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Gene Cuisine or Frankenfood? The Theory of Reasoned Action as an Audience Segmentation Strategy for Messages About Genetically Modified Foods

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Genetically modified (GM) foods are currently a controversial topic about which the lay public in the United States knows little. Formative research has demonstrated that the lay public is uncertain and concerned about GM foods. This study (N = 858) extends focus group research by using the Theory of Reasoned Action (TRA) to examine attitudes and subjective norms related to GM foods as a theoretical strategy for audience segmentation. A hierarchical cluster analysis revealed four unique audiences based on their attitude and subjective norm toward GM foods (ambivalent–biotech, antibiotech, biotech–normer, and biotech individual). Results are discussed in terms of the theoretical and practical significance for audience segmentation.

The introduction of genetically modified foods (GM) into American supermarkets went virtually unnoticed by most members of the lay public. Biotechnology, the use of recombinant DNA, cell fusion, and new bioprocessing techniques for research and product development (Human Genome Project, 2000), is the method used to create GM foods. Specifically, agricultural biotechnology allows a gene that governs a specific trait to be identified, cloned, and inserted into a plant (Rowland, 2002, p. 26). Awareness of agricultural biotechnology has grown in recent years due to media coverage and polls about the benefits and risks associated with GM foods (Brown, 2001; Nash, 2000; Pew Initiative on Food and Biotechnology, 2003). Following the role of many European countries (Heinrichs, 1999; Williams, 1998), some U.S. groups and citizens oppose the use of agricultural biotechnology (Fox, 1999), while most experts, scientific groups, and commercial entities support the use of the technology (Datta, 2001; Blanchfield, 2004). The risks and benefits beget controversy because the science surrounding the technology is young, without longitudinal

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studies to support the long-term effects of the technology on humans or the environment (Finucane, 2002). While most scientists and scientific organizations report the many benefits of agricultural biotechnology (International Food Information Council Foundation, n.d.), a degree of uncertainty exists for some members of the lay public as scientists continue to utilize and study biotechnology, and as proponents and opponents of the technology articulate their positions based on their interpretations of available evidence.

The controversy that exists about GM foods has been investigated primarily by researchers working with populations from European Nations (Finucane, 2002; Frewer & Salter, 2003; Frewer, Shepherd, & Sparks, 1994; Hursti, Magnusson, & Algers, 2002; and see Levidow & Carr, 2000), who cite a lack of trust by Europeans in the food regulatory and distribution systems as a reason for the minimal support for GM foods (Frewer & Miles, 2003). Europeans have dealt with more food-related problems like mad cow disease and Bovine Spongiform Encephalopathy, and were told initially that their concerns were unwarranted about BSE (Frewer & Salter, 2002), creating a level of mistrust in regulatory agencies and food safety. This is in contrast to the United States, where most citizens report high levels of trust in regulatory systems and the agencies that implement food-related policies (Pew Initiative on Food and Biotechnology, 2003). To address their concern with consuming GM foods, groups in both Europe and the United States have advocated for the labeling of GM foods. In Europe, labeling is mandatory (Livermore, 2003); in the United States, labeling of GM foods is not required because products containing GM material are not deemed to be significantly different than non-GM-produced products (United States Regulatory Oversight in Biotechnology, n.d.). Labeling of GM products generally is seen as a good idea in the United States, according to many U.S. polls (Center for Food Safety, 2000; and Pew Initiative on Food and Biotechnology, 2003).

American attitudes toward GM foods have been slow to form as compared with European Nations' attitudes. Genetically modified foods have been the focus of great debate in European countries for more than a decade as members of the lay public expressed outrage at the use of GM foods and legislative bodies practiced a precautionary principle (Levidow & Carr, 2000), that resulted in a ban of GM foods that only recently was lifted in May 2004 (British Broadcasting Corporation, 2004). In stark contrast, the first GM food product on the market, Flavr Savr tomatoes, was introduced into American supermarkets in 1994, after meeting Food and Drug Administration (FDA) standards and going through a regulatory process that included an opportunity for public comment. The Flavr Savr tomato, however, had a short life span on the market in the United States. Its failure was not due to public outrage about GM foods, but rather to a lack of marketing efforts and lack of appeal to consumers because of the Flavr Savr tomatoes' reduced flavor as compared with conventionally grown tomatoes (Soil Association, 2004). Despite the failure of this one GM product, the number of GM crops grown in the United States continues to increase, with 101.5 million acres planted in 2003 (United States Department of Agriculture, n.d.). Even though GM foods make up large amounts of shelf space and Americans are consuming them daily, sparse research has attempted to investigate empirically attitudes of people in the United States (Frewer, 2003) and, more specifically, the different audience segments that might exist in the United States.

