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An investigation of the theory of reasoned action concerning consumer acceptance of food irradiation

Natalia Frishman
Iowa State University

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Natalia Frishman

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Stephen G. Sapp, Major Professor
Gloria Jones Johnson
Catherine H. Strohbehn

Iowa State University

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Table of Contents

List of Figures

List of Tables

Abstract

This research examined how attitudes and subjective norms influence behavioral intentions to eat irradiated food. This inquiry is important because, food irradiation is controversial and the public's attitude toward it can influence the extent to which it is eventually adopted.

The data received from the first, large-scale commercially funded market test of irradiated food in supermarkets located throughout Minneapolis, Minnesota, has been used for statistical analysis. The test was conducted by Huisken's Meats, Inc. on spring of 2000. The data includes questionnaire responses of 225 participants.

The data analysis of consumers' opinions, concerning food irradiation, confirms the theory of reasoned action. However, the results show that subjective norms have a weak effect on intentions to eat irradiated food. Suggestions are offered for future research based upon the findings of this study.

Chapter 1: Introduction

This research examines the viability of using the theory of Reasoned Action to understand consumer opinions of food irradiation. The objective was to reveal which factors influence the behavioral intentions as these are related to irradiate food. The investigation of social attitudes toward food irradiation is important because, food irradiation is a new technology to the public and the public's attitude can influence the extent of its adoption. If people will not buy irradiated food, it will be economically inefficient to produce it. Consequently, it is necessary to investigate this problem and decide when and where to use it, or perhaps not to use it at all.

Sapp and Korsching (2004) explain that people usually receive information about controversial technologies from media sources, which can give positive or negative explanations about them. Different organizations, such as health, scientific, and food industries, presented their points of view concerning these problems. Sapp and Korsching (2004) described the importance for investigation by social scientists; the problems concerning new food production technologies, including food irradiation, by stating:

> Social scientists interested in the quality of the social fabric as an outcome of public discourse about technology examine public decision-making within the context of relationships among science, technology, and society (e. g., Beck 1992); the political economy of technology development and dissemination (e.g., Busch 2000); and community-level responses (e.g., Luloff, Albrecht, and Bourke 1998) to understand how technology decisions can affect social; structure and quality of the social fabric (p. 348).

Fishbein and Ajzen's theory of Reasoned Actions can help us understand some of these issues. Problems, such as "public decision-making", can be defined as behavioral

intentions, because a decision can be explained as an intention to perform the behavior, which is the compound of the theory of reasoned actions.

According to the theory of Reasoned Action (Fishbein and Ajzen, 1975), attitudes (i.e., evaluations of a behavior) and subjective norms (i.e., perceived social pressure to perform or not to perform the behavior) influence intentions to perform a behavior. Attitudes are influenced by beliefs, which are perceptions about the characteristics of the behavior (e.g., whether irradiated food is "safe to eat"). Similarly, subjective norms are influenced by the individual's perception about what referent others may think about certain behavior, and their motivations to comply with these opinions. Fishbein and Ajzen (1975) wrote that:

> The person may or may not be motivated to comply with any given referent. The normative beliefs and motivation to comply lead to normative pressures. The totality of these normative pressures may be termed “subjective norm” (p.16).

According to Fishbein and Ajzen, the anticipated consequences of performing, or not performing the behavior, affect beliefs about the behavior and opinions of referent others about the behavior, by the feedback mechanism.

The theory of Reasoned action can help to predict behavioral intentions related to irradiated food consumption and assess causal links between beliefs, attitudes, opinions of referent others, motivations to comply, subjective norms, and behavioral intentions. I hypothesize that, according to the theory of Reasoned Action, public attitude toward irradiated food and subjective norms, concerning this issue, can influence behavioral intention. According to Ajzen and Fishbein, (1980) “…individuals will intend to perform a behavior when they evaluate it positively and when they believe that important others think they should perform it” (p. 6). Consequently, it is possible to assume that if individuals have

positive or negative attitude toward the consumption of irradiated food and they know that important others think that it is beneficial or not beneficial to eat irradiated food, they will intend or will not intend to eat irradiated food.

This study investigates how social attitudes and subjective norms affect intentions to eat irradiated food. It examines the efficacy of the theory of Reasoned Action for understanding volitional behavior under conditions of uncertainty.

Chapter 2: Literature Review

Food Irradiation

For better understanding of any problem related to food irradiation, it is essential to know what food irradiation is and how irradiated food can affect human health, or whether does not affect it at all. According to Farkas (2006), "Food irradiation is a process exposing food to ionizing radiations, such as, gamma rays emitted from the radioisotopes Cobalt 60 and Cesium 137, or high energy electrons and X-rays produced by machine sources" (p. 148). Accelerated electrons do not penetrate the food beyond a few inches, depending on product density. Gamma rays and X-rays have better penetration ability. Reduced storage losses, extended shelf life, delaying the ripening and sprouting of fruits and vegetables, improving microbiological and parasitological safety of food can be achieved by irradiation. The effects depend on the absorbed radiation dose. Farkas claimed that ionizing radiations damage the microorganisms' DNA which prevent them from reproduction and consequently result in preservative effects on food. However, "radiation-induced, other chemical changes in food, are minimal" (Thaer, 1990, in Farkas, 2006, p.148). Radiation treatment does not cause significant temperature rise in the product. It can be applied through packaging materials and consequently can be performed after packaging, thus avoiding re-contamination of the product. Farkas claimed that research concerning the safety of irradiated food has been conducted over more than 50 years in different countries, and that its results support the safety of such food for consumption.

Diehl (2002) claimed that it is possible to trace the history of the food irradiation as long as history of radiation itself. In 1895, Roentgen discovered X-rays and in 1896, Becquerel discovered radioactivity. Following these discoveries, scientists started to investigate the effects of ionizing radiation on living organisms. Soon, inventors found practical applications of irradiation.

Diehl noted that other people in the 1920s-30s suggested using irradiation for bacterial inactivation in food products. However, none of these proposals were used because the radiation sources available at that time, were not powerful enough to treat food in sufficient quantities. Development of science, during World War II, provided the materials that could be used for food irradiation. In the 1950s, research concerning food irradiation, was conducted in many countries. According to Diehl, the first commercial use of food irradiation occurred in Germany in 1957. The International Project in the Field of Food Irradiation (IFIP) was created in 1970. The goal of this project was to determine the health and safety of irradiated food. In 1980, the Joint Food and Agriculture Organization, International Atomic Energy Agency, and World Health Organization (FAO/IAEA/WHO) Expert Committee on the Wholesomeness of Irradiated Food (JECFI), concluded that, "the irradiation of any food commodity up to an overall average dose of 10 kGy presented no toxicological hazard and no special nutritional or microbiological problems (WHO, 1981)" (Diehl, 2002, p. 212). According to Diehl, Food and Drug Administration (FDA) in the US approved irradiation of frozen meat for control of food's pathogen in 1997. Approval from the US Department of Agriculture's Food Safety and Inspection Service (USDA/FSIS) became effective in February 2000. In May 2000, the first packages of irradiated beef reached consumer market in the US. In the European Union, opposition of the food

irradiation prevents, or at least delays, the application of the new technology. The opposition against food irradiation exists in the US also. For example, as Tritsch G. L., a researcher, who worked in the Roswell Park Cancer Institute in New York, provided scientific explanation about his negative point of view toward the irradiated food in his article "Food irradiation" (2000). Tritsch claimed that, "irradiation produces mutagenic and carcinogenic compounds in food, and that the testing design for irradiated food safety has been inadequate to detect carcinogenicity in humans" (p. 698). He also claimed that irradiation at FDA-approved dose, kills 90-99% of microorganism, while those more radiation resistant bacteria survived.

