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# Shaping Health Perceptions: Communicating Effectively about Chemicals in Food

## ABSTRACT

Risk, by its nature, is based in uncertainty. In many instances, risk is subjectively constructed, resulting in many interpretations of hazards and uncertainty about the impact of risk. As the United States' food systems grow more complex, the diversity of risks surrounding food also increases. Public understanding of risks as well as benefits associated with food production and chemicals is an area in which efforts to reach a mutually acceptable consensus have been largely unsuccessful. This study constitutes an initial step in bridging the communication divide between scientists and consumers by establishing a baseline of understanding of how consumers view the potential risk of chemicals in the food supply.

Study results indentify both constraints and opportunities in the future development of educational materials explaining the role of chemicals in foods. Two phases of data collection, consisting of eight small focus groups of mothers in four cities and an electronic survey delivered to 1,000 mothers across the U.S., provide insight into health perceptions of food, decision-making, and understanding of chemicals in food. Finally, recommendations highlight communication challenges surrounding these risks and offer further insight on improving the effectiveness and accuracy of consumer health communication about chemicals in food.

## INTRODUCTION

Risk, by its nature, is based in uncertainty. Thus, discussion of the potential consequences associated with one's actions always has as its "central variable" the idea of uncertainty *(10)*. Slovic *(14)* goes so far as to conceptualize discussion of risk at a community or national level as "a game in which rules must be socially negotiated within the context of a specific problem." The National Research Council has long argued that this discussion can and should function as a "democratic dialogue" in which "multiple messages" from all stakeholders are considered *(9)*. Ideally, such a dialogue would enable all parties to reach a mutually beneficial agreement about what constitutes an acceptable level of risk. However, reaching such a consensus is often problematic.

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Public understanding of risks and benefits of chemicals in food production is one area in which efforts to reach consensus have been largely unsuccessful. Broadly speaking, consumers can think of "chemicals" in food as any ingredient added to foods. For some individuals, the phrase "chemicals in food" has a negative connotation. Yet scientists note that food itself consists of chemicals. Slovic *(14)* explains that tension surrounding the idea of chemicals in food is based, in part, on stigma. He notes that any discussion of risk related to chemical toxicity is particularly challenging, because chemicals have been "stigmatized by being perceived as entailing unnaturally great risks." The stigma associated with chemicals creates a risk perception chasm between consumers' perceptions and scientific evidence *(14)*.

Health literacy, is defined as "a person's ability to understand and act on health information" *(15)*, is an important component of a person's perceptions of chemicals in food. Low health literacy, which characterizes nearly half of all adults in the United States, correlates with decreased compliance with treatment regimens and increased mortality *(5)*. Similar findings are seen globally. Unfortunately, a growing body of evidence demonstrates that, compared with individuals processing adequate health literacy, those with inadequate health literacy are more likely to exhibit impaired decision making *(2)*. This also suggests that those individuals with low health literacy are more susceptible to, and less critical of, misleading and unbalanced news, advertisements, and social media items that make unsubstantiated claims regarding risks to health.

As mentioned previously, potential health risks associated with chemicals in food is a topic of great interest to the general public. As previous surveys demonstrate, chemicals in food are an important food safety issue (35%), second only to foodborne illness caused by bacteria (48%) *(1)*. For many consumers, the lack of understanding of basic concepts of science and toxicology may easily lead to the false perception that any type of chemical exposure presents a significant risk to their personal health *(13)*. This tendency toward misconstruing evidence on highly emotional issues has the potential to impede risk communication dialogue with a large segment of the population *(13)*. Ideally, consumers in a risk communication dialogue are given meaningful access to technical and scientific evidence. Meaningful access occurs when two criteria are met. First, consumers are able to interact with key decision-makers to acquire the information necessary to make an educated decision about a risk. Second, the technical or scientific information that is developed to respond to consumers' questions must be conveyed in a form that they can readily understand *(12)*.

Given health literacy constraints in the general population, practitioners in health, nutrition, and food science should strive to improve the health literacy of consumers, particularly regarding food safety and nutrition. Consistent with Slovic's *(13)* vision for a successful risk communication dialogue, the International Food Information Council (IFIC) Foundation helps bring stakeholders together to discuss the latest scientific developments and research on consumer attitudes. This study describes a strategy to bring parties together to enhance mutual understanding and respect. The results provide a means to understand constraints and create opportunities for future development of educational materials that explain the role of chemicals in the food supply.

**Preliminary research and rationale**

Recognizing the critical need to identify current science and health communication chasms, IFIC organized an expert roundtable on food and chemical risk communication in April 2011. These experts included representatives from academia, government agencies, and consumer/policy institutes, representing technical and scientific (environmental toxicology, food science, public health) and behavioral science disciplines. In this forum, we encouraged participants to offer their perspectives on risk communication related to chemical contaminants associated with food. Participants, on the basis of a 2010 IFIC Foundation Food and Health Survey, noted that, Americans are becoming increasingly interested in learning more about the potential risks of chemicals in food *(7)*. The 2010 survey found that respondents believe that illness from bacteria (foodborne illness) remains the most significant food health risk. Although 84% of respondents indicated they had questions about chemicals in their food, they acknowledged that they do not take actions in response to this concern *(6)*. One possible interpretation of this finding is that people may choose not to modify their behavior because their level of concern is low.

Results of IFIC Foundation's past surveys suggest that although consumers are questioning food safety more frequently, especially with regard to potential chemical risks; they are still reticent to take action. Survey respondents appear to lack an understanding that nutrients such as sugars, fats, proteins, etc., are chemicals. Consumer "chemophobia" is central to the problem of communicating about the risk associated with food chemicals. The members of the expert roundtable suggested that consumers should be informed about why certain chemicals are added to food and at what levels chemical contaminants could potentially cause adverse health effects *(7)*. Roundtable experts suggested that consumers should learn to ask, "Is this chemical supposed to be in food or not, and what is it doing there?" *(7)*. To understand comprehensively how laypersons understand these issues, it is necessary to recognize what the word "chemical" means to the general public. Risk perceptions, particularly about food, can be difficult to appreciate without formal probing. Food is

"cultural, emotional, symbolic, or even religious" because it is incorporated into the being of an individual *(7)*. For these reasons, even if chemicals can preserve the quality, safety, or freshness of food, they may be viewed negatively by consumers, many of whom perceive them to be unnecessary.