Some formative research has investigated the lay public's understanding, attitudes, and subjective norms about GM foods (Silk, Parrott, & Dillow, 2003).

Using a coding scheme based on the constructs of the Theory of Planned Behavior (TPB; Ajzen, 1985), Silk and colleagues revealed a general lack of knowledge about GM foods and a desire for more information about them. That research demonstrated the utility of the TPB as a lens for understanding attitudes, subjective norms, and perceptions of control related to GM foods. The goal of the current project is to extend the formative research of Silk and colleagues by using the attitudes and subjective norm constructs as an audience segmentation strategy. The perceived behavioral control construct of the TPB is not considered in this research because formative research revealed little variance on that complex construct. Thus, the theoretical framework of the TRA will be used in this study (Ajzen & Fishbein, 1980). As message designers continue to create messages about the risks and benefits associated with GM foods, they also need to identify the different audience segments whose understanding, attitudes, and subjective norms toward GM foods vary. A discussion of relevant research that pertains to attitudes and subjective norms associated with GM foods is provided along with a section that focuses on the role of audience segmentation for message design.

The Theory of Reasoned Action and GM Foods

The TRA (Fishbein & Ajzen, 1975) has been used widely in the health literature as a means to predict behavioral intentions and subsequent behavior. The theory assumes individuals to be rational decisionmakers who consider options and implications of a behavior before actually engaging in the behavior. According to the TRA, most behaviors of social relevance are under volitional control and, thus, behavioral intention is the single most important predictor of behavior (Fishbein & Ajzen, 1975). Behavioral intention refers to whether a person plans to perform a particular behavior. The greater a person's behavioral intention to perform a specific behavior, the greater the likelihood the person actually will perform that behavior. According to the TRA, behavioral intention is determined by an individual's attitude toward the behavior and by the subjective norm an individual perceives to exist in association with that behavior. The constructs of attitude and subjective norm will each be discussed.

Attitudes and GM Foods

According to the TRA, attitudes are composed of behavioral beliefs that have outcome evaluations associated with them (Fishbein & Ajzen, 1975; Ajzen, 1985). Individual attitudes toward a behavior are determined by the sum of the beliefs about performing the behavior, weighted by the evaluations of the beliefs. In general, behaviors that are thought to produce a favorable outcome have positive attitudes associated with them, while behaviors that are thought to produce negative outcomes have negative attitudes associated with them. In the case of GM foods, the outcomes associated with eating them are unclear for members of the lay public (Silk et al., 2003) because both negative and positive outcomes have been identified by scientific and popular media sources (Brown, 2001; Garza & Stover, 2003; Gates, 2000; Heinrichs, 1999; Hopkin, 2001; Kieckhefer, 1999; Nash, 2000).

Members of the lay public consume media messages about GM foods, forming the basis for their attitudes about them. The lay public's attitudes toward GM foods are marked by uncertainty due to unknown consequences related to human growth patterns and the environment that they associate with GM foods (Silk et al., 2003).

Even though the lay public has reservations about GM foods and may desire messages that clarify *both* the risks and benefits associated with biotechnology, most scientists have focused on the benefits of biotechnology (Blanchfield, 2004; Datta, 2001). Genetically engineered crops are promoted because they increase productivity and crop resistance to disease, insects, drought, or other natural pests as well as enhance taste and nutritional content (Hoban, 1995). Many researchers also stress the successes and future of biotechnology for being more cost-effective, efficient compared with conventional breeding techniques, and advantageous to poorer nations because of the potential for increased nutrients in GM food (Datta & Bouis, 2000; Philips, 2000; Tian & DellaPenna, 2001; Vasal, 2000). Other research supports some of the concerns expressed by the lay public, however, pointing to potential long-term risks associated with human consumption and the environment (e.g., Brown & Ping, 2003; Cummins, 2000; Ewen & Pusztai, 1999;[1] Falci, 2001; Woodworth, 2000).

Opponents also have pointed to concerns about biotechnology as it relates to food safety. For example, 80 million people are estimated to become sick from food-caused illness each year, and nine thousand of them die (Teitel & Wilson, 1999, p. 44). Although these deaths are not at all linked to GM foods, critics call for increased requirements for testing and labeling of GM foods to better ensure product safety and consumer knowledge of products. Labeling, in particular, has been a focus for individuals who seek tighter regulation of GM foods. Findings from Silk and colleagues (2003) demonstrate that the lay public supports increased testing and labeling of GM foods. Additionally, a Harris poll concluded that the lay public would be more knowledgeable, and that attitudes toward GM food might be more positive if the food industry had decided to label GM food as such from the beginning (Taylor & Leitman, 2001).