According to Tritsch, irradiation is not able to eliminate morbidity related to food pathogens, but delay the onset of symptoms. Tritsch also provides an example of the developing polyploidy at four malnourished children in India 4 weeks after feeding them with irradiated wheat. Tritsch claimed that all the studies that were conducted on animals are too short for demonstration of carcinogenic effect of irradiated food. He makes the parallel between the eating irradiated food and smoking when smokers develop cancer usually during the period of thirty to sixty years. According to Tritsch (2000), "…it will take four to six decades to demonstrate a statistically significant increase in cancer due to mutagens introduced into the food by irradiation" (p. 700). Ehlermann D.A.E. from the Federal Research Center for Nutrition, Karlsruhe, Germany, in his article, "Where is the proof? The Science?" (2002) responded on the Tritsch arguments. Ehlermann explained that Tritsch's statement that after the irradiation more radiation resistant bacteria survived was never been proved experimentally. Concerning the problem that irradiation does not eliminate morbidity related to bacterial contamination Ehlermann answered that heat pasteurization of milk also

does not eliminate morbidity completely. Ehlermann (2002) also explained that study about developing polyploidy by children in India after the consumption of irradiated wheat "was refuted by an Indian expert committee, by national and international bodies, and by WHO expert committee in 1980" (p. 755). (WHO – World Health Organization).

Ehlermann claimed that Tritsch did not prove that there was not conducted enough research concerning the safety of irradiated food. According to Ehlermann, mutagenic and carcinogenic effects of irradiated food on human health were investigated in numerous of studies on animals and human volunteers. Ehlermann (2002) claimed that WHO "with its full authority and competence, has stated that irradiated food is safe and wholesome at any dose" (p. 755). It can be seen from this scientific debate between the proponent and opponent of food irradiation that it is necessary to continue scientific investigation concerning this issue. However, most natural scientists expressed positive attitude toward this technology, and that has influenced the conclusions made by WHO and FDA.

> Irradiated food produced in accordance with established good manufacturing practices can be considered safe and nutritionally adequate because the process of irradiation:
>
> - Will not lead to changes in the composition of the food that from a toxicological point of view would have an adverse effect on human health;
> - Will not lead to changes in the microflora of the food that would increase the microbiological risk to consumer;
> - Will not lead to nutrient losses to an extent that would have an adverse effect on the nutritional status of individuals or populations.
>
> (World Health Organization, 1994, p. 153).

According to Pauli (1999), FDA administered legislative rules, which provide radiological safety, toxicological safety, microbiological safety, and nutritional adequacy of

irradiated food. During irradiation, food must be held in appropriate packages that were tested and shown to FDA's satisfaction for that use. Irradiated food must be appropriately labeled according to FDA regulations. Diehl (2002) noted that the potential benefits of food irradiation for consumers and food industry are great and his opinion is that this technology will be used more broadly in the future.

Public Attitudes Towards New Food Technologies

According to Sapp (1995), acceptance of new technologies by the public sometimes required several decades. Sapp reviewed three types of studies that were conducted for assessment of public's opinions concerning food irradiation. These studies include opinion polls, laboratory experiments, and market tests. He wrote that most of consumers uncertain about food irradiation and need to receive adequate information about this issue. Sapp (1995) noted that, "Polls indicate approximately 25-30% of consumers have initially favorable impression of food irradiation, approximately 55-65% are uncertain about the process, and 5-10% are opposed to it" (p. 103). He also noted that laboratory studies demonstrate that consumers' acceptance is highly dependent from normative factors. Normative factors can include discussions with another people the problem of food irradiation and "trust in the government and industry agencies responsible for the regulation and processing of irradiated food" (p.103). According to market tests, consumers will purchase irradiated food if it will be available in stores.

According to Bruhn (1998), U.S. consumers' are less concern about food irradiation than other food processing technologies. Bruhn noted that data received in 1996 by Abt Associates Inc. indicated that bacterial contamination and the usage of pesticides considered

by public in the US are much more hazardous than food irradiation. "When specifically asked, 29% considered irradiation a potential serious health hazard compared to 77% who identified bacteria as a serious hazard and 66% who classified pesticides as serious (Abt Associates, 1996)" (Bruhn, 1998, p. 129). Similar results were found by Ressurreccion, Galvez, and Fletcher (1995) among Georgian consumers, which consider food irradiation is much less hazardous than pesticides, animal drug residues, growth hormones, food additives, and bacteria. "More persons believed irradiation was 'no problem,' 20%, than other potential food safety issues such as food additives, 11%; growth hormones, 8%; animal drugs, 7%; and pesticides,7%" (Bruhn, 1998, p. 130). Bruhn also presented the data received by the Food Marketing Institute survey, which asked on whom consumers rely on to ensure the safety of food products. "In 1986 most consumers, 48%, responded 'yourself as an individual' (Abt Associates, 1996). The government received the second most frequent response with 33%" (p. 132). However, in 1996 only 25% of consumers relied on themselves and 21% relied on the government. An increasing number of consumers relied on manufacturers and food processors, "up from 8% in 1986 to 21% in 1996, and food stores, up from 2% in 1986 to 16% in 1996" (p.132). This data showed increased tendency to trust food manufacturers by consumers. In her article Bruhn explained that information about the irradiation and endorsements by health authorities increases of public's acceptance of this technology.

Eustice and Bruhn (2006) described food irradiation as the "most extensively studied food processing technology in the history of humankind" (p. 64). They noted that nevertheless that food irradiation supported by "virtually all medical and scientific organizations" (p. 64) it still considered as relatively "new" technology. Consequently, many people consider it as a change in a usual way of food production. The authors explained that

it is a “human nature to resist change” (p. 64). They cited words of economics professor from University of Houston Thomas R. DeGregory, who says: “We must measure the benefits of change against a risk of not changing” (p. 64). Eustice and Bruhn claimed that numerous studies demonstrates that when consumers have accurate information they willing to buy irradiated food and even prefer these products over products treated by another kinds of technology. They wrote that variety of studies conducted during the last two decades show that “80 -90% of consumers will choose irradiated products over nonirradiated after they hear the facts and understand benefits” (p.70). Eustice and Bruhn described the results of the study conducted by the scientists at the University of Georgia. This research evaluated the difference in consumers’ acceptance of irradiated food over a 10-year period (1993 versus 2003). The results of the survey completed by 50 consumers in the metro-Atlanta area show that “More than twice as many consumers were willing to buy irradiated products in 2003 than in 1993 (69% and 29% respectively)” (p. 72). This data demonstrates the tendency of increasing acceptance of irradiated food by the public. In sum, Eustice and Bruhn noted that “the results of dozens of studies at leading universities consistently show that information about the nature and benefits of irradiation is a major factor affecting consumers’ perception of and attitudes toward irradiated food” (p. 72).

Gunes and Tekin (2006) investigated consumers’ attitudes toward irradiated food in Turkey. They claimed that consumers’ awareness about the irradiated food in Turkey is (29%) much lower than in the US (72%). The researchers showed that information about irradiated food increased its acceptance substantially. On the basis of their data Gunes and Tekin conclude that consumers’ acceptance of irradiated food largely depends on knowledge about the benefits and process of food irradiation. “More efforts and investments are needed

to provide consumers with scientific and credible information about food irradiation" (p. 447).

