INTENTIONS TO PURCHASE GENETICALLY MODIFIED FOODS IN THE UNITED STATES AND GERMANY: THE IMPACT OF CONSUMER KNOWLEDGE AND ATTITUDES

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ii. Foreword

As a child growing up in the Mississippi Delta, I experienced firsthand the joys of a little girl running through the lush vegetation, planting and harvesting her own tomatoes, and feeding livestock. Living in the Delta afforded me the unique opportunity to learn how to add appropriate portions of fertilizer into the soil, appreciate the nutritional values of organic products, and understand each stage of growing and harvesting food and cash crops (e.g. corn and cotton).

At a young age, I was fascinated with the recurrent planting-harvesting cycle: i.e. seed planting, to applying fertilizer in the ground, to seeds breaking through the ground and stretching several feet high, to crop harvesting, and to beginning another cycle. Gleefully, I watched the landscape change from one season to another. Sometimes, when I looked at the fields, the scenery oddly appeared different. Some days the fields appeared a rich green, a dusty brown, or a pitch black. I was always pleasantly surprised peering through the car window, traveling minutes unending over the estates of agricultural lands. Growing up in the Mississippi Delta meant I was constantly surrounded by agriculture. More crucial was the reality that many of my childhood friends' parents were farmers, with a few owning cotton gins.

During my puerility, my friends and I often debated which crops the farmers would plant the next season. And these debates occurred months prior to harvest. We watched excitedly as the agriculture industry developed in ways we could not imagine as youngsters peering through the windowpane of out parents' vehicles. However, in the last decade I have watched how major crop producers within the agricultural industry have steadily shifted from traditional practice of planting and harvesting crops with the aid of fertilizers, pesticides, and herbicides, to producing genetically modified foods (GMFs). Today, as a young adult, I curiously investigate the controversies that surround this expanding agricultural practice and food production process.

Chapter I

INTRODUCTION

1.1 Theoretical Framework and Research Questions

A global controversy surrounding genetically modified foods (i.e., GMFs) began in the 1990s with the emergence of agricultural biotechnology, that engendered opposing views of and regulatory frameworks for GMFs research, cultivation, and production and the resulting transatlantic divide (Macnaghten, Carro-Ripalda, & Burity, 2015; Scholderer, 2005). This debate about biotechnology motivated the World Health Organization (an arm of the United Nations concerned with international public health) to formally define GMFs. According to the World Health Organization (WHO) (n.d.), genetically modified foods refer to the foods derived with genetically modified material (DNA) that has been modified in a way that does not occur naturally (e.g. through inserting a gene from a different organism into the food). In line with current literature on this subject, and for the purpose of this thesis, the term genetically modified foods (GMFs) is used interchangeably with genetically modified organisms (i.e. GMOs) and genetically modified food crops (i.e. GM crops) (Lynch & Vogel, 2001).

The end of the Second World War marked significant research improvements in crop yields, mainly through the development of plant-friendly herbicides, pesticides, fertilizers, and new farming techniques (Macnaghten et al., 2015). Subsequently, scientists began experimenting with alternative ways to enhance the quality, variety, and pest-resistance of farm products. These experiments led to the expansion of the biotechnology agricultural sector, which acted as a seedbed for GMFs research and cultivation and initiated the inclusion of GMFs in the daily diet of most American consumers (Macnaghten et al., 2015). Even though the research and development, production, and consumption of GMFs spans well over two decades, many

consumers lack adequate knowledge on which to base their attitudes about GMFs. McHughen, an academic molecular geneticist, explains that "[agricultural] biotechnology … remains controversial among the skeptical public" (2013, p. 172). Most of the potential benefits and risks of GMFs are still unknown to the public, and the resulting consumer ambiguity further fuels the consumers' skepticism and the global controversy.

The agricultural production boom experienced in the biotechnology industry eventually led to a significant increase in the supply of genetically modified foods in retail stores and supermarkets in the United States today. In particular, the variety of GMFs approved in the United States alone (by the Food Drug & Administration, i.e. FDA) has risen to approximately 144 crops (Benson, 2015). Furthermore, "of 1.5 billion hectares of arable land worldwide, approximately 175 million hectares or around 12 percent are cultivated with GM crops" (Macnaghten et al., 2015, pg. 8). Most of these crops are genetically modified, grown, and distributed in a handful of countries, particularly the United States, Canada, Argentina, India, and Brazil (Macnaghten et al., 2015).

The boom in the production and sales of GMFs has uncovered differences in the nature and the role of the government regulatory systems and institutions within these countries. For example, in the United States, no governmental institution has the sole responsibility of regulating GMFs. The Food & Drug Administration (FDA), which is empowered to assess all food products, is tasked with the responsibility to evaluate and approve of each GM product. Yet when inspecting each food product, the FDA does not distinguish foods modified genetically, from those modified organically (e.g. modified as a result of cross-planting), and from those grown conventionally. In contrast to the institutions in the United States, the institutions in most European countries not only regulate GMFs but also advise the government, providing vital

information and the nutritional value of the genetically modified products (Macnaghten et al., 2015).

Prior to releasing food crops into the market, the European regulators assess whether these crops are found to be healthy enough for consumption and safe for the environment. The findings resulting from the assessments are made available to both the government and the citizens. The contrasting nature of the processes and procedures adopted and practiced in the European regulatory system and the United States regulatory system stems from the differences in the methods used to assess risks, the effects of previous records of food technology incidents, and the efficiency of policy impact on consumer behavior (Macnaghten et al., 2015). The approach to safety assessment of GMFs in the United States focuses more on product's quality rather than on the output of the production process. The FDA does not measure additional risks associated with GMFs with this approach because the FDA considers GM and non-GM food products as substantially equivalent in nutritional value. With the adoption of the Coordinated Framework for the Regulation of Technology, the "FDA announced that it planned to apply the identical approach to GM foods that it had traditionally applied to foods developed by traditional plant breeding" (Marchant & Cardineau, 2013, p. 126). In other words, the consumption of GMFs is not perceived as risky in the U.S. as it is in Europe (Murphy & Levidow, 2006).