Another reason the lay public may feel uncertain about GM foods is because scientists cannot conclusively define what the potential impact of transgenic crops will be on the environment or humans. For example, one laboratory study found that monarch butterflies "reared on milkweed leaves dusted with pollen from Bt [Bacillus Thuringiensis] corn, ate less, grew more slowly and suffered higher mortality than larvae reared on leaves dusted with untransformed corn pollen or on leaves without pollen" (Losey, Rayor, & Carter, 1999, p. 214). Recent studies suggest that no compelling scientific arguments demonstrate that GM crops are innately different from non-GM crops or that their potential impacts would be different from them (e.g., invasiveness, weediness, toxicity, or biodiversity; Dale, Clarke, & Fontes, 2002). Researchers also point to the successes and future of biotechnology as beneficial (Datta & Bouis, 2000; Philips, 2000; Vasal, 2000). Other research, however, points to risks associated with human consumption and the environment (Cummins, 2000; Ewen & Pusztai, 1999; Falci, 2001; Woodworth, 2000), suggesting that GM foods might be dangerous. After reviewing published in vivo studies on the possible health consequences associated with GM plant materials, Pryme and Lembcke

[1]The research of Ewen & Pusztai (1999) was met with great controversy in the scientific community, with many scientists questioning the validity of the researchers' results. This controversy made its way into the media, bringing widespread attention to the possibility of negative effects associated with GM foods. While the methods by which the study was conducted are questionable for many scientists, the communication of negative effects associated with GM foods was still an outcome of the study that may impact individuals' perceptions.

(2003) conclude that much more scientific inquiry is necessary before conclusive statements can be made about the safety of GM foods.

One study examined social issues related to attitudes surrounding two biotechnologically engineered food products introduced in 1994, bovine somatotropin (BST) and Flavr-Savr tomatoes (Hoban, 1995). Based on early public reaction to the two food products and the public policy direction, the research minimized the issue of biotechnology as a social problem because the majority of individuals were disinterested in the issue. Interest in GM foods has increased due to the topic's exposure in the popular media. Specifically, stories about feeding third world countries and curing world hunger (Gates, 2000) mixed with articles about allergic reactions (Hopkin, 2001) and environmental risks (Brown, 2001) provide pieces of information on a complex topic from which individuals are beginning to form their understanding and attitudes about GM foods.

Consumers gain information about GM foods from a variety of sources—popular media (magazines, television, newspapers), books (popular fiction, textbooks), interpersonal sources (friends, family, coworkers), and, in some cases, scientific evidence (peer-reviewed scientific journals). All of these sources provide information about GM foods, but they do not necessarily provide a consistent picture of the risks and benefits associated with them, possibly leaving the lay public with a disjointed and minimal understanding of GM foods. Formative research demonstrates a lack of surety about agricultural biotechnology by the lay public as well as a desire for increased testing of GM foods (Silk et al., 2003). To gain more information about the topic 11% of individuals follow the news about biotechnology and 30% perceive the news to be a danger (Saad, 2001). About half of the Americans polled support the use of biotechnology in food production and 38% were against it (Saad, 2001). Thus, some individuals fully embrace the benefits of agricultural biotechnology and weight their behavioral beliefs more positively, applying the TRA framework, whereas others perceive risks and weight their behavioral beliefs toward GM foods more negatively. Even more likely to exist are individuals who are uncertain about how to weight their behavioral beliefs about GM foods because of the complex nature of the information associated with them.

For example, Silk and colleagues (2003) found that some participants recognized that food products containing genetically engineered ingredients are not labeled as such. Thus, participants who were willing to read food labels to determine whether a product contained genetically engineered ingredients may have associated the behavior of reading food labels with the behavioral belief of "useless," resulting in a negative outcome evaluation. If participants associated reading food labels with the behavioral belief of "safety," however, they might have assigned the behavior a positive outcome evaluation. Depending on the strength of each of the behavioral beliefs and the valence of the outcome evaluations, an individual may or may not develop a positive or negative attitude toward reading food labels. Recent research on perceptions of policy regarding the labeling of GM foods suggests that consumers' desire for labeling is increasing (Brown & Ping, 2003).

It is a prudent step for health communication researchers to examine the lay public's attitudes about GM foods as an audience segmentation strategy for the design of rational appeals that address the issue of agricultural biotechnology. Another construct of the TRA, subjective norm, also may serve as a theoretical variable useful for audience segmentation purposes.