Based on these observations, this initial roundtable with subject matter experts generated several conclusions, including the following: (a) consumers are not irrational, but rather respond to chemical risks based on their level of knowledge, attitudes, and beliefs; (b) new communication objectives should be developed to match the level of consumer understanding; and (c) misinformation on the Internet should be monitored and mitigated to avoid propagation *(7)*.

To accomplish these goals, IFIC initiated a two-phase research strategy. In phase one, qualitative focus groups were developed to foster broader participant understanding of chemical perceptions of risks and benefits associated with food production and food safety. In phase two, descriptive and generalizable data were collected to gather a representative understanding of chemical perceptions. Next, IFIC generated more comprehensive, current, user-friendly, and accurate risk and benefit messages designed to assist consumers with making decisions about food purchases and consumption.

## MATERIALS AND METHODS

This study employed a two-pronged approach to data collection. Phase one of the study used small group discussions (focus groups) to generate basic knowledge of how participants perceive food, food risks, and eventually chemicals. We used this background information on consumer perspective to guide phase two, in which we used a quantitative online survey to assess perceptions about specific chemicals in food.

### Phase one: Focus groups

To gauge existing consumer sentiment, in phase one we encouraged participants to speak openly about food, and more generally about how they understand food safety. Using a discussion guide, focus groups aimed to identify issues most salient to mothers. Mothers aged 18–54 were selected because of their influence in the food decision-making process and the high likelihood that they are responsible for the health and well being of their children. In September 2011, IFIC convened eight small focus groups (n = 4 participants per group) in four U.S. cities (two focus groups per city; n = 32 total): Chicago, IL (C. Focus Group); Baltimore, MD (Ba. Focus Group); Birmingham, AL (Bi. Focus Group); and San Diego, CA (S. Focus Group). These cities represent four diverse U.S. geographic regions: central, east coast, southeast, and west coast, respectively. One focus group in each city recruited mothers who harbored "middle-of-the-road" health values (low-to-moderate health literacy) and the other groups in each city consisted of "high health value" (proficient health literacy) mothers.

High health value participants possess characteristics that make them more aware of health issues than average or "middle-of-the road" mothers. Mothers with self-described higher "health values" tended to express increased awareness of chronic, or long-term, illness. Participants' occupations often predicted high-to-moderate levels of literacy. For example, participants who worked in a health field (e.g., nursing) were likely to fall within the high health value group. However, those with the greatest health awareness were not always those associated with higher education or professional experience. For example, focus group participants were asked (as were survey respondents in the later stage of this study), "Do you or a family member in your household who lives with you have any of the following: high blood pressure, high cholesterol, asthma or other respiratory disease, food allergy, ADHD/ADD, diabetes, lactose intolerance, heart disease, immunodeficiency disease, cancer, celiac disease, Crohn's disease, any other condition that requires restricted diets, [or] none of the above." Typically, if participants informally identified themselves as caretakers, they tended to have higher health literacy.

The moderator used a five-page, semi-structured discussion guide to collect participant data. All focus groups used the same discussion guide. The guide's four macro-structure sections consisted of an introduction, food purchasing habits and feelings, positive aspects regarding food, and negative aspects regarding food. The guide was also used to facilitate discussion about chemicals and additives, including both positive and negative aspects of chemicals. The focus group discussions were video recorded. Transcripts were generated and coded for themes, topic frequency, and negative and positive associations to food. Major themes and discussions from the qualitative data were subsequently used to generate the survey employed in phase two.

### Phase two: Survey

Phase two, which began in January 2012, used a questionnaire that consisted of multiple choice and open-ended questions. Instructions were included with the questions. The questionnaire was designed to assess consumer sentiment in six areas: (a) consumer perceptions of "chemicals in food" and influence of these on purchasing behavior; (b) motivating elements for specific attitudes about chemicals in food; (c) health questions related to chemical exposure; (d) communication strategies that may reduce concerns for specific chemicals; (e) significant factors that affect the decision-making process about food, and (f) the development and testing of messages about chemicals in food. Prior to full data collection, a small pilot

test was employed with respondents (n = 100). The pilot consisted of respondents from Artemis Strategy Group of Michigan, a communications strategy research firm specializing in motivation research.

Pilot respondents were selected from a national database based on qualifying questions. Survey respondents included mothers with at least one child aged 17 or younger and living at home. Other key screening factors included the requirement that respondents be the primary grocery shopper for the family and not be employed by a sensitive industry (defined as a grocery store, advertising company, or food-oriented government agency). The results suggested that survey instruments measured constructs effectively and that users correctly understood survey questions. We did not modify the questionnaire following the pilot test.

After the pilot test, an electronic questionnaire was administered to 1,000 mothers from a list of individuals provided by Artemis. The final survey used the same screening factors as the pilot study. Of those who received the final survey, 84% successfully completed their questionnaire. On average, respondents required 16 minutes to complete the questionnaire.

Respondents received one of two versions of the final questionnaire. Version A contained questions specifically about acrylamide (n = 500), and version B contained questions about Bisphenol A (BPA) (n = 500). Acrylamide is a naturally occurring compound that forms in certain foods that are baked, fried, or toasted. Studies indicate that at extremely high doses, such as those in some industrial or manufacturing settings, acrylamide is carcinogenic. However, only traces of naturally-occurring acrylamide have been detected in a broad range of foods such as cookies, crackers, and baked and fried foods *(3)*. BPA is a compound used in some plastics (e.g., incorporated into baby bottles and reusable cups, and into the lining of metal-coated food and beverage containers to ensure safety and packaging integrity.) Over time, the plastic may deteriorate and potentially expose consumers to trace levels of BPA; in cans, small amounts may migrate into food. Results from recent studies support FDA's assessment *(4)* that the use of BPA in food packaging and containers is safe. BPA was selected for inclusion in this study because it is a man-made, well-known packaging compound that is likely familiar to consumers. In contrast, acrylamide is a less well-known, naturally occurring chemical.