The FDA's announcement through the Coordinated Framework for the Regulation of Technology equally applies to the labeling and pre-market approval processes. Since the announcement, various anti-GMO groups (e.g. Just Label It and Alliance for Bio-Integrity) have instigated a campaign against the FDA's ruling on GMO labels (Marchant et al., 2013). Initiated in the late 1990s, this campaign, which has requested the inclusion of consumer demand in policy-making decisions regarding GMFs, inspired public hearings to discuss genetic

modification and encouraged "[at] least 25 states [to consider] proposed legislation to require mandatory GM labeling" (Marchant et al., 2013, p. 128). The primary goal of these anti-GMO groups is to ensure the "proper" labeling of GMFs, which reflects their belief that GMFs and conventional foods not genetically altered are materially different. The purpose of this group effort is to ensure that consumers would be provided "an option which makes the possible risk of eating GM food a voluntary choice" (Sleenhoff & Osseweijer, 2013, p. 166).

McHughen (2013) argues however that these anti-GMO activists, under the guise of the advocated goal of properly labeling GMFs, have an ulterior motive. McHughen emphasizes that the findings of scientific research have not provided support to the claim that GMFs are dangerous and unhealthy for consumption. Furthermore, he explains that public scientists, academic researchers, and many non-political institutions (e.g. the American Association for the Advancement of Science, Britain's Royal Society, the European Union's European Food Safety Agency, the United Nations Food and Agriculture Organization, and the World Health Organization) propose that "GM foods are categorically just as safe as conventionally bred foods of the same type" (McHughen 2013, p. 173). This contradicts the viewpoints of the anti-GMO activists in the United States about the perceived health risks of GMFs and that "labeling is necessary both to allow consumers to avoid such health risks and to track and investigate health problems that may result from the consumption of GM foods" (Marchant et al., 2013, p. 129).

The campaign of the anti-GMO advocates in Europe has also been aimed at investigating genetic modification labeling, but it did not rely on the presumption of health risks. "In Europe and other jurisdictions where GM labeling has been implemented, the official justification for such labeling is not based on any additional health risks of GM foods, but rather on factors such as consumer preference and choice" (Marchant et al., 2013, p. 129). Most importantly, genetic

modification technology "was introduced during a time when the political influence of green parties in Europe was especially significant, and European trust of government capacity to enter food security issues was at its lowest" (Zilberman, Kaplan, Kim, Hochman, & Graff, 2013, p. 202). Thus, while the anti-GMO advocates in Europe, such as the German Alliance '90/The Greens (one of the most prominent Green parties in Europe) and Greenpeace, virtually controlled the debate over GMFs, the anti-GMO groups in the U.S. did not make a comparable impact because they neither had gained significant consumer support nor had they put pressure on the government and biotechnology industry until the market was already flooded with genetically modified products (Zilberman et al., 2013).

Perceived health risks of GMFs is a prominent distinction between the current policies in the United States and Europe. In Europe, regulation is based primarily on assessing the processes of crop cultivation and production rather than on reviewing the qualities of the product. In particular, the European Food Standards Agency and a panel designated for creating policy on GMFs decide whether the cultivation and production of each GMF product is approved. Furthermore, "[each] member state has a veto on the decision for cultivation of the GMO in its territory (national safeguard measures), in which occasion the case goes to the Council of Ministers in Brussels for a final decision" (Macnaghten et al., 2015, p. 9). Hence, Europe and the United States have clearly different approaches to risk assessment and management. While the U.S. system has adopted a top-down structure that seems to benefit mostly big producers of GMFs, the European system implemented an upfront comprehensive regulation process aimed at proving the safety of GMFs before they are sold to consumers (Macnaghten et al., 2015). In general, in the U.S., GMFs are considered safe unless they are proven not to be, while in Europe, GMFs are not considered safe until they are proven to be.

Previous major incidents related to food supply have further contributed to the global controversy of GMFs as they have influenced both consumer and government views of GMFs. According to Zilberman et al., "[consumer] concerns about food safety inevitably increase with food safety problems, like the emergence of BSE, Hoof-and-Mouth (Foot-and-Mouth) disease, and other problems in Europe in the 1990s" (2013, p. 204). The outbreak of mad cow disease (i.e., Bovine Spongiform Encephalopathy – BSE) in the United Kingdom in the late 1980s is an example of a significant food supply incident. Although this epidemic was not linked specifically to modern biotechnology, it was generally related to food product safety and the effects on consumer perceptions. The risks associated with beef consumption and "the failure to acknowledge the uncertainties surrounding the link between bovine spongiform encephalopathy (BSE) and Creutzfeldt–Jakob disease (CJD) led ministers [in the UK] to be ill-equipped to deal with the crisis" (Macnaghten et al., 2015, p. 11). The risks and the failure to acknowledge have contributed to a decline in the trust that consumers place in their governments. However, today, the UK and European governments are actively taking actions to guarantee the availability of safe food products.

The mad cow disease incident is exemplary because the entire Europe was influenced by this outbreak, and therefore it provided a platform for anti-GMO groups within Europe. The BSE incident led to a more radical approach towards biotechnology and the implementation of the European Food Standards Agency's GMO panel. In 1990, the EU introduced the Deliberate Release Directive 90/220, which requires European Union member nations to confirm that foods containing GMOs are not harmful to human life (Wynne, 2001). Evidently, the apprehension from the mad cow disease incident resulted in the enactment of a lengthy GMF approval process within Europe. In contrast, the United States was not majorly impacted from the disease

outbreak, resulting in a prominent difference in the national anti-GMO and GMF labeling crusades and a difference in national consumer views on food safety and government trust. Furthermore, Pennings, Wansink, and Muelenberg recognize that "the differences between the United States and the European countries are not surprising since BSE has never been a problem in the United States" (2002, p. 96).

Since the onset of genetically modified food research and the development of the GMFs global controversy, many studies have focused on consumer perceptions and the willingness to purchase genetically modified foods. Specifically, "[researchers] over the past 15 years have delivered well over 100 estimates of consumers' willingness to pay for GM foods using surveys and experimental methods" (Colson and Rousu, 2013, p. 158). These studies have been conducted in multiple countries and addressed various food products and biotechnology methods. Even though there are several significant relationships consistently found in a majority of the studies conducted (e.g. that US consumers are more accepting of GM foods than European consumers), these research findings are difficult to apply to real-life situations (Colson et al., 2013). For example, the findings of one study that "the magnitude of consumers' discount for GM foods depends upon the type of genetic modification, the type of food product, and how the genetic modification alters the final product" (Colson et al., 2013, p. 163) are difficult to generate across samples due to different sample demographics and nationality, different data collection methods (e.g. surveys, auctions, experiments), and different methods used in testing products. In addition, the results of any specific test capturing the important awareness of and attitudes towards GMFs do not provide enough evidence for a global consensus about GMFs.