Subjective Norms and GM Foods

Subjective norms are defined as a person's beliefs that certain individuals or groups (referents) believe he or she should or should not perform a given behavior (Fishbein & Ajzen, 1975). Subjective norms are a function of different types of normative beliefs and are determined by the sum of the products of normative beliefs and one's motivation to comply. Normative beliefs are the individual beliefs that underlie subjective norms; they involve specific individuals (e.g., wife, parent, or pastor) or groups (e.g., church, sorority, athletic team) that may influence how individuals perceive a particular behavior (Ajzen & Fishbein, 1980). Motivation to comply with normative beliefs can range from nonexistent to very high, depending on the importance and influence of the referent(s). In other words, a person who perceives social pressure from important referents to perform a particular behavior will be more likely to perform that behavior than if he or she perceives no social pressure to comply or if the referents are not perceived to be important.

For example, in the case of GM foods, individuals have indicated that the topic has been discussed infrequently or not at all among their peers and family members (Silk et al., 2003). Infrequent discussion about GM foods might be related to low perceptions of social pressure from important others regarding the safety of these foods. Therefore, while the role of subjective norms would still be used as a predictor of behavioral intentions, it may have less of an influence on behavioral intentions than the attitude construct. Overall, the TRA states that attitudes and subjective norms, and the weight assigned to each of them, contribute to behavioral intentions (Fishbein & Ajzen, 1975).

Subjective norms toward GM foods currently are unclear to the lay public as discussions about them have been minimal (Silk et al., 2003). This partly may be due to the fact that the introduction of GM foods into the U.S. market went virtually unnoticed, as no specific regulations for GM foods are in place in the U.S. (Halsberger, 2000). Until recently, the theme in the United States was one of quiet acceptance combined with low awareness of GM food products, which does not facilitate discussions about them. Thus, it is difficult to assess what normative beliefs might exist as research has indicated that the American lay public has rarely, if ever, talked about GM foods with friends and family (Silk et al., 2003). Subjective norms associated with behaviors, however, are based on what individuals perceive significant persons or groups believe about a given behavior. Thus, European attitudes and American farmer attitudes might provide insight into the important influences on individuals' normative beliefs pertaining to GM foods.

European Norms

In European countries, attitudes toward biotechnology are mostly negative, with more than half of the Europeans consistently ranking biotechnology as not useful and risky (Boy, 2000). European restaurants routinely post whether they use GM ingredients in their food products, making the issue a visible, everyday decision for consumers. Europeans tend to have a more cautious view of GM foods compared with Americans and also report lower trust in their food regulatory processes (Frewer & Miles, 2003). As Americans learn more about the issue and the differences that exist between European countries and the United States, their normative beliefs about GM foods may become less favorable. For example, focus group participants discussed European attitudes toward GM foods (Silk et al., 2003), perhaps weighting

European countries as a significant influence on their subjective norm toward GM foods.

Heinrichs (1999) discusses the differences in regulatory and scientific perspectives on GM foods between the United States and Europe. Whereas the United States remains the leader in biotechnology applications as evidenced by the more than double number of people (100,000) working in biotechnology in the United States than in Europe (39,000; Heinrichs, 1999), researchers in Europe believe risks are not yet known and that assertions about minimal risks are premature because it seems the more scientists discover about DNA, the more complex and unknown DNA becomes (Worth, 2000). For example, scholars from Britain have met to discuss risks and hazards associated with GM foods (Worth, 2000), indicating a need for more information about the effects of GM foods before they are marketed. One researcher stated, "It is impossible to predict what will happen to all forms of life on this planet if experiments in genetic engineering continue unchecked" (Worth, 2000, p. 163). Opinions such as the previous one from individuals considered to be "experts" by the lay public could contribute to individuals' normative beliefs that compose their subjective norm about GM foods.

American Farmers

American farmers also may serve as an important referent group for shaping subjective norms associated with GM foods as farmers have been found to be the most credible sources of GM food risk information along with environmental groups (Bauer, Durant, Gaskell, Liakopoulos, & Bridgman, 1998). Farmers were some of the first individuals to gain information about GM foods because they have first-hand experience with GM seeds. Despite this experience however, it seems that consumers are not relying on the actions of farmers as a sign to support the production of GM foods. For example, some consumers did not react positively to the use of biotechnology for GM crops, even though farmers adopted the technology (Philips, 2000). Likely outweighing the influence of farmers' attitudes and behavior is the fact that the lay public has seen no direct benefit to the cost and quality of food due to the technology thus far (Philips, 2000). Farmers have the potential to be a strong referent group for subjective norm toward GM foods as more and more members of the lay public discuss GM foods and relate their use back to farmers (Silk et al., 2003).