Furuta, Hayashi, Hosokawa, Kekefu, and Nishihara (1998), Furuta (2004) published their results of investigation of consumers' attitudes toward food irradiation in Japan. For the purpose of public education about radiation the "Radiation Fair – the relationship between daily life and radiation" has been successfully held at Kintetsu Department Store, one of the major department stores in downtown Osaka, the second largest city in Japan, during summer vacation in every August for 19 years" (Furuta, 2004, p. 499). The questionnaires were distributed to the visitors to inquire about their attitudes toward radiation and irradiated food. The results of this study suggest that consumers have a positive image toward food irradiation if they have knowledge of radiation science.

In their review of the published literature on consumers' attitude toward food safety Wilcock, Pun, Khanona, and Aung (2004) noted that many consumers have misconceptions about the technology of food irradiation. The authors claimed that consumers' studies demonstrated that a high percentage of consumers accepted irradiated food when provided with scientific information.

Fishbein and Ajzen's Theory of Reasoned Action

Hill (1981) explained that a variety of theories or models were offered in an attempt to use attitude as one of the determinants of behavior. Fishbein and Ajzen's theory of reasoned action (1975) became the dominant in the area and "achieved a due recognition as a fundamental model for explaining social action" (Bagozzy, 1992, p. 178).

Ajzen and Fishbein (1980) explained that they developed their theory for the prediction and understanding of people's behavior. The authors emphasized that prediction and understanding of people's behavior is very important issue for the society. It helps "to solve applied problem and make policy decisions" (1980, p. 4). Fishbein and Ajzen provide numerous examples of the situations where application of their theory can be very useful. These examples include such diverse issues as family planning, weight loss, occupational orientations, consumers' behavior, voting in elections, and many others.

Fishbein and Ajzen mentioned that by developing their theory they assumed that people are usually quite rational by making their decisions about performing or not performing the behavior. Fishbein and Ajzen used a causal model for the explanation of human behavior (Figure 1). The model shows that beliefs about the behavior and evaluation of the behavior determine attitude toward the behavior, opinions of referent others about the behavior and motivation to comply with these opinions determine subjective norm, which are the "person's perception" about the acceptability of specific behavior by general public. Attitudes and subjective norms are two components that directly influence behavioral intentions. Ajzen and Fishbein (1980) wrote that "according to the theory of reasoned action, two major factors determine a person's behavioral intentions: a personal or attitudinal component and a social or normative component" (p. 54). Behavioral intentions determine a specific behavior.

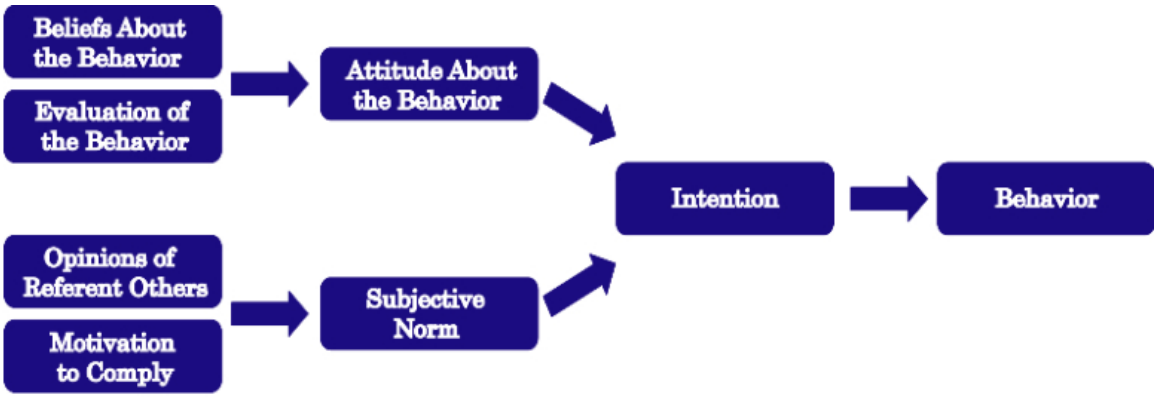


Figure 1. Fishbein-Ajzen Theory of Reasoned Action.

Each person has a large number of beliefs about any object or behavior. According to Fishbein and Ajzen (1975), "beliefs represent the information" that person has about the object (p.12). The authors "defined beliefs in terms of probability that a given object is related to some attribute" (p. 28). Most important beliefs, which the authors called "salient" influence the person's attitude. The authors emphasized that in order to find the link between salient beliefs and attitudes toward the behavior, it is important to ensure "correspondence in action, target, context, and time elements" (Ajzen and Fishbein, 1980, p. 64). Ajzen and Fishbein (1980) provide an example of person's beliefs about buying a car in the next six month for clarification of this statement. The authors explained that the action is buying the car by the person, the target is a specific car, the context can be buying the car from the local dealer, and a time is the next six month. Consequently, a person can hold specific beliefs concerning this issues and corresponding attitudes, which can be favorable or unfavorable depending from person's beliefs. The authors claimed that "a person's attitude toward a behavior is determined by his salient beliefs that performing the behavior leads to certain

outcomes and by his evaluations of those outcomes" (Ajzen and Fishbein, 1980, p. 77). For the determination of the attitude Fishbein and Ajzen (1975) provide an "expectancy- value model", which has been described by equation:

$$A = \sum_{i=1}^{n} b_i e_i$$

in which A - attitude toward the behavior; b - beliefs about the consequence of the behavior or outcome - i, e - evaluations about the consequences of the behavior, n – the number of beliefs about the behavior (p. 223). Thus, according to this equation:

> a person's attitude toward a behavior can be estimated by multiplying his evaluation of each of the behavior's consequences by his subjective probability that performing the behavior will lead to that consequence and then summing the products for the total set of beliefs (p. 223).

According to Albarracin, Johnson, and Zanna (2005), there are many definitions of attitude. Fishbein and Ajzen (1975) defined attitude as a "learned predisposition to respond in a consistently favorable or unfavorable manner with a respect to a given object" (p. 6). It is possible to understand from this definition that attitude is predisposes action. Fishbein and Ajzen (1975) noted that "attitude is typically viewed as a latent or underlying variable that is assumed to guide or influence behavior" (p. 8).

According to Ajzen and Fishbein, person's beliefs of what significant others think about his or her behavior influence the subjective norms. The authors call these beliefs "normative beliefs". However, sometimes a person wants to do what his or her referent others want, sometimes not. Consequently, a person's motivation to comply with referent others is another compound which influences subjective norm. In summary, the authors claimed that "a person's subjective norm is determined by his beliefs that specific salient

referents think he should (or should not) perform a given behavior and by his motivations to comply with those referents" (Ajzen and Fishbein, 1980, p. 77).

Subjective norm was defined as a "person's perception that most people who are important to him think he should or should not perform behavior in question" (Fishbein and Ajzen, 1975, p. 302).The authors explained that the origin of subjective norms is a combination of perceived expectations of important others and motivations to comply with those expectations. For the determination of subjective norm Fishbein and Ajzen provide the following equation:

$$SN = \sum_{i=1}^{n} b_i \, m_i$$

in which b – normative belief, i – reference group or individual that posses normative belief, m – motivation to comply with referent i, and n – number of referent others (p. 302).

For predicting and understanding behavioral intention, it is important to ensure that measures of attitude and subjective norm correspond to intention in "action, target, context, and time elements" (Ajzen and Fishbein, 1980, p. 58). Ajzen and Fishbein (1980) noted that sometimes attitude and subjective norms may not be in agreement. In such a case, an individual may hold a positive attitude toward performing a certain behavior, however, that individual may possess information that significant others think that he or she should not perform this behavior or perhaps even behave in an opposite manner. Consequently, behavioral intention depends on the relative importance of attitude or subjective norm for the person. According to Ajzen and Fishbein (1980):

> Each component is given a weight reflecting its relative importance as a determinant of the intention under consideration. A given component may have a very high weight or no weight at all. These relative weights may

> change from one behavior to another. The weight components are summed to predict the intention (p. 58).