As already mentioned, of the total sample of 1,000 respondents, 500 were assigned to complete a questionnaire for acrylamide and 500 for BPA. Each respondent was given a published news article on one of these two chemicals to read that discussed its potential negative health consequences. After reading the article, respondents viewed only one of two possible responses to the chemical issue. Randomly assigned respondents viewed either a question and answer (Q & A) response to the chemical news story or a new narrative (experimental) response that incorporated insights gleaned from focus groups. Unlike a familiar or expected Q & A presentation, the experimental response presented health information in a casual, story-oriented format. These responses allow for comparison of both respondent reactions to acrylamide and BPA, in addition to accounting for differences in response format (i.e., the Q & A vs. the experimental response).

The articles used in phase two (the message-testing portion of the survey) were selected by IFIC. The experimental response was crafted using information gathered from phase one (the qualitative portion of the study). The Q & A format was selected as a conventional and expected format for delivering health information. Words and phrases that elicited positive perceptions and increased confidence in respondents were integrated into the styles of both response documents to gain more feedback from consumers on positive and negative concepts, phrases, and specific word choices.

## RESULTS

### Phase one of focus groups: Attitudes toward food

Results from phase one confirmed that attitudes toward chemicals are strongly negative among those who care about chemicals, especially mothers who are very sensitive to the issue. These mothers are young *(18–34)*, have an above-average higher household income, are knowledgeable about food topics, and are engaged with most aspects of food, including shopping. They are also more likely to use social media as a source of information. These findings were further validated in phase two. The distrust of chemicals appears to stem from uncertainty concerning the potential consequences of exposure to chemicals from diet, or from a lack of understanding about chemicals in general. However, it is also important to note that chemicals are not identified as one of the most prominent health issues that mothers associate with their food. Furthermore, focus group results reveal that mothers take very few actions with regard to specific chemicals in response to food safety concerns.

### Phase one of focus groups: Low-to-moderate health literacy mothers

Of the 32 total participants, 15 mothers had low-to-moderate health literacy. Overwhelmingly, in response to the moderator's prompts asking about positive characteristics of food, mothers responded that perceiving a food as natural or pure was very important to them. The term "natural" was woven through all eight focus groups. In total, participants used the term "natural" 94 times. In addition, participants also frequently used the term "organic," which was used a total of 26 times as representing a positive food association.

Participants readily shared what "natural" means to them. A Birmingham mother described the trait as being related to an "historical romance," that makes her think "about a time… people grew most of their food." Other attributes, like "quality," were also connected to purity or naturalness. A Chicago participant described quality food as being desirable, yet she linked quality to "organic" and natural foods with "not a lot of preservatives." Product selection is also related to natural and pure foods, as mothers described fruits and vegetables as highly desirable items to buy because they are unaltered and natural (S. Focus Group). These fresh and natural foods are perceived to yield the most beneficial end results (health, more energy, happiness), which is what encourages participants to purchase them (Ba. Focus Group). These themes resonated with mothers in all focus groups.

Participants equate "positive" characteristics of food with familiarity. This certainty is provided by their experiences (foods with which they grew up), their knowledge about the food (no words on the packaging that are confusing or intimidating), and their confidence that the food will produce health benefits (fruits and vegetables are linked to healthful outcomes). In addition, participants discussed barriers that impede information seeking. When time and budgetary constraints are considered in the decision-making process, mothers say that little time and effort is spent investigating new foods, especially those that contain artificial ingredients or additives. A participant shared that she "always [has] a million things to do," and additionally, she doesn't "like grocery shopping" (Ba. Focus Group). These factors contribute to her relying on familiar foods, rather than considering new food options that might require additional time, energy, and thought (which many participants would prefer to spend elsewhere).

Negativity and rejection of foods stemmed from perceptions of artificiality. All focus groups articulated clearly their belief that artificial or man-made additions to products yield negative outcomes. For example, a Baltimore participant noted that she avoided sugar, artificial sweeteners, and anything processed. When asked why, the participant responded she did so because it is "not natural. They don't grow around us" and "our bodies aren't made to process them because they're not made from food." A San Diego participant also expressed confusion about products that contain "a plethora of like 30 or 40 things" when they are "all chemicals." Further, this mother stated that these products contain "names of some things [she] can't even pronounce. Like, why is this in here?" While participants linked pure foods to positive health outcomes, they also linked foods with added ingredients to negative health outcomes. Among the outcomes of consuming man-made products, participants mentioned cancer, high blood pressure, heart disease, addiction, early onset of puberty, and obesity.

Added chemicals were worrisome to participants. One mother noted, "a lot of it is the unknown, you are putting this chemical in your body and you do not know what is happening, it could affect you tomorrow, five years from now or fifty years from now, you just do not know and that is a problem" (Bi. Focus Group). Participants were unsure of the functionality of certain food ingredients. This uncertainty left some mothers feeling "terrible" because they are not assured that the products they have selected to feed themselves and their families are safe (Bi. Focus Group). Even when no threat was identified, discussion uncovered instances in which mothers simply worried if they were not serving natural products to their families (example: feeding infants formula instead of breast milk) (C. Focus Group).

**Phase one of focus groups: Moderate-to-high health value mothers**

Four mothers in each of the four geographic areas (n = 16 total) were moderate-to-high health value mothers. These mothers, identified as being more cognizant of health issues, are similar to "middle-of-the-road mothers" in that the idea of natural or pure foods is important to them. However, these participants articulated this concept with more precise language. For example, instead of defining "natural" with experiences or memories of their childhood, high health value mothers' explanations were more likely to be tangible and diverse. When asked what she looks for in food, a participant in Birmingham responded that she wants foods that are both fresh and natural. Explaining further, she articulated that this means avoiding "sugars, high fat content, trans-fat" (linked to high cholesterol, high blood pressure, heart disease), artificial flavors (like "Kool-Ade") and "sodium, cholesterol, MSG, limit red meat." In Baltimore, participants listed antioxidants, fiber, low sugar, calcium, low-calorie, fat-free or low fat, organic, and natural as being positive characteristics of food. However, organic and natural were also discussed as "a marketing thing" that did not necessarily hold meaning in and of itself (Ba. Focus Group). In total, high health value mothers mentioned "natural" 51 times, only slightly over half as often as our lower-to-moderate health value participants.