Results from Silk and colleagues (2003) highlight the lay public's increase in discussions related to GM foods and concerns about their effects. While the lay public recognizes the proliferation of GM foods into the food market, they were concerned about a variety of issues and, in particular, human growth patterns, the environment, and the economic implications of GM foods. In sum, message designers can play a role in addressing issues related to GM foods by developing well-crafted messages targeted toward specific audiences.

Audience Segmentation

Health message design is an audience-centered process, which means that health messages are designed primarily to respond to the needs and situation of the target audience, rather than to the needs and situation of the message designers or sponsoring organizations (Maibach & Parrott, 1995, p.167). Audience segmentation often is based on demographics, psychographics, or geographics with less attention to how theory might contribute to identifying target audiences (see Slater [1996] for a review of audience segmentation techniques). The TRA, with its constructs of attitudes and subjective norms, provides one opportunity to investigate how theory can contribute to audience segmentation. Currently, messages about GM foods have not been audience/consumer oriented, but have worked from a deficit model that assumes that experts know best about the benefits and risks associated with GM foods (Frewer, 2003; Hansen, Holm, Frewer, Robinson, & Sandoe, 2003). Simply supplying information about GM foods in a generic fashion is not an effective strategy for communicating about perceived benefits and risks. The lay public in the United States is composed of a majority of individuals who, when asked, are relatively uncertain about eating GM foods for a variety of different reasons cited earlier. Within this larger group exists different target audiences who may be better defined by their attitudes and subjective norms about GM foods. Message effectiveness depends on message designers' ability to gain audience members' attention as well as to create messages that audiences are able to process cognitively. Thus, messages about agricultural biotechnology should be tailored for different target groups. The attitude and subjective norm factors of the TRA provide one strategy for defining segments of the population regarding GM foods. This research explores public perceptions in this arena:

> RQ1: What attitudes and subjective norms do the lay public report about GM foods?
>
> RQ2: How does the theory of reasoned action perform as a theoretical strategy for audience segmentation in regard to GM foods?

Method

Sample

Data were collected in community-based settings in four geographic locations and via an on-line survey ($N = 858$). The geographic locations included (a) a southeastern town located near a large land grant university; (b) a southeastern, metropolitan city; (c) a northeastern town located near a large state university; and (d) a northeastern, metropolitan city. Southern participants made up 59.7% of the sample ($n = 512$), and northern participants composed 34% of the sample ($n = 292$). One method without geographic specificity was an on-line version of the survey ($n = 54$), which accounted for 6.3% of the data collected. At the southeastern locations, researchers collected data at a health fair, restaurants, churches, retailers, barbershops, beauty parlors, an airport, and laundromats ($n = 397$), and the university ($n = 115$). At the northeastern locations, researchers collected data at a train station, bus station, outlet mall, and business office ($n = 191$) as well as at a large, land grant university ($n = 101$). The goal was to obtain an economically, racially, and educationally diverse sample approximating the characteristics of the communities represented.

Participants included 339 males, 482 females, and 37 participants who did not report their sex. A variety of ethnic and racial backgrounds (62 Asians, 23 Hispanics, 273 Blacks, 470 Whites, 26 Other, and 4 unreported) were represented in the sample. Age of participants ranged from 18 to 73 years ($M = 29.48$; $SD = 10.09$). Education levels varied from less than high school (3%), high school diploma (15.7%), some college (23.8%), college degree (30.1%), vocational–techological degree (3.7%) to advanced degrees (21.2%). Most participants had not taken a genetics course in college (81.3%). The majority (63.6%) of the participants did not have children, 22.8% had either one or two children, while 11.4% of the sample had three or more children. In addition, 87.1% of the sample had health insurance.

Representative Sample

According to 2000 Census Data (United States Census, n.d.), males composed 46% of the population in the southeastern town, compared with 42% of our sample recruited from that area; 54% in the northeastern town were male, as compared with 37% of our sample; 47% in the southeastern metropolitan area were male, as compared with 32% in our sample; 46% in the northeastern metropolitan area were male, as compared with 83% in our northeastern metropolitan sample. In the southeastern metropolitan area, 58% of the participants self-identified as Black, compared with 61% in the 2000 Census data; the southeastern town's sample included 33% of the participants self-identifying as Black, compared with 27% in the 2000 Census data. In the sample data, 3% of the sample collected in the northeastern town self-identified as Black, with 2000 Census data revealing that 4% identified as Black; 43% in the northeastern metropolitan city identified themselves as Black, compared with 93% of the participants ($n = 68$) recruited from that site. Data were first collected in the southeast region, with oversampling of males and Blacks undertaken in the northeastern metropolitan location to achieve more equal participation of both groups, a heretofore unattained goal for much applied research (Vesey, 2002). Thus, while the sample does not purport to be random, it does attempt to reflect demographics in the sampled regions, with the greatest difference reported for the oversampled African American males from the northeast metropolitan location.