Due to the lack of a collective global consensus about health risks of GMFs, I want to examine how in two nations the overall actions of the government, production companies, and

anti-GMO advocacy groups are mapped differently onto consumers' attitudes towards genetically modified foods. As a result of these differences, the consumers' affective and cognitive attitudes towards GMFs are likely to differ. In this study, I focus on examining cross-nationally, Germany and the U.S., whether affective (i.e. "emotion") or cognitive (i.e. "knowledge") attitudes influence consumer purchasing intent related to foods labeled as not containing-GMOs. I sample consumers from Germany and the United States because they provide two representative cases that have diverse cultures, government systems, influential power of environmentalist groups, and access, although very limited in Germany, to GMFs. This leads to the following research questions that are addressed in this thesis:

1. **"How are GMFs purchasing intentions different between consumers in Germany and the United States?"**

2. **"How do cognitive and affective attitudes towards GMFs affect the purchasing intentions of consumers in Germany and the United States?"**

To address these questions, I use the Health Belief Model (i.e. HBM). This model and the related key concepts and research design are described in the subsequent section.

1.2 Research Model

To examine how national differences in the perceptions of genetically modified foods pertaining to government regulations and producer/government actions are mapped onto affective and cognitive consumer attitudes that influence their purchasing intentions related to GMFs, I use the Health Belief Model (HBM). The HBM was originally developed in the 1950s by a team of psychologists at the United States Public Health Service to explain behaviors related to perceived health risks (Hochbaum, Rosenstock, & Kegels, 1952). The HBM proposes the importance of one's personal attitudes in determining health related behaviors. For the

purpose of my thesis, I have adapted the model to fit into the context of genetically modified foods (Hochbaum, 1958; Turner, Hunt, Dibrezzo, & Jones, 2004).

Having reviewed the key variables used in the various adaptations of the Health Belief Model (Hochbaum et al., 1952), in my thesis I focus on cognitive attitudes (which I label as "knowledge") towards GMFs and the affective attitudes about GMFs of consumers in Germany and the United States. By studying the influence of knowledge, I can assess the rational decisions made by consumers based on their level of knowledge about GMFs (e.g., choosing whether to purchase a GMF product because the government approves the product as safe to consume). In contrast, studying consumer affective attitudes reveals their non-rational decisions made based on their emotions (e.g., choosing to avoid GMFs due to the personal belief that they are harmful to the environment). Figure 1 below is a pictorial representation of the formal model adapted to explain the relationships between the consumers' cognitive attitudes (knowledge) and affective attitudes on their purchasing intentions of the GMFs.

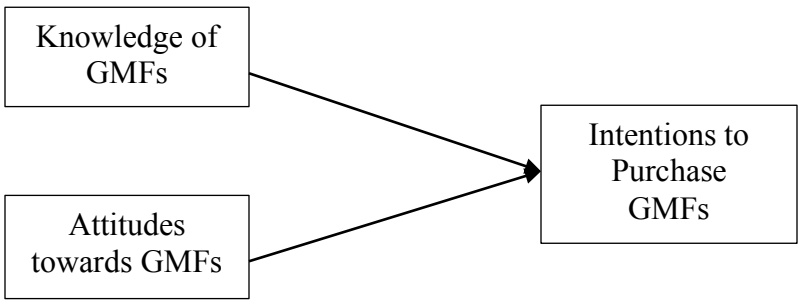


Figure 1: Relationship between knowledge of GMFs, attitudes towards GMFs, and GMFs purchasing intentions

This model is tested comparatively in the American and German contexts since these two countries provide two national cases with different consumer attitudes towards and knowledge of GMFs. In the United States, there is a significant extent of GMF cultivation and production with no specific GMFs labeling requirements, because GMFs are considered substantially equivalent

to conventional foods. In Germany, however, there is in place an extensive regulatory process, as many governmental institutions must approve the production and cultivation of any GMF product. These differences reflect the variances in the producers' practices and the government policies in both the U.S. and Germany. Therefore, the purpose of my thesis is to study how these differences are mapped onto the differences in the knowledge about and attitudes towards GMFs between German and American consumers and how both variables influence consumers' purchasing intentions.

To identify the key differences in the factors influencing purchasing intentions related to GMFs of German and American consumers, I collected survey responses, separately analyzed the data for consumers of each and compared the results for German and American samples. Comparing these results is expected to provide a deeper understanding of consumer knowledge and attitudes, as well as allow me to contribute to the current literature on consumers behaviors related to GMFs. Studying consumers' intentions in both Germany and the U.S. provides a unique opportunity to gain insight on how consumers in culturally diverse nations view GMFs (e.g. through the lens of government regulations or through the lens of labeling requirements) I believe that the results of my thesis have the potential to provide relevant data on how consumers are differentially guided in their intentions to purchase GMFs.

In the following chapters of my thesis, I review extant literature on GMFs, the Health Belief Model, key variables used in my research, and various methodologies and then provide my findings and a discussion of the results. The subsequent Chapter II describes the constructs of knowledge, attitudes, and purchasing intentions and analyzes previous works. In Chapter III, I explain the methodology used to gather and analyze the data, including the description of the independent and dependent variables and the way they are operationalized. In Chapter IV, I

present the results and findings of my analytical comparison of German and U.S. consumers. In the final chapter, Chapter V, I provide a discussion of my findings, limitations to my research, and outline my suggestions for future research on cross-cultural differences in consuming genetically modified foods.

Chapter II

LITERATURE REVIEW

In this chapter, I describe the key constructs used in my model that I have developed to address the research questions of my thesis. I base the development of my model, which is an adapted Health Belief Model, on the literature review of previous empirical studies conducted in the context of genetically modified foods. I focus the review on the constructs of knowledge, attitudes, and labeling to propose the hypothesized relationships among these variables, which I test empirically by analyzing the data that I have collected using the survey method.

2.1 Key Variables

Knowledge is one of the key variables in the Health Belief Model. As it is linked to health related behaviors, knowledge is an independent variable of the model used in this study. Knowledge, which reflects cognitive attitudes, is a complex notion that can be interpreted, as the Merriam-Webster dictionary elucidates its definition, as information or understanding obtained with experience or education, as well as awareness of something (Merriam-Webster online dictionary, n.d.). In the survey I developed, both ways to interpret knowledge are included to capture a full perspective of consumer cognitive attitudes and their effects. The survey questions pertain to both general awareness of GMFs (e.g., where you can find them) and the amount of information a consumer has previously gathered about GMFs, including through both self-research and the collection of information given by the government and production companies. In summary, knowledge is assessed in order to obtain an understanding of the cognitive attitudes that influence the purchasing intentions of consumers.