High health value participants recognized the physiological benefits of eating healthful foods in moderation. A San Diego participant discussed food qualities important to her, explaining that "foods that are high in nutrition will help [her family] live longer, provide long-lasting energy" and contribute to "a constant burning metabolism." Mothers also listed seeking out foods that specifically alleviate certain conditions. A Chicago participant noted that she proactively searches for and buys low-sugar foods to diminish her family's odds of developing diabetes. Other mothers expressed beliefs abut the detrimental side effects of eating poorly, stating that outcomes of poor diet include diabetes,

weight gain, high blood pressure, high cholesterol, sluggishness, and negative emotional states. Participants did refer to some personal experiences that guided their decision making (one participant shared that she had been obese, but has since lowered and maintained her weight.) However, their stories involved their own families, as opposed to stories from media or friends.

Participants in the moderate-to-high health value focus groups more readily recognized that foods with some chemicals could provide benefits, such as longer shelf life, added vitamins, increased nutritional value, improved taste, decreased cost, aesthetics, decreased risk of "spoilage," and more pleasant aroma (All Focus Groups). The high health value mothers from all focus groups acknowledged that man-made additives are not all inherently detrimental, and conversely could offer important health benefits.

Negative associations of chemicals or additives included increased difficulty with digestion, unknown long-term effects (particularly related to cancer), and diminished overall health. Similar to our middle-of-the-road participants, high health value mothers related that one aspect of most concern of added substances was "the unknown long-term effects of health problems" (S. Focus Group). The perception of "long-term illness" was also discussed in relation to chemicals and food additives. While health-savvy mothers may be confident in their ability to select foods that will nourish and maintain their own and their families' health in the short term, identifying foods that will positively impact future health seemed to be more difficult.

Participants generally recognized that they should eat healthfully to avoid negative health outcomes. However, specific foods, additives, and chemicals do not appear to be foremost on their mind. Mothers discussed these issues in generalities–and almost never mentioned specific instances of food groups completely avoided or substances they rigidly excluded from their diets. Perhaps more perplexing is the frequency of responses that indicate that little information is available to aid mothers in their decision-making process. Therefore, the absence of certainty regarding chemical safety may contribute to problems related to purchasing decisions.

**Phase two: Survey**

Focus group results from phase one suggest that participants are aware of perceived risks but less aware of the benefits of food additives. Using content generated from focus groups, phase two explored the idea of uncertainty with a larger and more diverse sample. Respondents (n = 1,000) were mainly Caucasian (81%) and married (69%). Other ethnicities represented included African American (10%), Hispanic (6%), and Asian or Pacific Islander (4%); 2% of mothers selected "other" for their ethnic background. Education and income varied considerably. Most mothers had "some college or associate's degree" (44%) or a bachelor's degree (25%). Thirty percent of the sample had a total household income (in 2011) of $35,000, 20% fell between $35,000 and $50,000, and 22% ranged from $50,000 to $75,000.

**Phase two: Chemical perceptions**

Respondents overwhelmingly perceived products with chemical components negatively. Two-thirds of respondents said that chemicals have a strong impact on their food purchases. One-third stated that packaging (which mentions or excludes information about chemicals) has a strong impact on their decision to buy a product. Mirroring the observations from the focus groups, survey respondents expressed a significant degree of chemophobia, although this risk competed with other food purchasing factors (e.g., cost, convenience, other health concerns, such as allergens).

**Phase two: Motivating elements for specific attitudes**

Consumers shared that they have powerful intentions to buy, cook, and serve healthful food for their families. However, this priority often conflicts with the convenience, cost, and access to foods that contain added substances. Mothers say that their greatest health concerns are food safety involving microbes (such as *E. coli, Salmonella,* or *Listeria* outbreaks) and food that might contain ingredients that could evoke allergic reactions in family members. When asked what actions respondents would take regarding food safety, they listed personal relevance to issues. For example, 60% of respondents would alter food choices based on allergen labeling, compared with 35% percent who would stop purchasing foods with BPA and 24% percent who would stop purchasing foods with acrylamide.

**Phase two: Health and chemicals**

Survey results show two-thirds of households (63%) have a family member impacted by at least one health issue. One-quarter mention high blood pressure and/or high cholesterol as a family health condition. Nearly one in five (17%) acknowledge that a family member lives with a food allergy. Seventy-one percent of mothers state that these factors have a very strong impact on their food and beverage selections. However, of the respondents indicating health factors as a strong impact on food choice, only 7% list food additives as being a concern, and a mere 6% list chemicals specifically. Consequently, placed in context with other health concerns, chemicals are generally perceived as less important than food safety issues involving microbial risks. In fact, 12% of mothers listed chemicals as being an issue while 51% chose microbial food safety as important. Twenty-three percent mentioned ingredients as important and 15% listed agricultural or production issues.

When prompted by the survey to think about chemicals, two-thirds of the respondents said they are influenced

by the mere presence of chemicals in food and beverages when shopping (n = 637). Sixty-four percent indicated that chemicals in foods/beverages have a strong/very strong influence on their grocery purchases. In addition, 71% state that the effects on personal health of foods/beverages have a strong/very strong influence on grocery store purchases. However, when purchasing foods and beverages, chemicals and personal health are both overshadowed by product taste (92%), value (85%), and freshness (88%). Half of the respondents (49%) disclosed that they are heavily influenced by the presence of preservatives in food and beverages. However, only 13% look for information on the label of dyes or food coloring, 7% look for MSG, preservatives, or sugar, and 8% try to determine whether a product is generally harmful or unhealthful (typically determined by individual perceptions about the product). Approximately 75% of respondents say they have changed their purchase behavior (in that they have reduced or stopped purchasing products.) Reasons for this behavior change included concerns about allergens, genetically engineered foods, heavy metals, hormones, or BPA. This sample of respondents represents those who say they are strongly (n = 54) or very strongly (n = 342) influenced by the presence of chemicals as determined by the survey questions. Of the 342 strongly influenced respondents, 96% stopped or reduced purchasing products because of the amount of fat (including *trans* fat), sugar, or sodium in some foods. These data suggest that up to one-third of our respondents are equally influenced by the amount of fat (including *trans* fat), sugar, or sodium in some foods as they are by genetically engineered foods, heavy metals in food, hormones in meat, and the possible presence of BPA.