Fishbein and Ajzen defined behavioral intention as a "person's location on a subjective probability dimension involving a relation between himself and some action. A behavioral intention, therefore, refers to a person's subjective probability that he will perform some behavior" (Fishbein and Ajzen, 1975, p. 288). Ajzen and Fishbein (1980) explained that knowledge of the information about the behavioral intentions is enough for a prediction of the behavior because people usually, but not always, do what they intend to do. They wrote "intention is the immediate determinant of behavior, and when an appropriate measure of intention is obtained it will provide the most accurate prediction of behavior" (1980, p.41). Ajzen and Fishbein claimed that measure of intention must correspond to behavior in "action, target, context, and time" (p. 51).

Fishbein and Ajzen (1975) present the central equation of the theory of reasoned action as following:

$$B \sim I = (A_B)w_1 + (SN)w_2$$

In which B – the behavior, I – intention to perform the behavior, A_B – attitude toward the behavior, SN – subjective norm, w_1 and w_2 – empirically determined weights (p. 301).

In sum, Fishbein and Ajzen (1980) wrote:

> There is a causal chain linking beliefs to behavior. On the basis of different experiences, people may form different beliefs about the consequences of performing a behavior and different normative beliefs. These beliefs in turn determine attitudes and subjective norms which then determine intention and corresponding behavior. We can gain understanding of a behavior by tracing its determinants back to the underlying beliefs (p. 91).

Many investigations have provided support for the use of the theory of reasoned action in prediction of social behaviors. These studies include research of prediction of

blood donation (Charng, Pilivan, and Callero, 1988), attitudes toward divorce (Kapinis, 2005), and other works.

Sparks, Shepherd, and Frewer (1995) used Fishben and Ajzen's theory of reasoned action in a study of attitudes toward the use of gene technology in food production. The authors noted that, nevertheless, often people have little knowledge about gene technology, but they indicate concern about it. By analyzing the survey results of 334 respondents they found a strong predictive link between behavioral beliefs/outcome evaluations, attitudes, and behavioral expectations concerning the technology. The authors emphasized the importance of investigation of public attitudes toward modern technologies.

Chapter 3: Methods

This chapter is divided into four parts: study hypothesis, explanations about the data, descriptive statistics, and variable operationalization.

Study Hypotheses

Based upon the review of the literature regarding the theory of reasoned action and prior research regarding consumer opinions of irradiated food, I posit the following three hypotheses:

1. The more favorable the beliefs about food irradiation the more favorable the attitude about food irradiation;

2. The more favorable the opinions of significant others regarding food irradiation, the more favorable the subjective norms regarding food irradiation;

3. The more favorable the attitude and subjective norms regarding food irradiation the greater the intent to eat irradiated food.

It is possible to hypothesize that beliefs about food irradiation determine attitude toward food irradiation because Fishbein and Ajzen (1975) wrote that "beliefs represent the information" that person has about the object (p.12). For example, if a person knows that food irradiation promotes bacterial decontamination and that this technique is not hazardous to human health, most likely he or she will have a positive attitude toward this issue. However, it is possible to suppose that if person does not know anything about this technique, he or she will worry about safety of irradiated food and probably will have a negative attitude toward it.

According to Fishbein and Ajzen (1975), a person's beliefs of what significant others think about his or her behavior is defined as "normative beliefs" (p. 16). Normative beliefs

and motivations to comply with these beliefs determine subjective norms. It is possible to suppose, therefore, that beliefs of surrounding and trustful people or organizations can influence a person's perception of what important others think about the consumption of irradiated food. This perception, which is defined as subjective norm, will be more salient if person has motivation to comply with opinions of referent others.

According to Fishbein and Ajzen's theory of reasoned action, if person has a positive attitude toward eating irradiated food and perceptions that important others thinks that it is good and safe to eat irradiated food, he or she will have an intention to eat irradiated food.

In addition to examining the validity of the model variables for explaining consumer acceptance of irradiated food, it will be useful to investigate the effect of demographic variables, such as, age, sex, education, and income, on intent to eat irradiated food. That is, it is important to understand how the effects of demographic variable moderate the effect of model variables on intent. Previous studies demonstrate that greater knowledge about an innovation improves attitudes toward it. Eustice and Bruhn (2006), for example, claimed that "most studies find higher education associated with more favorable attitudes toward irradiation" (p. 75). These authors noted that usually women are more worried about irradiated food than men and the effects of age and income toward this issue are unclear. The investigation of the effect of demographic variable on consumers' opinions toward irradiated food in the current study will help to reveal additional data concerning this issue.

Data

The data received from the "first large-scale, commercially funded market test of irradiated food (i.e., beef patties) in supermarkets located throughout Minneapolis, Minnesota" (Sapp and Korsching, 2004, p. 356) has been used for statistical analysis. The test was conducted by Huisken's Meats, Inc. on spring of 2000. According to Sapp and Korsching (2004), survey respondents "were selected at random from all households with listed telephones located within the Minneapolis interstate highway loop" (p. 356). The authors noted that during the survey period the market test for irradiated food received local media coverage.

> A public radio station aired a segment that included interview with one proponent and one opponent, and the *Minneapolis-St. Paul Star Tribune* carried two articles that announced the market testing and one letter to the Editor that expressed a favorable opinion of food irradiation (p. 354).

At first, 981 people were contacted by telephone and asked to participate in a study concerning food safety. The issue about food irradiation was not mentioned at that time. Four hundred and fifty three persons agreed to participate in this study. Subsequently these people received a "background questionnaire and an incentive fee of $ 15.00 to participate further" (Sapp and Korsching, 2004, p. 356). Questions about demographic information, about media exposure, and opinions about food safety were included in this questionnaire. People who returned a completed questionnaire were randomly divided into 2 groups and subsequently received "Questionnaire 1 (Q1), at which they were informed that the remainder of the study would focus on food irradiation" (p. 357). Participants from one of

the groups simultaneously with Q1 received an information packet which contained two 15-minites videotapes. The first videotape from Iowa State University (1996) presented data which support food irradiation. The second videotape from Enviro Close-Up (1993) presented data which opposite food irradiation. Participants who received this information were asked to review it and complete Q1. People who did not receive the information packet were informed that other participants received it. People who did not receive the information packet also were asked to complete the Q1 and subsequently learn about food irradiation by themselves. Three months after all of the participants returned Q1 they received Questionnaire 2 (Q2). According to Sapp and Korsching, "Of the 308 persons who agreed to participate and completed Q1 (i.e., 68 percent of persons who agreed to participate over the telephone then completed Q1), 225 returned a completed questionnaire" (p. 357). It was assumed that the attrition from Time 1 to Time 2 occurred at random.

This research used data from Questionnaire 2. The data includes responses of 225 participants concerning their beliefs, attitudes, opinions of referent others, motivation to comply, subjective norms, and behavioral intentions towards food irradiation. According to Sapp and Korsching, all of the participants were before handed that they do not need to buy or eat irradiated food to participate in the study.

Most variables were measured using Likert-type questions with seven point response scales. The response scales on the questionnaire were coded as 1 (no concern, strongly disagree, etc.) to 7 (strong concern, strongly agree, etc.).

The four control variables – age, sex, education, and income were used in the current research. According to Sapp and Korsching, "age was measured in years. Formal education was measured in five categories (less than high school, high school graduate, vocational

school/technical school/some college, 4-year college degree, and post-graduate education)" (p. 358). Total household income was measured before taxes in dollars. Sex was coded as male 1, female 0.