The second independent variable used in the model of this study, consumer attitudes towards GMFs, is also a critical building block of the Health Belief Model. Consumer attitudes,

which play a major role in most studies about GMFs, encompass attitudes related to perceived risks and benefits. In previous studies examining consumers' GMF purchase intentions, consumer attitudes were contextualized as reflecting "a person's attitude toward GM foods is a function of his/her beliefs about GM foods and the implicit evaluation responses (or aspects) associated with those beliefs" (Han, 2006, p. 80). Additionally, cultural traditions, government regulations, and trust in the biotechnology scientists were also found to influence consumer attitudes. The survey questions related to consumer attitudes are formulated to elicit the emotional reactions of consumers towards GMFs based upon perceived risks and benefits. Hence, this variable has been included in my model to uncover the consequences that affective attitudes have on consumer GMF purchasing intentions.

The dependent variable of my model reflects consumer purchasing intentions in terms of the likelihood that a consumer would be buying a product with a label stating that the product contains no GM-ingredients. Alternatively, I could have included a question measuring the degree to which a consumer intends to buy a product labeled as non-GMO versus a similar product with no label or with a label stating that the product does contain GMOs that would allow a more complete view of consumer purchasing intentions of GMFs. However, as it would have been virtually impossible for me to determine whether the products with GM ingredients and those without GM ingredients were equally available to the sampled consumers, such a question was not included in this study.

In the United States and Germany, there is a lack of labels indicating genetic modification, both on products containing GMOs and products without GMOs. The reasons for this scarcity are different in both nations, but observing a label can alter a consumer's purchasing decision. For example, many studies conduct auctions, in which new pieces of information about

the product being sold are progressively provided as the auction proceeds. With each new piece of information, previous studies found that participants often alter their original bids when the product was offered with no label or additional information. Purchasing intentions are predicted through consumer affective and cognitive attitudes, but including a non-GMO label on the product affords a closer look into the dependent variable by adding another dimension to my thesis study.

The three key variables adapted from the Health Belief Model (HBM) and described above are the key components of the model used in my thesis. Consumer attitudes, knowledge, and purchasing intentions of GMFs are the main focus of this research because GMFs have inspired and expanded the global controversy and transatlantic divide surrounding biotechnology. In order to understand GMFs controversy, it is imperative to understand how it affects consumers' GMF purchase intentions. The literature review provided in the subsequent section is focused on the description of the key variables of my model and illustrating how these variables have been used in past research on consumer intentions to purchase GMFs.

2.2 Literature Review Supporting My Model

The field of biotechnology, which has been growing for decades, has expanded deeply into the process of food production. In particular, genetic plant modification stemming from biotechnology affects methods of plant cultivation and food manufacturing in a global scope. This modification occurs when a gene from species A is inserted into the DNA of species B, thus a new organism is created with the aid of technology (Vecchione, Feldman, & Wunderlich, 2015). In the United States, it has been estimated that approximately "75-80% of packaged or processed food items on supermarket shelves nationwide contain GMOs" (Vecchione et al., 2015, p. 1). Similar estimates, though, are not available for Europe or Germany.

Due to the relatively large quantity of GMFs produced in the US and the global controversy surrounding GMFs, researchers have conducted an abundance of studies on how consumers respond to products containing genetically modified ingredients. The focus of most past studies was on the perceptions, consumer reactions, and attitudes towards GMFs. As they are related to consumer purchasing intentions based on labeling, and perceived risks and benefits of GMFs. In the subsequent section, I focus on the methodologies used in the previous literature to support my hypotheses on the differences of German and American consumers' purchasing intentions in regards to GMFs.

Methodologies: The most common methodologies used in the previous studies are surveys, questionnaires, and mock auctions. Surveys, mostly structured to collect quantitative rather than qualitative data, have been used because they are an efficient way to assess the respondent's knowledge of GMFs and their attitudes towards them. For example, Bredahl (1999) used a laddering interview technique to evaluate consumer views in four European nations and included in his publication figures showing phrases that consumers could associate with both natural and genetically modified yogurt and beer. Studies using this methodology have also been conducted in the United States, but they lack the element of comparison provided in Bredahl's study (Tegene, Huffman, Rousu, & Shogren, 2003; Bredahl, 1999). Moreover, the study is specific to yogurt and beer, while a majority of the other studies with surveys or interviews are more general, asking about the overarching idea of GMFs.

The other popular method used in previous studies is mock actions. Colson and Rousu argue that "[experimental] auctions avoid two of the primary concerns surrounding choice experiments: they are theoretically incentive compatible due to their non-hypothetical nature and they directly elicit a measure of individuals' [willingness to pay] without any researcher

assumption of functional form" (2013, p. 158). Given these properties of auctions, they have been utilized in a significant number of past GM studies. However, Colso et al. (2013) also emphasize the limitation of auctions related to the special procedures used in an individual auction. The setup of each auction has the potential to affect the bidding values of the consumer participants, resulting in the auction not being an accurate measure of real-life consumer purchasing decisions. Even with this limitation, auctions have consistently been used in studies pertaining to assessing intentions of consumers to purchase GMFs.

In a study using an auction methodology, Noussair, Robin, and Ruffieux (2004) utilize the Becker-DeGroot Marschak auctioning mechanism. The auction allows participants to place bids on products, and before each round of bidding, a new piece of information about the product is given, such as the where the food was produced or the ingredients of the product. Also, the reactions to labeling can be easily evaluated through an auction. Another study using an auction experiment researched consumer willingness-to-pay when food products do and do not contain labels that indicate the product was made with genetic modification (Tegene, Huffman, Rousu, & Shogren, 2003). "Prior to the bidding, each participant received one of six information packets containing statements about biotechnology gathered from a variety of sources," and the packets could contain all pro-GMF statements, all anti-GMF statements, or a mixture of both (Tegene et al., 2003, p. 2). The study found that the information given to participants, as well as the diverse sources of knowledge, influenced the bidding amounts. The finding is that a label on GMFs is influential to consumer purchasing intentions. Other methodologies used included focus groups and interviews, but neither of them has been used as frequently as surveys or auctions.

