Cultural symbolism is as important as nutritional nourishment when it comes to understanding, reshaping, and improving people's complex relationships with food.

The above finding is also consistent with anthropological research showing that food constitutes an important "cultural text" – one's cultural values can be semiotically read from the food one chooses (not) to eat as well as how one eats (Mintz & Dubois, 2002). Further, food cultures are characterized by *edible ideologies* (Lebesco & Naccarato, 2008), that is, dominant attitudes, expectations, and assumptions about food and eating that often serve the interests of particular social groups. Food is a cultural signifier and eating is an act of signification whereby the eater can reproduce or transform a culture. From this perspective, it can be argued that Megan's cultural appraisal of pumpkin served to reproduce dominant cultural ideologies of seasonal consumerism of pumpkin as a highly profitable capitalist commodity during Halloween and fall harvest as well as a mythological symbol of American rurality. While farming practices received a considerable amount of attention from Megan and her students, culinary use of pumpkin (as an ingredient for cooking) was merely mentioned. Recognizing when pumpkins in

a patch were ripe and ready to be picked (like a farmer or gardener) took precedence over the actual making and eating of pumpkin pies.

Conclusion

Our findings underscore the many pedagogical benefits and potential challenges of engaging students in talk about food in the science classroom. The ubiquitous presence of food in human life can serve as an important source of student interest and engagement as a personally relevant topic to which they can easily relate. As Mintz and Du Bois (2002) so eloquently point out, "next to breathing, eating is perhaps the most essential of all human activities, and one with which much of social life is entwined" (p. 102). As such, classroom discussion about food provides elementary teachers with a unique opportunity to engage children in science and to promote learning of very important concepts such as health and nutrition. While judgment and appreciation are perhaps inevitable characteristics of a teacher's appraisal system, it is critical that teachers consider the messages implied by their discourse (e.g., word choices and tone) to ensure respect of all students with regard to their epistemologies of food. As our discourse analysis revealed, underlying such food interactions are multiple layers of affective, cultural, and nutritional meanings that can disempower students and unintentionally reinforce problematic cultural ideologies. These varied evaluative meanings and potential complications need to be carefully taken into account by elementary teachers in order to effectively promote student health and empowerment through science rather than judgment about food epistemologies.

Lastly, it should be pointed out that this study is not without limitations. One important shortcoming was that our data collection was limited to a single read-aloud session facilitated by only three elementary teachers in their own classrooms. As such, our findings are not generalizable beyond the classrooms examined. The extent to which similar food-related practices and meaning-making process occur in different classrooms remains to be determined. Another important limitation is the unavailability of data on the students' perspectives (e.g., interviews, student artifacts, etc.). These additional data would have allowed for a higher degree of analytical triangulation and shed some light on the impact of particular practices on students. Nonetheless, we are confident that the analytical measures taken ensured that the reported findings are within acceptable levels of validity and trustworthiness.

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Appendix

Transcription Conventions

The following notation is adopted in all transcripts excerpts included in the present manuscript:

?	indicates rising intonations
.	indicates falling intonations
CAPS	indicates reading text aloud
[ ]	indicates observer comments
<u>underlining</u>	indicates key features of the provided excerpts.