**Phase two: Strategies to improve consumer education and awareness**

Consumers provided feedback on an existing IFIC Foundation Q&A fact sheet or an article written in response to a one-sided and scientifically unbalanced publication about one of two chemicals. One chemical was moderately well known (BPA; 50% of respondents acknowledge familiarity) and the other was less well known (acrylamide; 26% of respondents acknowledge familiarity). This distinction is important, because the BPA article seems to reinforce what respondents have already heard about the chemical, whereas the acrylamide article introduced a potentially new threat to a majority of the respondents. Both articles (about BPA and acrylamide) prompted 10% of consumers to state they would immediately discontinue use of food or food products with these substances. Ultimately, the Q & A fact sheet alleviated concern more than the article did for BPA. The Q & A fact sheet also generated understanding better than

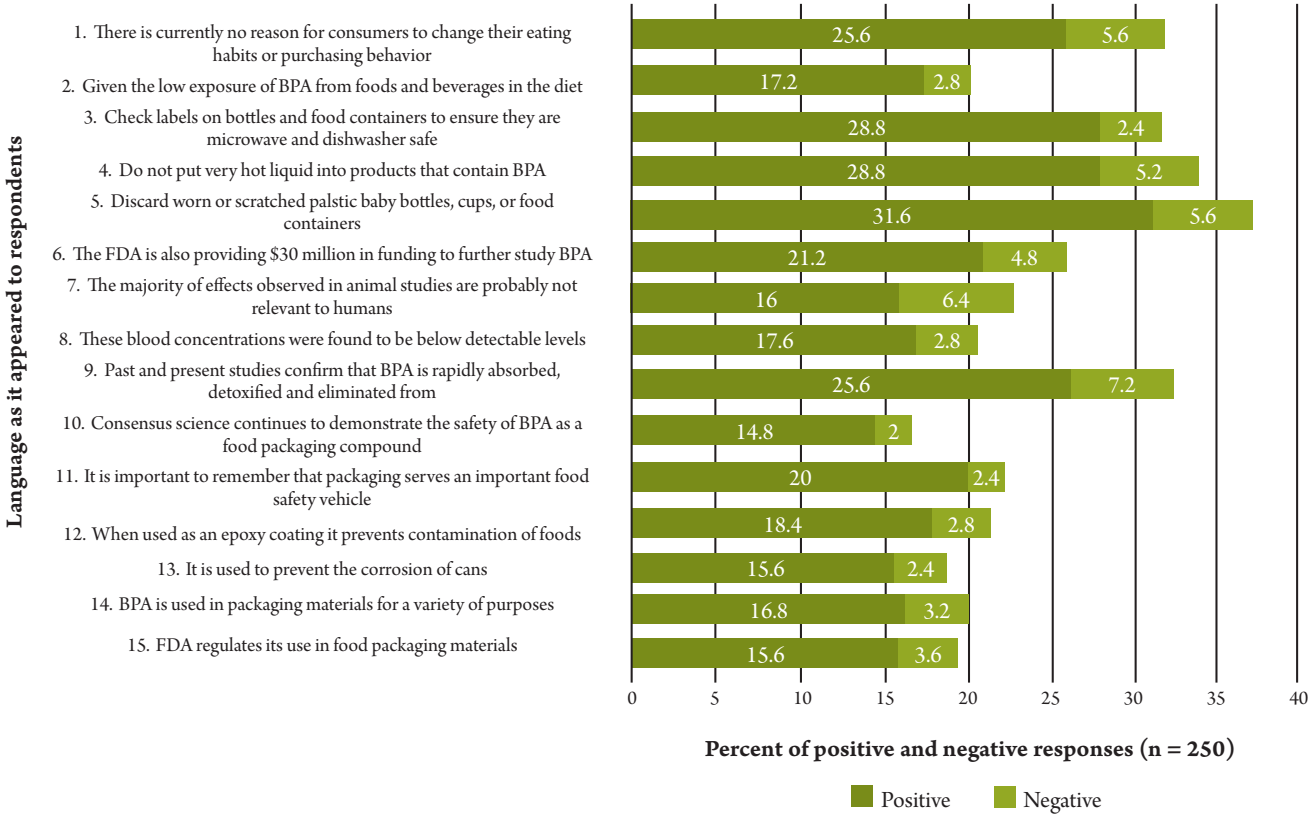


*Figure 1. Positive and negative statements when reading the BPA Q&A article*

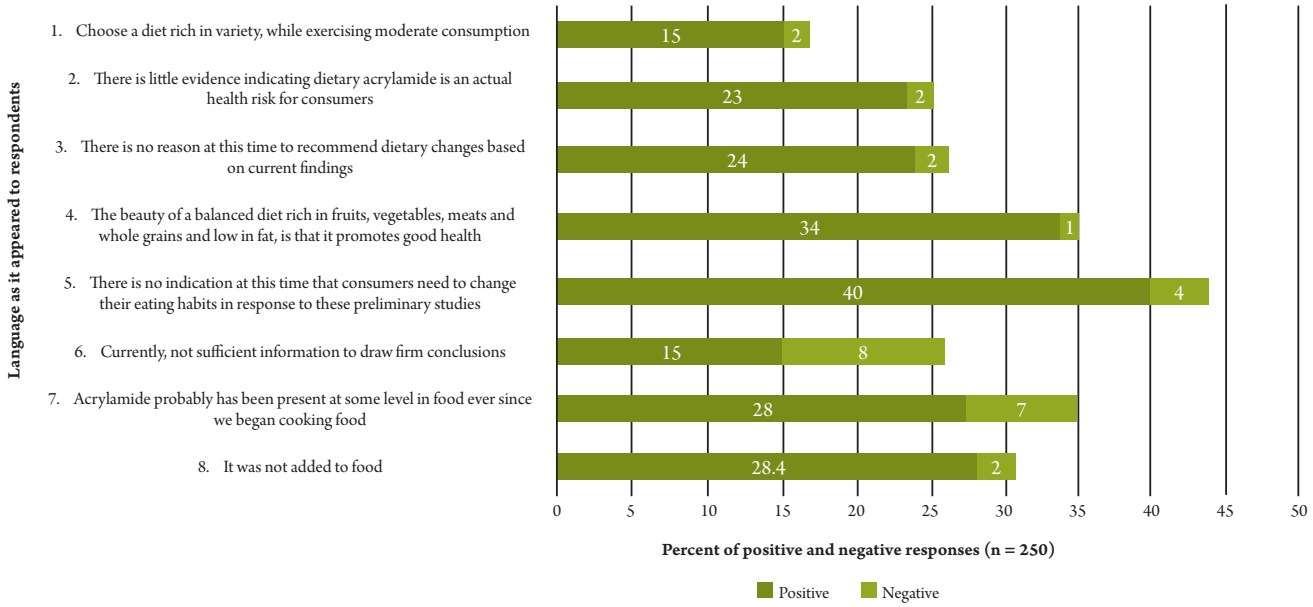


*Figure 2. Positive and negative statements when reading the acrylamide Q & A article*