Labeling: A common theme permeating most studies is labeling, in terms of pertinent regulations and how labels affect the purchasing of GMFs (Tegene et al., 2003). For example,

Teisl et al. (2002) conducted a study to assess the responses to food labels of respondents in three American cities. In the work, most respondents stated that they either would not understand a GM-label or would ignore it because they were unaware of the related implications (Teisl et al., 2002). In addition, many participants claimed they would prefer visible and clear labeling because of their assumed right to know what they were consuming (Teisl et al., 2002). In another study, Hemphill and Banerjee (2015) found that the Federal Department of Agriculture viewed genetically modified foods in the same way as conventional foods, with no material difference acknowledged. This finding implies that the governing body in the United States does not perceive a need for labels distinguishing GM from non-GM foods. Noussair et al. (2004) recognize the difficulty in quantifying the demand for GMFs in the United States from market data, due to the lack of related labels, although the studies on GMFs show that consumer purchasing intentions are influenced, both positively and negatively, by such labels. By surveying consumers in supermarkets in New Jersey, another study examining labeling suggests that a nationwide labeling requirement "would assist consumers in making informed purchase decisions," but the work also notes that labeling still remains voluntary for production companies in the United States (Vecchione et al., 2015, p. 1).

Another study focused on labeling examined the traceability of genetically modified foods in the European Union based on Regulation 1830/2003, which was inspired by prior identification of a mystery DNA in Monsanto soybeans (Lezaun, 2006). The regulation grants consumers the right of choice based on information provided about the way in which the product was produced (Lezaun, 2006). In Germany, labels showing that a product contains GM-ingredients are as uncommon as they are in the United States, although this scarcity is due to German regulations discouraging GMF production. Furthermore, the European Union requires

proper labeling when a product contains more than the threshold of 0.9% genetically modified ingredients (Vecchione et al., 2015). Therefore, respondents in the study conducted by Noussair et al. (2004) in France were found to associate the absence of a label on a product with a low likelihood of genetically modified content. Moreover, a study in Germany surveyed French fries street vendors to assess the impacts on consumer choice, by giving one batch of fries a genetically modified label and the other batch a conventional label. More than half of the consumers chose the conventional fries, a fifth chose the genetically modified fries, and a fifth had no preference (Nielsen, 2013). In summary, all of these studies show that labels influence consumer purchasing intentions towards GMFs.

Overall, the literature review supports my choice of research focus, examining consumers in Germany and the U.S. cross-nationally in order to assess their intentions to purchase foods with genetic modification labels. Therefore, I propose the following hypothesis:

H1: German consumers are more likely than American consumers to purchase a food product with a label stating the product contains no GMOs.

Knowledge: The second reoccurring theme that permeates previous studies is the knowledge about GMFs and biotechnology. The evaluation of this awareness is measured in studies conducted both Europe and the United States. In the United States, a study by Teisl et al. (2002) found participants were concerned that they did not know how wide the range of GMFs extended. Hemphill and Banjeree (2014) claim that today, approximately 70-80% of the foods consumed by Americans have been genetically modified or contains GM ingredients. Consumers believe that they know whether or not they consume GMFs, but the "lemons' scenario" still exists worldwide (Noussair et al., 2004, p. 104). This scenario highlights that consumers cannot distinguish between the conventional lemon and the genetically modified lemon without proper labeling (Noussair et al., 2004). The New Jersey study also found that, "as knowledge of GMs

increased, positive attitudes towards non-GM-containing foods increased, or purchasing behavior of non-GM-containing foods increased" (Vecchione et al., 2015, p. 5). This study suggests that, in the United States, knowledge and attitudes are correlated and likely influence consumer purchasing intentions towards GMFs.

European consumers also exhibit a lack of knowledge about GMFs, although not as severely as American consumers. Vecchione et al. (2015) elucidate that this awareness rose after several food safety issues, such as, but not only, the mad cow disease, which occurred prominently within Europe in the 1990s. By association, the media not only exaggerated the potential negative effects of GMFs, but also provided to Europeans more information about GMFs, thus causing a higher level of distrust in GMFs and biotechnology (Vecchione et al., 2015). However, significant discrepancies in the trustworthiness of information coming from various sources have created a problem in recognizing the difference between accurate information and misinformation. One example of misinformation is an argument made by the Alliance for Bio-Integrity that "some religions prohibit the consumption of GM foods" (Marchant & Cardineau, 2013, p. 127). Later, this argument was acknowledged as false when the Alliance was unable to identify a religion in which this claim was truthful, yet it remains misinformation about GMFs.

Another study conducted in the United Kingdom indicates that consumers mostly associate genetically modified foods with unnaturalness, yet lacked the knowledge to explain why GMFs are not natural (Frewer, Howard, & Shepherd, 1996). These findings help clarify that notions sensitive to psychological and cultural influences, such as the notion of *natural*, do not correspond to the real scientific risks and benefits associated with GMF consumption. In 2014, a research conducted in Turkey to assess consumer awareness of GMFs revealed that the "majority

of consumers were aware of the term GMO, but they do not have enough knowledge about genetic modification technology and how genetic modification is carried out" (Mürsel et al., 2015, p. 1437). The gaps in the area of knowledge about GMFs raise questions of how consumers can obtain information and whose responsibility it is to educate consumers about these foods: the government, the producers, or the consumers themselves.

Attitudes: Past studies have provided evidence that affective attitudes play a major role in research pertaining to GMFs, including the emotional reactions to perceived risks and benefits. For example in their survey, Frewer et al. (1996) included questions about the tangible benefits and perceived risks of genetically modified foods in the examination of subjects in the United States; future generations were considered to have the most benefit, but they were also seen to have the most potential risk. In Wachenheim's study on the perceptions of GMFs among students enrolled in a College of Agriculture, Food Systems, and Natural Resources, "[females] perceived a higher risk than males" (2006, p. 36). In addition, it is revealed that students' backgrounds, such as growing up on a farm, influence their attitudes measured by survey responses, which indicates that there is a relationship between attitudes, GMFs, and consumer purchasing. Most importantly, as attitudes vary across nations, consumer nationality should be included when studying intentions related to GMFs.

Personal attitudes towards GMFs were also studied in multiple works conducted within Europe. Bredahl's (1999) cross-national study conducted in four different nations, including Germany, found that any perceived benefits associated with GMFs did not overcome the perceived risky consequences of consuming GMFs. Consuming products containing genetically modified ingredients was believed to "inhibit the achievement of important life values, such as a long and healthy life, happiness and inner harmony, security and responsibility for nature and

other people" (Bredahl, 1999, p. 350-351). This study clarifies that German nationals in particular view GMFs as a barrier not only to sustaining their health but also to achieving their happiness, because genetic modification is perceived as "morally wrong" (Bredahl, 1999, p. 352). Sparks, Shepherd, and Frewer (1995) argue that perceptions of uncertainty about potential effects of GMFs have the foremost influence on affective consumer attitudes. The affective attitude held by many European consumers is reflected in the statement "I dread the idea of GM food" (Springer, Mattas, Papastefanou, & Tsioumanis, 2002). The emotions engendered by this kind of "beliefs" vary however between consumers in, for example, Greece and West Germany (Springer et al., 2002, p. 9), thus indicating that the significance of the relationship between attitudes and purchasing intentions of GMFs may vary across nations. Therefore, I propose:

H2: Both German and American consumers' purchasing intentions of GMFs will be influenced by their cognitive attitudes (i.e. knowledge) and their affective attitudes (i.e. beliefs).