Descriptive Statistics

According to the theory of reasoned action (TRA), attitude and subjective norm determine behavioral intention. The dependent variable is related to the behavioral intention compound of TRA. VAR247 – (I intend to eat irradiated food within the next four weeks) from section G in Appendix A is a dependent variable.

According to TRA beliefs about the behavior and evaluations of the behavior determine attitude about the behavior. Opinions of referent others and motivation to comply determine subjective norm. Consequently, attitude and subjective norm are dependent variables as well. However, they are related to behavioral intention as independent variables. A mean variable of attitude was constructed: ATT = mean of ATT21, ATT22, ATT23, and ATT24. Attitude variables are from section E (Attitude about the behavior) of Appendix A, where ATT - attitude, ATT21 - eating irradiated food would be Good/Bad for me; ATT22 - eating irradiated food would be Foolish/Wise for me; ATT23 - eating irradiated food would be Desirable/Undesirable for me; ATT24 - eating irradiated food would be Harmful/Beneficial for me.

The following variables: eating irradiated food would be Good/Bad for me (ATT21), and eating irradiated food would be Desirable/Undesirable for me (ATT23) were reversed with the purpose of correspondence with other variables.

The mean variable of subjective norm was constructed as follows: SN = mean of VAR213 and VAR227. Subjective norms variables are from section F (Subjective norms) of Appendix A, where SN – subjective norm; VAR213 – Most people will be in favor of eating irradiated food; VAR227 – Eating irradiated food will likely be accepted by the American public.

Behavioral intention variable is from Section G (Intention) of Appendix A. It is a variable - VAR247 – I intend to eat irradiated food within the next four weeks.
All of the dependent variables were measured using Likert-type questions with seven point response scales.

Table 1. Simple Statistics for Endogenous Variables.

Variable	N	Mean	Std Dev	Minimum	Maximum
Behavioral intention	225	2.810	1.742	1.000	7.000
Attitude	225	2.162	1.562	-1.110	7.000
Subjective Norm	225	-.329	1.126	-3.210	2.740

There are two groups of independent variables in this research: beliefs about irradiated food and opinions of referent others about irradiated food. Attitude toward irradiated food and subjective norm also are considered as independent variables in relation to behavioral intention.

Beliefs and opinions are constructed variables with the purpose of correspondence with the Fishbein and Ajzen model. According to Fishbein and Ajzen theory of reasoned

action, beliefs about the behavior and evaluation of the behavior determine attitude about the behavior.

> A person's attitude toward a behavior can be predicted by multiplying her evaluation of each of the behavior's consequences by the strength of her belief that performing the behavior will lead to that consequence and than summing the products of total set of beliefs.

(Ajzen & Fishbein, 1980, p. 67). The Beliefs variables were constructed by multiplying "beliefs about the behavior" by the "evaluation of the behavior", according to previous definition. Variable B1 = VAR214*IMP14 (Eating irradiated food will be safer than eating non-irradiated food * Eating safe food is important to me); variable B2 = VAR216*IMP13 [Eating irradiated food will increase my likelihood of contracting cancer (this variable was previously reversed) * Not contracting cancer is important to me]; variable B3 = Var224*IMP14 (Eating irradiated food is a safe thing to do * Eating safe food is important to me). The following variables: VAR214 – Eating irradiated food will be safer than eating non-irradiated food, VAR216 – Eating irradiated food will increase my likelihood of contracting cancer, VAR224 – Eating irradiated food is safe thing to do, IMP14 – Eating safe food is important to me, and IMP13 - Not contracting cancer is important to me - were measured using Likert-type questions with seven point response scales. The following variable from section A (Attitude) Appendix A - VAR216 (Eating irradiated food will increase my likelihood of contracting cancer), was reversed for the purpose of correspondence with other variables.

According to the TRA, opinions of referent others and motivation to comply with these opinions determine the subjective norm. A person's subjective norm can be predicted "if we multiply her normative beliefs by the corresponding motivations to comply and then

sum the products" (Ajzen & Fishbein, 1980, p. 75). Opinion variables were constructed by multiplying the "opinions of referent others" by "motivation to comply with these opinions." Variable O1 = VAR201*VAR207 (VAR201 - Scientists think I should eat irradiated food * VAR207 - I do what scientists think I should do); variable O2 = VAR202*VAR208 (VAR202 - Public health officials think I should eat irradiated food * VAR208 - I do what public health officials think I should do); variable O3 = VAR205*VAR211 (VAR205 - My family thinks I should eat irradiated food * VAR211 - I do what my family thinks I should do); variable O4 = VAR206*VAR212 (VAR206 - My friends think I should eat irradiated food * VAR212 - I do what my friends think I should do). The following variables: VAR201 - Scientists think I should eat irradiated food, VAR202 - Public health officials think I should eat irradiated food, VAR205 - My family thinks I should eat irradiated food, VAR206 - My friends think I should eat irradiated food, VAR207 - I do what scientists think I should do, VAR208 - I do what public health officials think I should do, VAR211 - I do what my family thinks I should do, VAR212 - I do what my friends think I should do - were measured using Likert-type questions with seven point responds scales. Mean variable of beliefs and opinions were constructed: BELIEFS = mean of B1, B2, and B3; OPINION = mean of O1, O2, O3, and O4.

Four demographic variables – age, sex, education, and income had been used in the current assessment.

Table 2. Simple Statistics for Exogenous Variables.

Variable	N	Mean	Std Dev	Minimum	Maximum
Beliefs	225	19.244	9.013	-2.900	42.000
Opinion	225	3.798	5.698	-12.000	25.000
Age	225	52.000	16.574	21.000	88.000
Education	225	3.507	1.122	1.000	5.000
Income	225	2.955	1.305	1.000	6.000

Sex	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	139	61.78	139	61.78
1	86	38.22	225	100.00

Operationalization and Factor analysis

The correlations between the variables were assessed by data analysis that is helpful for understanding which of the variables is more influential towards the behavioral intentions (see Appendix B).

Principal components method of factor analysis was used as a statistical technique to determine the dimensionality of scales intended to measure the latent variables specified by the theory of reasoned action. According to Kline (1994), factor analysis is used for simplifying complex sets of data. “A factor is a dimension or construct which is a condensed statement of the relationships between a set of variables” (Kline, 1994, p. 5). It is possible to see how well each of the variables correlated with a factor by finding their factor loadings. For example, by finding factor loadings of each of the beliefs variables it is possible to see

weighted assessment of the variables and understand how well beliefs variables correlated with beliefs factor. The computation of Cronbach's alpha coefficient has been used for reliability assessment.

A factor loading for B1 (VAR214 - Eating irradiated food will be safer than eating non-irradiated food * IMP14 - Eating safe food is important to me) is 0.894, for B2 [VAR216 - Eating irradiated food will increase my likelihood of contracting cancer (this variable was previously reversed) * IMP13 - Not contracting cancer is important to me]is 0.777, and for B3 (VAR224 - Eating irradiated food is a safe thing to do * IMP14 Eating safe food is important to me) is 0.886. These values show high correlations of each variable with beliefs factor. Eigenvalue 2.188 that is > 1 that is significant and cumulative percent of variables that is 72.94% explain important amount of the variability in the data. Rotation is not possible because there is only one factor. Cronbach coefficient alpha for three beliefs variables together is 0.813. This value shows that reliability of measurements of the average correlation among beliefs variables is high.

Table 3. Factor Loadings and Reliability Results for Beliefs Variables.