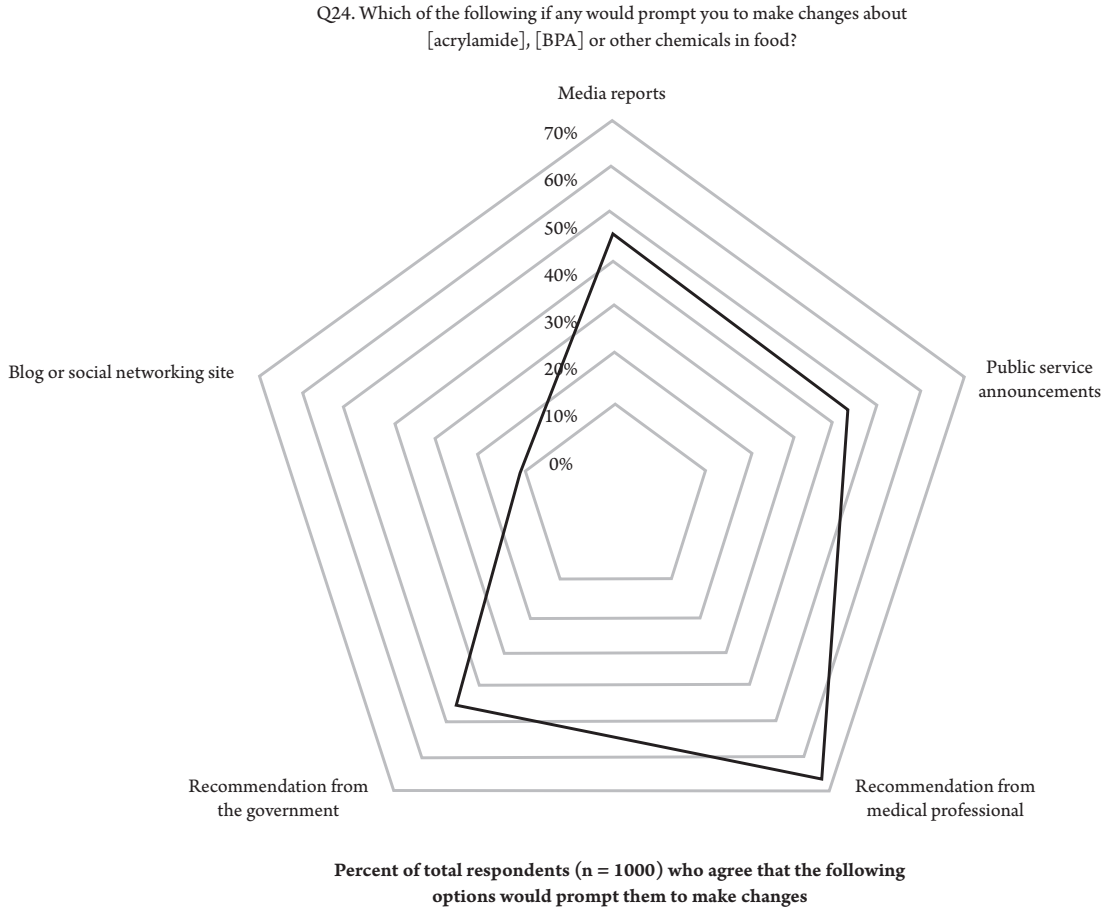


*Figure 3. Respondent answers to communication interventions about chemicals*

the article did for acrylamide, as 80% of respondents found it understandable and 72% labeled the writing as convincing.

Respondents were asked to identify portions of the experimental article they favored and to simultaneously record information and wording they did not understand or like. Respondents rejected statements that failed to offer certainty. Respondents also frequently rejected sentences that contained heavily scientific information or technical jargon such as "probable human carcinogen," "known toxicity," and "epoxy resins." Finally, respondents preferred that material about potential chemical risk be grounded outside a discussion of technical risk alone. Rather, they preferred the chemical be placed in a context that is understandable and that clearly illustrates a particular level of human risk or harm to them, and that is connected to the well being of their family or themselves.

Respondents' remarks also demonstrate a desire for fact-based evidence from credible sources that are perceived positively (such as the FDA and other government agencies). Furthermore, words that are familiar and simple to understand were appreciated. Written descriptions of actions occurring in response to potential chemical exposures and hazards (research and ongoing monitoring) were selected as desirable. Finally, instructive and prescriptive information to guide individual decision making comprises the final component of desirable food safety messaging. See *Fig. 1* for specific positive and negative associations for Q & A articles.

**Phase two: Decision influencers**

Respondents listed numerous factors that influence their food-purchasing decisions, the most important of which were taste, freshness, cost, and trust in branded products *(Table 1)*. Respondents note that they are influenced most by credible experts, including medical professionals and government agencies *(Fig. 3)*. Notable television and media personalities were viewed as influential, both negatively and positively. This finding also corresponds with preference for precise, fact-based language as opposed to ambiguous statements. Interestingly, consumers also disclosed that they occasionally use marketing cues to make decisions about products that contain chemicals. Products that claim to be "free" of chemicals (e.g., "no nitrates") on the label are favored over products that list no such claim. While mothers may not understand what the chemicals are, food labeling is ultimately used as a warning map for issues about which they should be aware in making their purchasing decisions.