My second hypothesis (**H2**) developed after reviewing studies conducted in both Europe and the United States, suggesting that labeling-related knowledge and affective attitudes diversely influence purchasing intentions related to GMFs of German and U.S. consumers. Due to the scarcity of labels for GMFs in both the United States and Germany, it is researched in this thesis whether or not the both nations' citizens will have the same or different reactions to the labeling of genetically modified foods, as the developed survey seeks to uncover a relationship between labeling and purchasing intentions. The attitudes grounded in the beliefs of consumers are measured in the survey, along with the level of consumer knowledge in each nation. I follow the suggestion of Finucane and Holup that "the reasons underlying objections to GM foods may vary, but often can be traced to important socio-cultural beliefs, values, customs, and histories that orient and inform people making decisions in the face of uncertainty" (2005, p. 1607).

In the subsequent chapter, I describe how my survey data was administered and collected in order to capture consumer attitudes and knowledge and their influence on consumer purchasing intentions of GMFs in the United States and Germany. I also describe how the hypotheses that I articulated are tested and how the data is analyzed in the following chapters. Lastly, I explain the methodological techniques used to gather and examine the data, and the results from the analytical procedures, along with the research findings and the implications of these results.

Chapter III

METHODS

3.1 Overview

My thesis seeks to measure consumers' cognitive and affective attitudes towards genetically modified food, or food crops derived from organisms whose genetic materials (DNA) have been modified in a scientific way (e.g., through the human inserting a gene from one organism into a different organism) (World Health Organization, n.d.). My study's research model is based on the Health Belief Model (HBM) developed by Hochbaum, Rosenstock, and Kegels (1952). The HBM emphasizes the importance of an individual's personal beliefs in determining health-related behaviors. Researchers in the Health Sciences have applied this model in multiple empirical studies, to examine the various health behaviors of people (Hochbaum, 1958; Turner et al., 2004). To test my hypotheses described in Chapter II, I developed a survey in Qualtrics, based on my adaptation of the Health Belief Model, and administered the survey to German and American citizens via Mechanical Turk (MTurk) and Clickworker, respectively. Boas and Hidalgo (2013) assert that Qualtrics is a crowdsourcing software that is recognized as a successful online surveying engine founded for academic research and available on the websites of many universities.

3.2 Data Collection and Sample

The first step in collecting my data was the creation of the questionnaire in Qualtrics. A sample of the complete survey is available in *Appendix A*. Next, I administered the online survey to residents in the United States and Germany through Amazon's Mechanical Turk (MTurk) and Clickworker, a German crowdsourcing platform. From U.S. and German participants, I collected 331 survey responses with 171 responses from the US and 160 responses from Germany.

However, after examining the responses for accuracy, only 293 of these responses were usable (i.e. 153 responses from the US and 140 from Germany), resulting in an 88.5% response rate.

As described earlier, I employed MTurk to collect responses from American consumers because it easily connects researchers with participants of diverse backgrounds, work experience, and dispersed geographical location (Buhrmester, Kwang, & Gosling, 2011). MTurk also ensures that participants are easily compensated for their time and effort once they have successfully completed the survey. In order to explain the purpose of my research, I published the survey on the MTurk platform as a HIT (Human Intelligence Task). Amazon describes a HIT as "a single, self-contained task that a Worker can work on, submit an answer, and collect a reward for completing" (Amazon Mechanical Turk, n.d.). Paolacci, Chandler, and Ipeirotis depict MTurk as "an online labor market where employees (called *workers*) are recruited by employers (called *requesters*) for the execution of tasks (called *HIT*s, acronym for Human Intelligence Tasks) in exchange for a wage (called a *reward*)" (2010, p. 411). Workers and employers are both anonymous, and workers are able to see only the HITs in which they meet the criteria specific to that HIT, such as a minimum age or set location (Paolacci et al., 2010). If a worker was able to see and complete my HIT, then the worker confirmed that they were 18 years or older, in accordance with the Children's Online Privacy Protection Act of 1998 (COPPA) (Federal Trade Commission, 1998). Furthermore, the United States was the initial nation selected as the study's sample location due to funding restrictions and a previous knowledge of the relationship between the U.S. workers and MTurk.

From the American data, 171 respondents began the survey, but 153 (89.47%) respondents completed the survey. The non-completion of responses by 18 participants may be due to the use of open-ended questions, arranging questions in table format (Bosniak & Tuten,

2001), and/or the participants' lack of knowledge of or familiarity with web based surveys (Sheehan, 2002). Hence, these responses were excluded in the final date. Further examination of the response pattern of the 18 participants revealed that 12 participants responded to 5% of the questions asked in the survey. Similarly, 4 participants completed only 50% of the questions asked, while one participant responded to all questions except for questions requesting information on his or her demographic characteristics (e.g. gender, race). I assume that this participant's decision to not provide such information may be due to privacy concerns (Sheehan, 2002). Finally, one respondent indicated that his age fell within the "12-17 years old" bracket. This response contradicted my HIT instruction that only respondents 18 and older are allowed to participate in the survey (Federal Trade Commission, 1998). Therefore, I eliminated the responses of this participant.

Further analysis of the United States sample showed that 60.1% of the respondents were male and 39.9% were female. Over half, 62.1%, of the participants were employed for wages, 15.0% were self-employed, and only 5.2% were students. Moreover, 67.3% did not have children, 58.8% were single or had never been married, and 34.0% were either married or engaged in a domestic partnership. 52.9% were between 25 and 34 years old. The majority, 43.1%, had a Bachelor's degree, while approximately a quarter, 24.8%, had no degree but some college credit. The demographic information included age, employment status, gender, marital status, level of education, and whether or not the respondent had children. These factors are present in many previous studies in multiple fields, allowing the option to look deeper into how demographics affect the hypothesis and dependent variable. Therefore, this study has the opportunity to examine any important relationships between demographics and the dependent

variable, purchasing intentions, to explain the findings of the data analysis. The complete demographic summary of the United States sample is shown in Table 1.