Description	Factor 1
B1 = Var214*IMP14 (Eating irradiated food will be safer than eating non-irradiated food * Eating safe food is important to me)	0.894
B2 = Var216*IMP13 [Eating irradiated food will increase my likelihood of contracting cancer (this variable was previously reversed) * Not contracting cancer is important to me]	0.777
B3 = Var224*IMP14 (Eating irradiated food is a safe thing to do * Eating safe food is important to me).	0.886
Eigenvalue	2.188
Cumulative %	72.94
Cronbach's Alpha	0.813

According to these data, variable B1 has the highest factor loading. Consequently, it is possible to understand that participants of the survey showed the product of multiplication of Var214 (Eating irradiated food will be safer than eating non-irradiated food) by IMP14 (Eating safe food is important to me) as most the important. Factor loading of the variable B1 is a little higher than factor loading of the variable B3. The difference is in the statements "Eating irradiated food will be safer than eating non-irradiated food" and "Eating irradiated food is a safe thing to do". This difference can be explained by the fact that beliefs that eating irradiated food is safer than eating non-irradiated food is more important for participants of this research than the beliefs that eating irradiated food is safe. Variable B2 has lowest factor loading. Consequently, it is possible to understand that participants' beliefs in safety of irradiated food are stronger than their worry about contracting cancer by eating irradiated food.

Table 4 presents the factor loadings for opinion variables. The factor loadings for O1-O3 were 0.873, 0.894, and 0.881, respectively. These values show high correlations of each variable with the opinions factor. The eigenvalue equals 3.127 and the cumulative percent explained equaled 78.18%. The Cronbach coefficient alpha equaled 0.901.

Table 4. Factor Loadings and Reliability Results for Opinion Variables.

Description	Factor 1
O1 = Var201*Var207 (Scientists think I should eat irradiated food * I do what scientists think I should do)	0.873
O2 = Var202*Var208 (Public health officials think I should eat irradiated food * I do what public health officials think I should do)	0.888
O3 = Var205*Var211 (My family thinks I should eat irradiated food * I do what my family thinks I should do)	0.894
O4 = Var206*Var212 (My friends think I should eat irradiated food * I do what my friends think I should do)	0.881
Eigenvalue	3.127
Cumulative %	78.18
Cronbach's Alpha	0.901

These data show that variable O3 has highest factor loading, than in descending order of the factor loadings are variables O2, O4, and O1. Consequently, it is possible to see that the opinions of family members are most important for the participants of the current survey. The opinions of public health officials, friends, and scientists, come in descending order of importance. The Pearson correlation coefficient has been used for determination of the correlation between the variables. Model testing and finding Standardized Beta coefficients help to estimate causal link between the components of Fishbein and Ajzen model.

Chapter 4: Results

In this chapter I will present the results from data analysis, which helped to reveal causal links between beliefs, attitudes, opinions of referent others, subjective norms and behavioral intentions concerning consumption of irradiated food. This chapter consists from the two parts: the correlation matrix, and explanation about the model testing.

Correlation Matrix

Appendix B shows the correlations among the model variables. Pearson correlation coefficient among the beliefs and attitude is 0.721 that is large and it is corresponds to Fishbein and Ajzen model. The correlation between the opinion and subjective norm is 0.422. The correlation between behavioral intentions and attitude is 0.578; that is larger than between behavioral intentions and other variables (correlation between behavioral intention and beliefs is 0.499; between behavioral intention and opinion is 0.386; between behavioral intention and subjective norm is 0.353). (Appendix B). The correlation between behavioral intention and subjective norm is smaller than correlation between behavioral intention and other variables. These results are different from what would be expected from the Fishbein and Ajzen model because subjective norms were expected to directly influence behavioral intention. The correlation between the subjective norm and attitude is 0.492 that is larger than correlation between the subjective norm and behavioral intentions. It is important to emphasize that correlation between the opinion and attitude is 0.457 that is larger than correlation between the opinion and subjective norm, which is 0.422. The next step of the

assessment of Fishbein and Ajezen model concerning irradiated food would be the determination of the level of significance of the links among the variables.

Model Testing

For the estimation of causal links between the variables it is necessary to find standardized beta coefficients. Standardized regression of attitude on beliefs is 0.716 that is significant at 0.01 level (Table 5). This result supports the hypothesis that beliefs about food irradiation determine attitude toward food irradiation. People that had positive beliefs about food irradiation also had positive attitude toward this issue.

Standardized regression of subjective norm on opinion is 0.267 that is significant at 0.01 level. This result supports the hypothesis that opinions of referent others and motivations to comply with those opinions determine subjective norm concerning food irradiation. People that think that significant others have positive beliefs concerning eating irradiated food and that are ready to comply with those beliefs, also think that general public will accept this behavior. People that think that significant others have negative beliefs concerning eating irradiated food, also think that general public will not be in favor of eating irradiated food.

Standardized regression of behavioral intentions on attitude is 0.506 that is significant at 0.01 level. This result supports the hypothesis that attitude toward consumption of irradiated food determines behavioral intentions related to this issue. People that had a positive attitude toward eating irradiated food intended to eat these products and vice versa.

Standardized regression of behavioral intentions on subjective norms is 0.097 that is not significant. This result does not support the hypothesis that subjective norm concerning food irradiation determine behavioral intentions related to this issue.

It was found that standardized regression of attitude on subjective norm is 0.414 that is significant at 0.01 level. This result demonstrates that attitude toward consumption of irradiated food determines subjective norm related to this issue. People that have positive attitude toward eating irradiated food perceive that general public will accept these products and vice versa.

Standardized Beta estimates of beliefs and opinions on the control variables are following: standardized regression of beliefs on age is 0.282 that is significant at 0.01 level (Table 5). Standardized regression of beliefs on sex is 0.142 that is significant at 0.05 level. Standardized regression of beliefs on education is 0.161 that is significant at 0.05 level. Standardized regression of beliefs on income is (–) 0.018 that is not significant. Standardized regression of opinion on age is 0.101 that is not significant. Standardized regression of opinion on sex is (–) 0.027 that is not significant. Standardized regression of opinion on education is 0.192 that is significant at 0.01 level. Standardized regression of opinion on income is (–) 0.042 that is not significant.

Standardized Beta estimates of attitude, subjective norm, and behavioral intention on the control variables are not significant (Table 5).