**Phase two: Message preferences**

Consumers prefer effective messages that use short explanations, are intuitively understood, and contain declarative language about risk, with credible content. Mothers tell us that statements like "discard worn or scratched" and definitive statements like "there is currently no reason" or "past and present studies confirm" are most helpful. Respondents want to know more about the food they eat and serve to their families. However, they need information that is understandable, clear, and concise. Respondents identified content, topics, and words they liked and disliked when reading the responses to the chemical news articles. Specific phrases in the Q & A fact sheets for BPA and acrylamide are depicted, along with respondent preferences, in *Figures 1 and 2*.

## DISCUSSION

Findings in phase one of the project imply that those who have lower health literacy are generally more fearful of chemicals in the food supply than are those with higher health literacy. The lower literacy group described a general distrust of chemicals regardless of whether they were used intentionally for flavoring or preservation, or had made their way into the food supply unintentionally. Conversely, those with higher health literacy appeared to be able to appreciate both the benefits and potential risks of chemicals in food. The term "natural" was consistently identified as a safe alternative to chemicals in the lower literacy group, although the participants were not able to provide a consistent definition of the term. In fact, the term was used in the lower literacy group to describe foods participants ate as children, in addition to categories of food (e.g., organic products). The higher literacy group was more discriminating in its use of the term "natural" and was more likely to use specific terms to relay their feelings and opinions toward food (e.g., they also listed antioxidants, fiber, low sugar, calcium, low-calorie, fat-free or low fat, and organic as being positive characteristics of food).

Higher health literacy participants discussed topics that were largely absent from the discussions of the lower literacy group. For example, the higher literacy group was concerned about selecting foods based on nutrition, weight control, sugar content, and sodium, factors that they themselves perceived as possibly contributing to a number of long-term health hazards. The link between these dimensions of the food supply and disease management or prevention appeared considerably less often in the lower literacy group. Therefore, the preoccupation with chemicals in the food supply shown by the lower literacy group may actually distract such individuals from making choices that could address immediate concerns related to blood sugar, weight gain, and blood pressure.

Those with lower literacy levels expressed a broad array of misconceptions regarding chemical content without a full appreciation of how food choices affect immediate health threats such as obesity, diabetes, and high blood pressure. As a result, the long-term fear of the potential for adverse health effects of chemical ingredients can and should be balanced with a realistic understanding of how poor nutrition can have more immediate and scientifically verifiable health consequences.

**TABLE 1. Decision factors for purchasing food and beverages**

| Q7. If and how much do each of the following impact your purchases when you select foods and beverages at the grocery store? | Strong/Very Strong Impact on Purchase |
|---|---|
| 1. Taste | 91.6% |
| 2. How fresh it is | 88.2% |
| 3. Is it a good value for the money | 84.9% |
| 4. Brand I trust | 75% |
| 5. Nutritional value | 74.4% |
| 6. What effects it could have on my health | 70.8% |
| **7. Are there chemicals in it** | **63.7%** |
| 8. How convenient it is: time saving/easy to prepare | 55.6% |
| 9. Where it originated - local, U.S., or country of origin (imported) | 52.9% |
| 10. Are there additives in it | 51% |
| 11. Are there preservatives in it | 49.4% |
| 12. How food is produced (conventional, organic, cage free, free range, etc.) | 48.6% |
| 13. What kind of packaging is it in | 33.6% |

Both groups share a general concern about the long-term impact of chemicals in food. The higher literacy group is better able to distinguish between the roles of chemicals in the food supply. Both the high and low literacy groups expressed some concern that, over a long period of time, some of the chemicals could contribute to health problems such as cancer. However, neither group provided a clear definition of what constitutes a "long period of time." Thus, there was no clear "threshold" described by the participants as to when a chemical that is intentionally added to food could be declared safe. By contrast, experienced toxicologists rarely think of chemical thresholds as relating to specific (or quantified) exposure duration. Typically, they think of thresholds in terms of concentrations, levels, or amounts of exposure to a chemical. This consumer gap in knowledge may be worth pursuing in future research to help frame the debate about chemical exposure via food.

The phase two results suggest that this fear of long-term consequences of consuming chemicals varies by context. As Slovic *(14)* predicted, respondents in phase two expressed general disdain for chemicals, saying that they have a strong impact on their choices of foods they purchase. Similarly, respondents stated that they prioritize their family's health when purchasing food. That said, issues such as cost, convenience, freshness, and taste frequently offset this concern about chemicals. Food allergens were the sole area where respondents said they are unwavering in their purchasing decisions; a majority of respondents are willing to change food choices based on concern that a member of the family has a food allergy, whereas slightly less than one-fourth of respondents would avoid a product reported to have traces of a potentially dangerous chemical. In general, respondents consistently expressed concern about chemicals in their foods, but this apprehension was fleeting if consumers felt they could purchase a better tasting, more convenient, or more affordable product.

The fact that respondents in this study prioritized quality and affordability of the product over their general anxiety about chemicals has notable communication consequences. For example, any consumer advocacy campaign warning consumers about the presence of a chemical in certain food products would benefit from considering the influence on the product's quality or cost. Even if consumers have an overestimated perception of the potential hazard of chemical(s) in a food product, other factors may sway them to continue purchasing and consuming it. Consider the current example of BPA in metal packaging (cans). While most of today's popular press and consumer advocacy groups promote a message of negativity, the canned food and beverage industry continues to promote the safety, quality, and efficacy of BPA, perhaps the most persuading factor for continued consumer tolerance is the fact that

there is no current replacement for BPA. Conversely, if unsubstantiated claims by consumer advocacy groups or health bloggers surface about an approved food additive, food industry organizations should encourage proactive public information on the safety assessment and benefits of the chemical. Based on tested information formats in our survey, results show that a Q & A-style fact sheet would be the best way to communicate this type of information to consumers.

The respondents' responses to specific messages (about BPA and acrylamide) analyzed in the study are somewhat troubling. Eighty percent of the respondents stated that they understood the content of the messages, yet respondents tended to reject messages that lacked certainty. Specifically, consumers seem to value declarative packaging messages (e.g., "no nitrates"), but are less influenced by messages suggesting possible long-term consequences. These observations further support the finding that although respondents are concerned about potential long-term consequences, they are not firmly committed to basing current decisions on that trepidation. Consumer confidence in the safety of the food supply and in the government's ability to protect the safety of food remains high, at 70% *(8)*. Nevertheless, over time, consumer confidence may decrease if consumer anxiety about chemicals in food increases without targeted, consistent, and proactive communication.