Attempts to collect data in Germany using MTurk were not effective, due to an exceptionally small amount of responses completed within the first 24 hours the survey was published. After researching various platforms, Clickworker, which was founded in Germany and holds the official domain name of clickworker.com, was used to gather the German responses (Singla & Krause, 2013). Clickworker, which performs the same tasks as MTurk even though it is not as globally known, was incorporated in 2005 and has a working population of over 700,000 people (Clickworker, n.d.). A similar process of recruitment as MTurk occurred as potential respondents of the study saw the HIT and a link to the Qualtrics survey. Also, the location of prospective respondents was confined to individuals specifically in Germany, and the age minimum was 18 years of age, which agrees with the COPPA of 1998 (Federal Trade Commission, 1998). A total of 160 respondents answered the survey, and of these, the responses of 140 participants were usable, or 87.50%. Each of the 160 participants completed the questions entirely, but in the survey for German participants, I included a question to check the attention and language proficiency of the respondents, since the survey was in English and there existed the risk that respondents would not understand the questions while completing the survey. Overall, 20 participants did not select "5 = Strongly Agree" when requested to at the end of the knowledge question series, therefore their responses were unusable and excluded from the data.

Of the respondents in Germany with usable answers, 53.6% were male and 46.4% were female. 17.1% of the participants were students, 22.1% were self-employed, and only 36.4% were employed for wages. Also, 60.7% of participants did not have children, while 52.6% had never been married and 38.9% were married or in a domestic partnership. The majority of the

Demographic Factor	*United States*	*Germany*	*Combined Sample*
Gender: Male	60.1%	53.6%	57.0%
Gender: Female	39.9%	46.4%	43.0%
Age: 18-24	16.3%	16.4%	16.4%
Age: 25-34	52.9%	29.3%	41.6%
Age: 35-44	16.3%	29.3%	22.5%
Age: 45-54	9.8%	18.6%	14.0%
Age: 55-64	3.9%	4.3%	4.1%
Age: 65-74	0.7%	2.1%	1.4%
Education: No schooling completed	0%	.7%	.3%
Education: Some high school, no diploma	1.3%	12.1%	6.5%
Education: High school graduate, diploma or equivalent	10.5%	19.3%	14.7%
Education: Some college credit, no degree	24.8%	12.1%	18.8%
Education: Trade/technical/vocational training	.7%	5.0%	2.7%
Education: Associate degree	11.8%	6.4%	9.2%
Education: Bachelor's degree	43.1%	5.9%	1.3%
Education: Master's degree	5.9%	12.9%	9.2%
Education: Professional degree	1.3%	.7%	1.0%
Education: Doctorate degree	.7%	0%	.3%
Education: Other	0%	4.3%	2.0%
Kids: Yes	32.7%	39.3%	35.8%
Kids: No	67.3%	60.7%	64.2%
Marital Status: Single, never married	58.8%	45.7%	52.6%
Marital Status: Married or domestic partnership	34.0%	44.3%	38.9%
Marital Status: Widowed	0%	2.1%	1.0%
Marital Status: Divorced	5.9%	5.0%	5.5%
Marital Status: Separated	1.3%	2.9%	2.0%
Status: Employed for wages	62.1%	36.4%	49.8%
Status: Self-employed	15.0%	22.1%	18.4%
Status: Out of work and looking for work	5.2%	7.9%	6.5%
Status: Out of work but not currently looking for work	2.6%	0.7%	1.7%
Status: A homemaker	6.5%	7.1%	6.8%
Status: A student	5.2%	17.1%	10.9%
Status: Retired	1.3%	1.4%	1.4%
Status: Unable to Work	2.0%	3.6%	2.7%
Status: Other	0%	3.6%	1.7%

Table 1: Demographics of the United States, Germany, and Combined Samples

respondents, 41.6%, were between 25 and 34 years old, followed by 22.5% between 35 and 44 years old and 16.4% between 18 and 24 years old. The highest education level of 19.3% of respondents was the completion of high school. Moreover, 12.9% held a Master's degree and 12.1% had some college credit but no degree. Table 1 provides the complete summary of the demographic factors of the total combined sample, the American sample, and the German sample. Each survey respondent answered questions pertaining to the knowledge of, attitudes towards, and behaviors concerning genetically modified foods. A description of how these variables were utilized occurs in the following section.

In addition, I tested whether my data samples of both Germany and the United States are representative of the real life national populations of these nations. I first focused on the age of the respondents, and then the gender. The German population has a median age of 46.5 years, and 41.38% of the population is between 25 and 54 years of age (Central Intelligence Agency, n.d.). In the sample I collected in Germany, 77.2% of the respondents are between 25 and 54 years old. Moreover, the median age of the overall United States population is 37.8 years, while 39.76% of the population is between 25 and 54 years of age (Central Intelligence Agency, n.d.). In my American data sample, 79.0% of the participants are between 25 and 54 years old. Neither of my German or American samples precisely displays the age demographics of their respective nations. The balance of the age demographics in my sample tilts more towards younger participants and does not represent the older generations. However, the age bracket, 25-54 years old, with the highest portion of the respondents in each nation corresponds to the largest portion of the overall population. This discrepancy and variation is possibly due to the younger generations being more likely to understand and use computer software such as Clickworker or MTurk. Also, I did not make my survey available to individuals younger than 18 years of age,

thus hindering more than 13% of the German population and more than 18.99% of the American overall population from taking my survey.

I also looked at whether the gender ratios of my samples are representative of the real national populations in Germany and the United States. In Germany, the total population has .97 males/females and the 25-54 years old age bracket has 1.03 males/females. In the United States, the total population also has a gender ratio of .97 males/females, while the 25-54 years old age bracket has a 1/1 male to female ratio. These ratios differ greatly from my sample since the American dataset has a gender ratio of 1.51 males/females and the Germany sample has a ratio of 1.16 males/females. Even with these discrepancies, my data samples are balanced enough with the overall population to provide valid research.

3.3 Measures of Independent Variables

The explanation for choosing the variables in my thesis is presented in the previous chapters. This section shows how knowledge and attitudes, the independent variables, and purchasing intentions, the dependent variable, were operationalized. Based on my adaption of the Health Belief Model, questions and statements were developed to assess these variables in relation to GMFs, and below is a description of how these variables were evaluated.

Knowledge about GMFs

To measure the participants' cognitive attitudes towards GMFs, I created a questionnaire within the survey that examined consumer knowledge. This series consisted of ten statements with corresponding answers scored on a 5 point Likert scale, ranging from "1 = Strongly Disagree" to "5 = Strongly Agree." The survey instrument was developed due to a lack of existing scales used to measure the knowledge and perceptions of GMFs. Sample statements

from the questionnaire include: “I have actively researched what a GMO is” and “Genetically modified foods are substantially equivalent to non-genetically modified foods.”