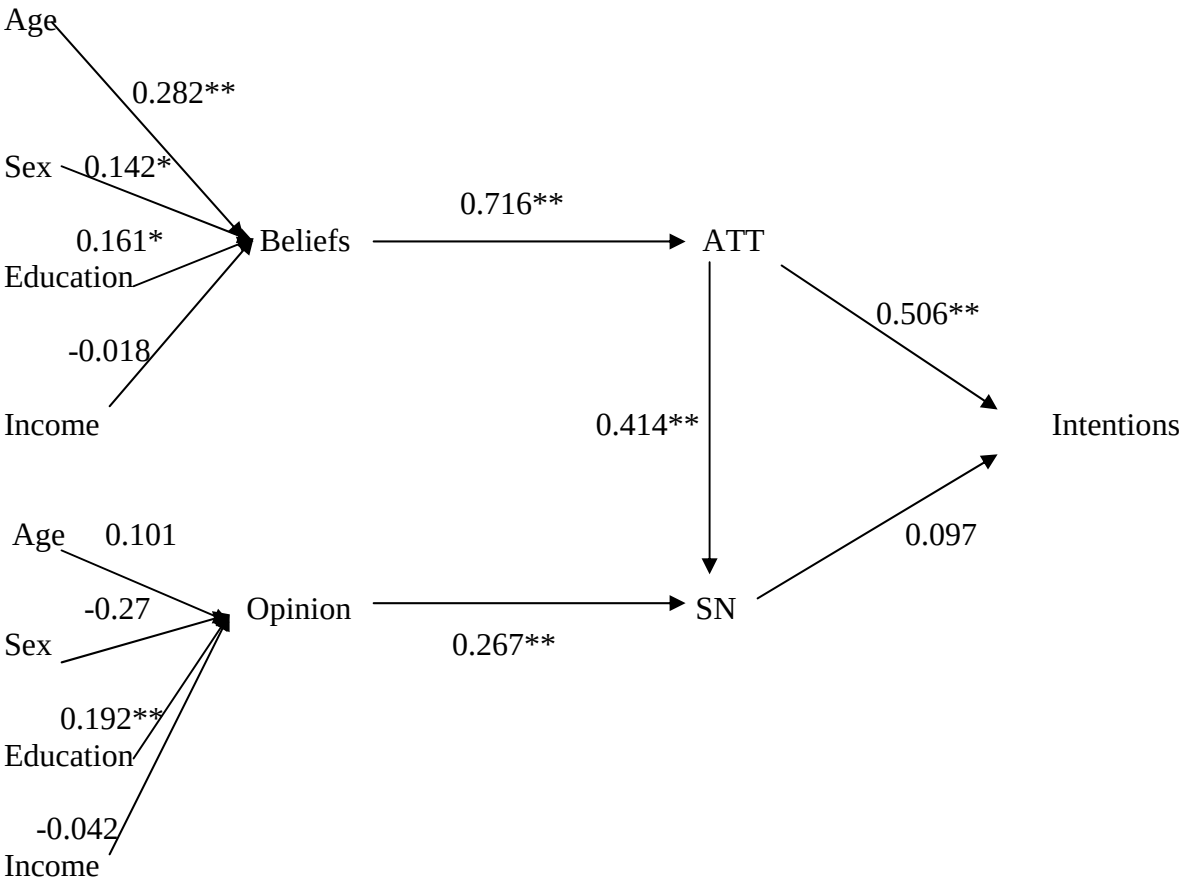
This analysis shows that control variables influence beliefs and opinions, which are the independent variables of Fishbein and Ajzen model. However, effect of control variables on dependent variables of Fishbein and Ajzen model is not significant. These results can be explained by the fact that effect of the compounds of the Fishbein and Ajzen model on

dependent variables is much stronger than effect of the control variables. As it is possible to see, from the Table 5 that effect of beliefs on attitude is much stronger than effect of age, sex, education, and income on attitude. Effect of opinion and attitude on subjective norm is much stronger than effect of age, sex, education, and income on subjective norm. Effect of attitude on behavioral intention is much stronger than effect of age, sex, education, and income on behavioral intention.

Table 5. Standardized Beta Estimates for the Model Variables.

	Beliefs	Opinion	Attitude	Subjective Norm	Behavioral Intention
Age	.282**	.101	-.018	-.054	.065
Sex	.142*	-.027	.045	-.042	.058
Education	.161*	.192**	.010	-.081	.051
Income	-.018	-.042	.000	.080	.000
Beliefs			.716**		
Opinion				.267**	.506**
Attitude				.414**	.097
Subjective Norm					
R^2	.114	.035	.522	.236	.342

*p < .05; ** p < .01
Chi-Square = 66.578 (P = 0.00)
Critical N (CN) = 73.897
Goodness of Fit Index (GFI) = .944
Adjusted Goodness of Fit Index (AGFI) = .721
Parsimony Goodness of Fit Index (PGFI) = .189



*p < .05; ** p < .01

Figure 2. Causal links Among the Control and Model Variables.

Chapter 5: Discussion

Data received from the "first large-scale, commercially funded market test of irradiated food (i.e., beef patties) in supermarkets located throughout Minneapolis, Minnesota" (Sapp and Korsching, 2004, p. 356) was used for statistical analyses in this research. The test was conducted by Huisken's Meats, Inc. in spring of 2000. The data includes questionnaire responses of 225 participants concerning irradiated food.

Most variables were measured using Likert-type questions with seven point response scales. The response scales on the questionnaire were coded as 1 (no concern, strongly disagree, etc.) to 7 (strong concern, strongly agree, etc.). Factor loadings showed high correlations of each of the beliefs variable with beliefs factor. Factor analysis demonstrated that participants' beliefs in safety of irradiated food were stronger than their worry about contracting cancer by eating irradiated food. Cronbach coefficient alpha for beliefs variables was 0.813. This value shows that reliability of measurements of the average correlation among beliefs variables was high.

The factor loadings showed high correlations of each of the opinion variables with opinion's factor. Factor analysis demonstrated that opinions of family members are most important for the participants of the current survey. The opinions of public health officials, friends, and scientists, come in descending order of importance.

The Cronbach coefficient alpha for opinions variables was 0.901. This value shows that reliability of measurements of the average correlation among opinion variables is high.

Age, sex, education, and income were used as control variables in the current research. Assessment of the control variables' effect on the components of Fishbein and

Ajzen model demonstrated that control variables influenced beliefs and opinions, which are the independent variables. The analysis showed that effects of age, sex, and education on beliefs was significant. These results indicated that older people, men, and higher educated people have more positive beliefs concerning food irradiation than younger, less educated people, and women. These results can be explained by suggestion that persons with higher education were more knowledgeable about food irradiation. Literature data indicated that more knowledgeable people have more positive beliefs concerning food irradiation. Gunes and Tekin (2006) claimed that information about irradiated food increased its acceptance substantially. Eustice and Bruhn (2006) noted that "most studies find higher education associated with more favorable attitudes toward irradiation" (p. 75). Effect of income on beliefs was not significant. According to National Center for Education Statistics (2006), in the State of Minnesota 32.6% of women and 32.4% of men 25 years and older have bachelor's or higher education. This data showed that in Minnesota area, where the survey for the current research was conducted, level of education for women is slightly higher than level of education for men. Consequently, educational factor does not explain why women have less positive beliefs than men concerning food irradiation. Subsequent research needs to be done for the finding of an answer on this question. The effect of education on opinions was significant. However, effect of age, sex, and income on opinions was not significant.

The effects of control variables on dependent variables of Fishbein and Ajzen model were not significant. These results can be explained by the fact that effect of the compounds of the Fishbein and Ajzen model on dependent variables is much stronger than effect of the control variables.

Eustice and Bruhn (2006) wrote that most studies that examined effects of demographic characteristics on decisions to purchase irradiated food found that:

> Females are more concerned about irradiated food than males and, in most but not all cases, that individuals with more formal education are more accepting of the technology. Regarding the effects of age and income, results are mixed and generally not statistically significant (Lusk and others 1999 in Eustice and Bruhn 2006, p. 75).

The finding of the Pearson correlation coefficients showed that beliefs about the consumption of irradiated food strongly correlated with public's attitude toward the consumption of irradiated food (Pearson correlation between the beliefs and attitude is 0.722). The beliefs variable was constructed in the current research for convenience of data analysis. This variable includes beliefs about the behavior and evaluation of the behavior. (Appendix A). The standardized regression of attitude on beliefs was 0.716, which is significant at 0.01 level. In sum, the results show that beliefs about the behavior and evaluation of the behavior strongly influence public's attitude toward the consumption of irradiated food. These results correspond to the theory of reasoned action.

The Pearson correlation demonstrated a strong relationship (0.423) between the opinions and subjective norms concerning food irradiation. The opinion variable was constructed from the variables which include opinions of referent others concerning food irradiation and motivation to comply with these opinions (Appendix A). The standardized regression of subjective norm on opinion was 0.267, which is significant at 0.01 level. These data showed that opinions of referent others and motivation to comply with these opinions determined subjective norms concerning irradiated food. This finding corresponds with the theory of reasoned action.