## CONCLUSIONS

From the perspective of health literacy, these findings suggest certain communication challenges, one of which is the low willingness of consumers to accept messages that express uncertainty. Another is the willingness of consumers to overlook risk based on other, more pressing contextual variables about the product. Many health educators aspire to reach the shared level of dialogue advocated by Palenchar, Heath, and Orberton *(11)*, and by Slovic *(13)*. To do so, they will need to account for the priority system consumers apply to their food purchasing habits. An increased recognition that consumers evaluate risk through different lenses will allow health educators to adjust current communication strategies to reflect how consumers evaluate risk. Successfully communicating risks will depend on the ability of organizations engaged in health communication to develop materials that meet the needs of the target audience. This strategy might entail providing more information on the benefits of certain chemicals, using persuasion to alter existing consumer priority systems, refuting misinformation, and conducting more work to understand the relationship of differences in race/ethnicity to risk perception.

The literature has demonstrated that meaning occurs when consumers share concerns with the scientific community and when information is accessible, available, and accurate. Unfortunately, chemical risks were not understood by participants in this study. The entire food information continuum (e.g., media, the food industry, and food producers, as well as individual competencies about food) leaves consumers to form their own perceptions about ingredients and health outcomes, which they must do without backgrounds in food science or health, based on often one-sided information available to them. Rather than passively relying on consumers to research product ingredients, the food industry may benefit from explaining the purpose and benefit of components added to their products. In addition, information on both detrimental and beneficial chemicals may ease consumer uncertainty and worry, which could improve decision making.

Initially, objectives for this project included the need to identify the key factors that influence those persons responsible for purchasing food for their families. The study has shown that the decision-making process is multifaceted and that it occasionally (though not always) takes added chemicals in food into account. Second, communication objectives for future work are identified in the survey. Results suggest that the Q & A format for imparting chemical information is preferable to a more conventional narrative. Additionally, this study tested keywords, phrases, and concepts that will be implemented and tested again in the future. Finally, an analysis of how the Internet influences food purchasing decisions needs to be conducted. Future steps may be to identify and evaluate prominent Internet sources used during information seeking. This knowledge could identify Internet opinion leaders and citation material. A better appreciation of the decision-making process used in making food choices for individuals and their families is important in helping the public make informed decisions. Reducing chasms between laypersons and the scientific community is the first step in minimizing unfounded and unnecessary gaps in risk perception.

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## REFERENCES


1. Cody, M. M., R. Gravani, M. Smith Edge, C. Dooher, and C. White. 2012. International Food Information Council Foundation food and health survey, 2006–2010, food safety: A Web-enabled survey. *Food Prot. Trends* 32:309–326. Available at: http://www.foodprotection.org/publications/food-protection-trends/article-archive/2012-06international-food-information-council-foundation-food-and-health-survey-2006-2010-food-safet/. Accessed 11 April 2014.
2. Drainoni, M., S. Rajabiun, M. Rumptz, S. L. Welles, M. Relf, C. Rebholz, and A. Frye. 2008. Health literacy of HIV-positive individuals enrolled in an outreach intervention: Results of a cross-site analysis. *J. Health Comm.* 13:287–302. doi: 10.1080/10810730801985442.
3. Food and Drug Administration (FDA). 2013a. Guidance for industry: Acrylamide in foods. Available at: http://www.fda.gov/downloads/Food/GuidanceRegulation/GuidanceDocuments RegulatoryInformation/ChemicalContaminantsMetalsNaturalToxinsPesticides/UCM374534.pdf. Accessed 29 December 2013.
4. Food and Drug Administration (FDA). 2013b. Bisphenol A (BPA): Use in food contact application. Available at: http://www.fda.gov/newsevents/publichealthfocus/ ucm064437.htm#current. Accessed 11 April 2014.
5. Guise, N. B., T. Y. Koonce, A. B. Storrow, S. V. Kusnoor, and F. Ye. 2012. Using health literacy and learning style preferences to optimize the delivery of health information. *J. Health Comm.* 17:122–140. doi: 10.1080/10810730.2012.712610.
6. International Food Information Council Foundation (IFICF). 2010. 2010 Food & health survey: Consumer attitudes toward food safety, nutrition & health. Available at: http://www.foodinsight.org/Resources/Detail.aspx?topic=2010_Food_Health_Survey_Consumer_Attitudes_Toward_Food_Safety_Nutrition_Health. Accessed 29 December 2013.
7. IFIC. 2012. Chemical risk expert roundtable proceedings. Washington, D.C.: N. Alexander.
8. IFIC. 2013. 2013 Food & health survey. Consumer attitudes toward food safety, nutrition & health. Available at: http://www.foodinsight.org/Content/3840/FINAL%20 2013%20 Food%20and%20Health%20 Exec%20Summary%206.5.13.pdf. Accessed 21 August 2014.
9. National Research Council 1989. Improving risk communication. Washington, D.C.: National Academy Press.
10. Palenchar, M. J., and R. L. Heath. 2002. Another part of the risk communication model: Analysis of communication processes and message content. *J. Public Relations Res.* 14(2):127–158. doi: 10.1207/S1532754X-JPRR1402_3.
11. Palenchar, M. J., R. L. Heath, and E. M. Orberton. 2005. Terrorism and industrial chemical production: A new era of risk communication. *Comm. Res. Reports.* 22(1):59–67. doi: 10.1080/0882409052000343525.
12. Sellnow, T. L., and D. D. Sellnow. 2010. The instructional dynamic of risk and crisis communication: Distinguishing instructional messages from dialogue. *The Review of Comm.* 10(2):111–125. doi: 10.1080/15358590903402200.
13. Slovic, P. 2000a. Informing and educating the public about risk. P. 182–198 *In* P. Slovic (ed.), The perception of risk. Taylor & Francis, London, UK.
14. Slovic, P. 2000b. Trust, emotion, sex, politics and science: Surveying the risk-assessment battlefield, p. 390–412. *In* P. Slovic (ed.), The perception of risk. Taylor & Francis, London, UK.
15. Wynia, M. K., and O. Y. Chandra. 2010. Health literacy and communication quality in health care organizations. *J. Health Comm.* 15:102–115. doi: 10.1080/10810730.2010.499981.