Survey Instrument

The survey that participants completed was part of a larger study that dealt with both human genetics and GM foods. This article is interested in the latter topic. The survey first asked participants to answer 10 true/false knowledge questions, where 9 of the questions, were about human genetics research and one asked about GM foods (e.g., organic foods are the same thing as GM foods). The rest of the survey asked about attitudes and beliefs about human genetics, of which 21 statements about GM foods were present. Questions pertaining to GM foods were constructed based on themes that emerged from the coding scheme used in Silk and colleagues (2003). Specifically, questions asked about attitudes and subjective norms about GM foods. Only those items pertaining to GM foods will be discussed and considered for further analyses in this article.

Cluster Analysis

Cluster analysis provides a means for grouping subjects across attributes, while factor analysis groups attributes across subjects (Aldenderfer & Blashfield, 1984). Cluster analysis affords a significant strategy to guide audience segmentation within constructs associated with proximate audience variables associated with health behavior (see Slater, 1996). The goal of this project was to examine whether there were natural clusters within the attitude and subjective norm dimensions of the TRA and derive models to classify individuals within these groups. Cluster solutions for the two factors were examined to determine the most parsimonious solution. Selection criteria were based on the following: (a) heuristic inspection of the dendrogram to ascertain the different groups that were present in the data; (b) examination of the means of each factor to assess the differences between each of them across possible cluster solutions; and (c)distribution of participants across the cluster solutions.

Results

Data Reduction

For data reduction purposes, a factor analysis was conducted with the 21 Likert-type items. Six of the statements formed a developmental factor (e.g., "Eating GM foods can change the genes of adults," and "Eating GM foods can harm children's genes"); Cronbach coefficient alpha = .89. Four of the statements formed a subjective norm factor (e.g., "Most of my friends' attitudes toward GM foods are positive," and "My family thinks GM foods are safe to eat"); Cronbach coefficient alpha = .86. Table 1 reports the retained loadings for each factor.

Research Questions

Research question one asked about lay public perceptions about GM foods. Descriptive statistics are reported for the developmental factor and subjective norm factor (see Table 2). Research question two asked how the theory of reasoned action can be used as a strategy for audience segmentation. To address research question two, the attitude and subjective norm factors were used to perform a cluster analysis on all members of the sample ($N = 858$). A hierarchical agglomerative cluster analysis was performed to group participants by the aforementioned factors of attitude and subjective norm toward GM foods. Standardization of the variables was unnecessary in the study because all the variables were measured on the same 5-point Likert-type

Table 1. Retained factor loadings

	DVLP	SN
Eating GM foods can change the genes of adults.	.68	–.02
Eating GM foods can change teens' genes.	.80	.02
Eating GM foods can change children's genes.	.84	–.01
Eating GM foods can harm teens' genes.	.81	.00
Eating GM foods can harm children's genes.	.77	–.02
Eating GM foods can harm humans' genes.	.69	–.08
Most friends who are important to me think GM foods are safe to eat.	.01	.67
Most of my friends' attitudes toward GM foods are positive.	.02	.80
My family's attitude toward GM foods is positive.	–.04	.89
My family thinks that GM foods are safe.	–.08	.78

Note. DVLP = developmental factor (Cronbach's alpha = .89); SN = subjective norm (Cronbach's alpha = .86).

Table 2. Descriptive information for the developmental and subjective norm factors

	Mean	Median	Mode	SD
Developmental factor	2.73	2.83	3.00	.63
Subjective norm factor	2.89	3.00	3.00	.66

Note. All items were measured on a 1 to 5 Likert-type scale, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

scales. The cluster analysis proceeded with use of Ward's Minimum Cluster Variance to determine the optimal number of clusters. A Squared Euclidean Distance index, a dissimilarity measure that assumes larger values as two entities become less similar, also was used in this study (Aldenderfer & Blashfield, 1984). Three-, four-, five-, and six-cluster solutions were assessed, revealing that the best solution was one that identified four different subgroups in the population sample based on the aforementioned criteria and, in response to the second research question, affirming discernible patterns in participant responses.

Dendrogram

The three-, four-, five-, and six-cluster solutions were depicted in a dendrogram, providing a graphic representation of the homogeneous groups. A Ward's method solution, using Euclidean distance, narrowed the examination to three- and four-cluster solutions as they provided the most clear structure possibilities for the two factors. Based on the length of the "branches" of the dendrogram, the four-cluster solution appeared to group participants in the most straightforward and interpretable fashion. To further investigate the differences in the cluster solutions, means for each group were examined.