The Pearson correlation coefficient between the public's attitudes toward the consumption of irradiated food with behavioral intentions to consume irradiated food was stronger than correlation between any other variables from Fishbein and Ajzen model and behavioral intentions. The correlation between behavioral intentions and attitude was 0.578, which is stronger than between behavioral intention and beliefs, behavioral intention and opinion, and behavioral intention and subjective norm. According to the theory of reasoned action, attitude and subjective norm directly influence behavioral intention. Consequently, these two variables should correlate with behavioral intentions more strongly than other variables. However, the results show that attitude toward food irradiation correlate with behavioral intentions to consume irradiated food stronger than subjective norm concerning food irradiation correlate with behavioral intention to consume irradiated food. Ajzen and Fishbein (1980) assumed possibility of such inclination. They wrote: "For some intentions attitudinal considerations may be more important than normative considerations, while for other intentions normative considerations may predominant" (p. 6).

The Pearson correlation coefficient between the behavioral intentions and subjective norm was smaller than correlation between the behavioral intentions and any other independent variables from Fishbein and Ajzen model. The standardized regression of behavioral intentions on attitude was significant at 0.01 level, but standardized regression of subjective norms on behavioral intentions was not significant. This occurrence can be explained because people tend to trust their own understanding of an issue more so than they trust the opinions of others.

The Pearson correlation between attitude and subjective norm was 0.492, which was larger than correlation between the subjective norm and behavioral intention. The

standardized regression of subjective norm on attitude was significant at 0.01 level. These results show that attitude influences subjective norm concerning irradiated food. Previously Tarkiainen and Sundqvist (2005) found that subjective norms influenced attitude toward buying organic food. According to Tarkiainen and Sundqvist, "Fishbein and Ajzen (1975) have admitted that attitudinal and subjective influences might be dependent on each other" (2005, p. 816). This interrelation between attitude and subjective norm can be logically explained in the case of irradiated food. If a person has positive attitude toward irradiated food, he or she thinks that most likely the public will accept this product, if a person has negative attitude toward irradiated food, he or she thinks that the public will not accept this product. At the same time, if a person knows that the general public accepts or does not accept irradiated food he or she would develop positive or negative attitude toward this product.

Chapter 6: Conclusions

The data analysis showed that people's understanding of the problem of food irradiation influences their attitudes toward this issue. Opinions of referent others and motivation to comply with these opinions determined subjective norms concerning irradiated food. Attitudes influenced behavioral intentions to eat irradiated food. These results confirmed the theory of reasoned action to some extent. However, the effect of subjective norms on behavioral intention to eat irradiated food was not significant, which does not support the theory of reasoned action. The data analysis showed that attitude influences subjective norm concerning irradiated food, which also does not support the theory of reasoned action.

The effects of control variables on dependent variables of Fishbein and Ajzen model (attitude, subjective norm and behavioral intention) were not significant. However, older people, men, and higher educated people have more positive beliefs concerning food irradiation than younger, less educated people, and women. The data showed that the effect of income on beliefs was not significant. The effect of education on opinions was significant. However, the effect of age, sex, and income on opinions was not significant. These results can be explained by noting that the effects of the model variables on intent were much stronger than the effects of the control variables. The results show that the effect of beliefs on attitude was much stronger than effect of age, sex, education, and income on attitude. Similarly, the effect of opinions on subjective norms was much stronger than effect of the control variables on subjective norms. Also, the effect of attitude on behavioral intention was much stronger than the effect of control variables on behavioral intention.

In sum, the current research reveals the differences from the theory of reasoned action, which include the fact that subjective norms had little influence on behavioral intentions to eat irradiated food. Another difference from the theory of reasoned action it is that the attitude toward consumption of irradiated food determines subjective norms related to this issue. The results show that people take into consideration only their own attitude when making the decision to eat irradiated food. Additional investigations need to provide further understanding of why subjective norms have little influence on behavioral intention to eat irradiated food. Ajzen's (1985) theory of planned behavior might prove useful for this purpose.

The results demonstrate that if a person believes that eating irradiated food is safe, he or she has a positive attitude toward this issue. Attitude strongly influences behavioral intentions to eat irradiated food. According to Fishbein and Ajzen, beliefs about food irradiation represent the information that a person has about this issue. Consequently, it is very important to provide consumers with scientific information about food irradiation. It might help to increase acceptance of irradiated food by the general public. The results showed that consumers considered opinions of public health officials concerning food irradiation as very important. Thus, it might help to increase consumers' understanding of this issue if public health officials will express their points of view toward food irradiation and provide an explanation of it.

This study analyzes the opinions of 225 consumers who live in the Minneapolis area. As such, all of the participants are urban citizens from the same geographical location which provides a relatively demographically homogeneous population. Consequently, in the future it would be useful to conduct research that will include demographically more diverse

population from different geographical locations. It will be useful to include survey questions that will help reveal why women have less positive beliefs about eating irradiated food then men. Another possibility to improve our understanding of consumers' points of view toward food irradiation it is to use a qualitative research method of interview. The interview method, for example might provide active feedback from participants during direct conversation. It might be useful to conduct interviews with representatives of demographically different parts of the population including residents of rural areas. During interviews, people will be able to freely express their thoughts and emphasize the problems which they consider most important concerning food irradiation. The data received from interviews might significantly enrich the general picture of public opinion concerning food irradiation.

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Appendix A: Desciption of Model Variables

A (Beliefs about the behavior)

VAR 214	Eating irradiated food will be safer than eating non-irradiated food
VAR 216	Eating irradiated food will increase my likelihood of contracting cancer
VAR 224	Eating irradiated food is safe thing to do
VAR 232	Eating irradiated food will increase my likelihood of experiencing health problems later in life
VAR 234	Eating irradiated food will be safer for small children than eating non-irradiated food

B (Evaluation of the behavior)

IMP 13	Not contracting cancer is important to me
IMP 14	Eating safe food is important to me
IMP 18	Low-cost food is important to me
VAR 217	I trust public health officials who support food irradiation
VAR 221	I trust scientists who support food irradiation

C (Opinions of referent others)

VAR 201	Scientists think I should eat irradiated food
VAR 202	Public health officials think I should eat irradiated food
VAR 205	My family thinks I should eat irradiated food
VAR 206	My friends think I should eat irradiated food

D (Motivation to comply)

VAR 207	I do what scientists think I should do
VAR 208	I do what public health officials think I should do
VAR 211	I do what my family thinks I should do
VAR 212	I do what my friends think I should do

E (Attitude about the behavior)

For me, eating irradiated food would be:

ATT 21	Good/Bad
ATT 22	Foolish/Wise
ATT 23	Desirable/Undesirable
ATT 24	Harmful/Beneficial

F (Subjective norms)

VAR 213 Most persons will be in favor of eating irradiated food
VAR 227 Eating irradiated food likely will be accepted by American public

G (Intention)

Within past 12 months, do you intend to:
VAR 247 I intend to eat irradiated food within the next four weeks

New variables:

Beliefs

B1 = Var214*IMP14
B2 = Var216*IMP13
B3 = Var224*IMP14

Opinions

O1 = Var201*Var207
O2 = Var202*Var208
O3 = Var205*Var211
O4 = Var206*Var212

ATT = mean of ATT21, ATT22, ATT23, and ATT24
SN = mean of Var213 and Var227
BELIEFS = mean of B1, B2, and B3
OPINION = mean of O1, O2, O3, and O4

Appendix B: Correlation Matrix

	Beliefs	Opinion	Attitude	Subjective Norm	Behavioral Intention
Beliefs	1				
Opinion	. 420*	1			
Attitude	.721*	.457*	1		
Subjective Norm	.426*	.422*	492*	1	
Behavioral Intention	.499*	.386*	.578*	353*	1

* $p < .01$

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