Means

The means for the attitude and subjective norm factors were assessed as a strategy to identify distinct differences between possible cluster solutions. The means provided a measure by which to identify the level at which participants scored on each of the two factors, based on a 5-point scale. Subsequently, the four-cluster solution was deemed to identify the most distinct segments of the sample population. Means of the four-cluster solution represented the most parsimonious grouping structure, retaining distinct mean differences across the two factors as compared with the three-, five-, and six-cluster solutions. For example, when we moved from the four- to the three-cluster solution, two of the clusters merged into one cluster, blurring differences that existed.

Cluster Size

It was important that each of the clusters be composed of a significant proportion of the sample population to merit inclusion as a distinct audience segment. Assessment of the four-cluster solution revealed a large distribution across two of the four clusters (42% and 38%), with a lower distribution across the two remaining clusters (14% and 6%). Each of the groups contained a substantial number of members who were distinct from one another on the three factors.

Table 3. Means and standard deviations for a four-cluster solution

	Sample size	Subjective norm	Attitude developmental factor
Cluster 1	357	3.07 (.29)	3.15 (.34) (ambivalent–biotechs)
Cluster 2	50	1.76 (.47)	1.90 (.37) (antibiotechs)
Cluster 3	329	3.17 (.49)	2.19 (.43) (biotech–normers)
Cluster 4	122	2.04 (.44)	3.32 (.50) (biotech–individuals)

Cluster Interpretation: The TRA and GM Foods

Review of cluster solutions with the aforementioned criteria and segmentation goals led to the conclusion that the TRA factors, attitude and subjective norm, intersected to form four separate segments of our sample population. An examination of the descriptive information provides the mean score and standard deviation for each group (see Table 3). The means for Cluster 1 are largely around the neutral range, suggesting that members of this cluster are *ambivalent* in their attitude ($M=3.15$; $SD=.34$) and subjective norm ($M=3.07$; $SD=.29$) regarding GM foods. The means for Cluster 2, on the other hand, seem fairly negative in both their attitude ($M=1.90$; $SD=.37$) and subjective norm ($M=1.76$; $SD=.47$) about GM foods, indicating this group has a more *anti*biotechnology perspective. Cluster 3 contains individuals whose scores on the subjective norm factor ($M=3.17$; $SD=.49$) were the highest of all four groups and their attitude was negative ($M=2.19$; $SD=.43$). In other words, Cluster 3 individually holds negative attitudes despite the more positive subjective norm they perceive to exist (i.e., *biotech-normers*). Conversely, the means for Cluster 4 were reverse of those in clister 3. Specifically, Cluster 4 scored low on the subjective norm factor ($M=2.04$; $SD=.44$) and the highest on the attitude factor ($M=3.32$; $SD=.50$), indicating a belief that this group individually holds positive attitudes toward GM foods despite the more negative subjective norm they perceive to exist (i.e., *biotech-individuals*). These different group clusters affirm the heuristic value of the TRA for investigating attitudes and subjective norms toward GM foods, which enhance and extend theoretically derived approaches to audience segmentation.

Discussion

Genetically modified foods already have made their way to supermarket shelves and are gaining momentum as biotechnologies expand. The entrance of GM foods came about rather quietly in the United States as compared within European countries where the lay public protested and governments banned them until recently (British Broadcasting Corporation, 2004). More recent murmurs of concern over GM foods tend to be focused on issues of labeling and environmental effects. It seems that biotechnology in the United States will remain a critical tool in the food production process because the benefits seem to outweigh the risks for food growers. In addition, although the lay public report a consistent theme of uncertainty about GM foods, they do not seem to be ready to discontinue consumption of them, perhaps believing that only adequately tested and regulated products are available in supermarkets. The reality is that GM foods are part of our food supply and are currently perceived to be no different than non-GM foods by the government.

The controversy around GM foods likely will continue as agricultural biotechnology has quickly become the norm for growing the majority of our food supply. The purpose of this study was to identify attitudes and subjective norms of the lay public toward GM foods as a strategy to define audiences for the purpose of message construction. The theoretical and applied implications are discussed next.

Theoretical Implications

The continuation of systematic and theoretically grounded behavioral science research is needed to guide the construction of appropriate messages to address gaps in understanding about GM foods; or else, little can be done to advise health message designers about more efficacious ways to communicate with the lay public about pertinent health issues. Numerous messages around GM foods are working their way into the lay public's spheres of influence. These include messages that highlight the benefits of agricultural biotechnology and downplay the risks associated with it. Individuals' beliefs and attitudes toward GM foods may be influenced by important others (e.g., family and friends). This research suggests that frameworks for assigning GM foods a role on health are likely to be significantly associated with attitudes and subjective norms.

Audience segmentation strategies traditionally have been based on audience demographics, psychographics, or geography. Cluster analysis, a popular method for audience segmentation, has been considered more of an atheoretical statistical analysis used primarily for marketing and other applied purposes. Adding theory to strategies that assist in defining target audiences addresses the absence of theory associated with cluster analysis. In this study, the TRA (Fishbein & Ajzen, 1975) provided the relevant constructs based on formative research, but the TRA is not the only theory that can be used as a tool for audience segmentation. Researchers should attempt to identify theories that identify relevant determinants related to their anticipated outcomes of interest. For example, the TRA allowed for an examination of variables that lead to behavioral intention, which is a predictor of behavior (e.g., the lay public's purchase/consumption of GM foods). The inclusion of theory in the cluster analysis does not occur in a vacuum; theoretical approaches should be also combined with other hierarchical audience segmentation taxonomies to maximize effectiveness (Slater, 1996).

Applied Implications for Audience Segmentation

Four frameworks for audiences emerged from the cluster analysis of the TRA variables: ambivalent-biotechs, anti-biotechs, biotech-normers, and biotech-individuals. Tailoring information to the concerns of these different groups likely would have a greater impact on attitudes (Miles & Frewer, 2001). Ambivalent-biotechs are neutral about GM foods and their health. This audience segment may be seeking information that definitively states the advantages or disadvantages of GM foods. Messages designed for this group might focus on scientific information that is new to this group to promote greater awareness of the risks and benefits of GM foods (i.e., health and environmental issues). Antibiotechs have negative attitudes and norms toward agricultural biotechnology. Because this group has the strongest negative attitudes, it is possible that they will respond with more of an affective orientation to messages about GM foods. In particular, messages geared toward this group might aggressively focus on educating, clarifying, and refuting any misconceptions about GM foods, while acknowledging that longitudinal studies have not been conducted to definitively conclude risks. The group known as the biotech-normers holds negative attitudes toward GM foods, yet their peers are more neutral. The more positive influence of subjective norms may guide health promoters and message designers to create messages that address the relationship between norms and attitudes, connecting the two as a way to discuss issues related to GM foods. In contrast, the final group identified through this research displays the opposite pattern of the biotech-normers. This group, the biotech-individuals, seems to hold positive individual attitudes toward GM foods in spite of the negative subjective norms they perceive to exist. Messages targeted toward this group may include information from salient referent groups like friends or even farmers, as a way to frame information pertaining to GM foods.

Given the relative "newness" of this topic, it appears as if a majority (42%) of the sample population (Cluster 1: ambivalent-biotechs) is still determining their attitudes and subjective norms about GM foods. Based on the large percentage of individuals who are ambivalent toward this topic, health promoters and message designers are working with relatively "clean slates." Because these people are in the middle, it may be easier to shift their views to a more favorable position, than, say, the antibiotechs. Message designers however, also may be able to shift the ambivalent-biotechs' views to an unfavorable position too. While the antibiotechs represent only 6% of the sample population, we cannot dismiss this group. Because they might be adamant in their stance, they also are more likely to take action against GM foods based on the strength of their beliefs. Messages that provide balanced information regarding agricultural biotechnology need to be constructed for each of these different target groups.

Limitations and Future Research

This study is based on community samples drawn from northeastern and southeastern regions of the United States. A randomly selected sample may have resulted in different views. It was deemed critical to the advancement of knowledge associated with the topic of GM foods however, that a culturally and educationally diverse sample be recruited and census data report parallel distributions of race and sex in the sample (U.S. Census Bureau, 2000). Another limitation is that the factors of attitudes and subjective norms can not completely encompass all of the possible dimensions of those variables. The factors emerged from questions formulated from focus group discussions of GM foods however, indicating that the questions on the survey were representative of issues of salience for the lay public. Additionally, the segmentation criteria were limited to two variables; the addition of other variables likely would change the current cluster solution.

Future research should examine the usefulness of designing health messages related to the clusters advanced in this research. Additionally, including the constructs of a theory within message content to directly address different audiences may improve the effectiveness of messages. For example, messages about GM foods derived around the constructs of attitudes and subjective norm might contribute to whether individuals intend to purchase and consume GM foods. Future research also should focus on issues of source credibility and trust in regulatory agencies and processes as key elements to message construction and message acceptance.

Finally, future research could use other relevant theories and cluster analytic techniques to extend the heuristic value of theory in the applied context of audience segmentation.

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