Utilizing a common factor analysis, I created a single variable from the statements to measure knowledge. Two of the ten original statements make up this new variable. Common factor analyses focuses on sharing variance as opposed to maximizing variance, in order to see how much the factors as a whole represent the concept of knowledge. Performing a factor analysis and observing the Varimax rotations that included each of the statements was the first

Rotated Component Matrix			
	Component		
	1	2	3
KNOW1	0.085	-0.232	0.756
KNOW2	**0.628**	0.091	-0.037
KNOW3	**0.768**	0.039	-0.251
KNOW4	0.033	0.251	-0.691
KNOW5	**0.536**	0.371	-0.32
KNOW6	-0.102	0.243	0.676
KNOW7	**0.584**	0.296	0.153
KNOW8	**0.711**	-0.101	0.135
KNOW9	0.072	**0.867**	-0.035
KNOW10	0.149	**0.824**	-0.174
Extraction Method: Principal Component Analysis.			
Rotation Method: Varimax with Kaiser Normalization.			
Reliability Statistics: Column 1		Reliability Statistics: Column 2	
Cronbach's Alpha	N of Items	Cronbach's Alpha	N of Items
0.691	5	**0.758**	2

Table 2: Factor Analysis and Reliability of Independent Variable Knowledge

step in creating the variable. Table 2 shows the Varimax Rotations and the reliabilities of the tests performed. Initially looking at the first column of the Rotated Component Matrix table, five statements (KNOW2, KNOW3, KNOW5, KNOW7, and KNOW8) were >.40 threshold. Next, The reliability of the five statements was tested, which needed to have a collective reliability >.70, but had a reliability equal to .69. Thus, the second column in the table was observed, and it contained two statements >.40 (KNOW9 and KNOW10). Since these two variables have reliability equal to .76 and pertained to similar aspects of knowledge, the two were used to compute the new knowledge independent variable. The statements are the following: "The government has educated consumers about genetically modified foods." and "Production companies have provided sufficient information to consumers about genetically modified foods."

Attitudes towards GMFs

In order to form a complete understanding about the participants' attitudes towards GMFs, I developed a second questionnaire within the survey. The scale comprised of fourteen statements scored on a 5 point Likert scale, ranging from "1 = Strongly Disagree" to "5 = Strongly Agree." Examples of the items in the questionnaire include: "The production of genetically modified foods is not a natural process, potentially harming nature," "I see value in spending money on GMO-free foods," and "Cultivating genetically modified foods is harmful to the environment."

Using the same process as the independent variable knowledge, I generated a new variable to measure attitudes. The process included conducting a factor analysis and evaluating the Varimax rotation results. Next, I performed a reliability test on the variables in the first column of the Rotated Component Matrix table that were >.40. There were seven statements with the value >.40 (ATT4, ATT5, ATT6, ATT7, ATT10, ATT13, and ATT14), which had a

Rotated Component Matrix				
	Component			
	1	2	3	4
ATT1	-0.004	0.053	0.879	-0.065
ATT10	**0.483**	0.274	0.069	0.194
ATT11	-0.062	0.438	0.235	0.632
ATT12	0.003	-0.236	-0.1	0.823
ATT13	**0.775**	0.2	-0.078	-0.183
ATT14	**0.72**	0.318	-0.067	-0.087
ATT2	0.289	0.71	-0.018	-0.043
ATT3	0.232	0.737	0.018	0.03
ATT4	**0.749**	0.344	-0.091	-0.029
ATT5	**0.726**	-0.169	0.041	0.078
ATT6	**0.769**	0.177	-0.093	-0.069
ATT7	**0.772**	0.09	0.017	0.054
ATT8	-0.036	-0.533	0.451	0.225
ATT9	-0.571	-0.227	0.475	0.26
Extraction Method: Principal Component Analysis.				
Rotation Method: Varimax with Kaiser Normalization.				
Reliability Statistics				
Cronbach's Alpha	N of Items			
0.864	7			

Table 3: Factor Analysis and Reliability of Independent Variable Attitudes

joint reliability equal to .86. Therefore, these seven statements were computed into the new consumer attitudes variable. The statements used are the following: "The production of genetically modified foods is not a natural process, potentially harming nature," "Genetically modified foods do not provide critical nutritional values," "Genetically modified foods are harmful to my body," "Consuming genetically modified foods is less enjoyable than consuming non-GMO foods," "I see value in spending money on GMO-free foods," "I believe that all

GMOs should be banned," and "Cultivating genetically modified foods is harmful to the environment." Table 3 shows the Varimax Rotation values and the reliability of variables.

3.4 Measure of the Dependent Variable

Purchasing Intentions

The dependent variable in this study measures the behaviors of consumers towards GMFs by evaluating purchasing intentions. In the survey, I ask questions that assess consumer purchasing intentions of a food product that has a label stating that it contains no genetically modified ingredients. The specific type, size, location, and other identifying characteristics of the label are not specified; thus, respondents could envision the label as a Non-GMO Project certification label, a USDA Organic label, or another clearly noticeable label. See Figure 2 for an example of these labels.

Figure 2: Examples of USDA Organic and The Non-GMO Project Labels

The question in the survey used to gather data on purchasing intentions is the following: "How likely are you to buy a product with a label claiming the product contains no genetically modified ingredients?" The answer scale for this one question was scored on a 7 point Likert scale, ranging from "1 = Very Unlikely" to "7 = Very Likely." The question could have been asked without asserting that the product has a non-genetically modified label, but the inclusion of a label allows the respondents to understand that the product is not genetically modified, thus

avoiding the "lemons scenario" (Noussair, Robin, & Ruffieux, 2004, p. 104). In this scenario, which Noussair et al. (2004) claims exists worldwide, consumers cannot distinguish the difference between a conventional, organic lemon and a genetically modified lemon without a label, thus the use of a label is vital when consumers want to solely buy non-GMF products. The intent to purchase as the dependent variable will aid in testing the hypothesis that there are relationships between knowledge and attitudes and behaviors in both the United States and Germany. Since there is only one question making up the dependent variable, I was not able to conduct a reliability test on this variable.

Recall, the question examined as the dependent variable asks, "How likely are you to buy a product with a label claiming the product contains no genetically modified ingredients?" Admittedly, this question could be seen as confusing for the different national consumers. In Germany, a product made without genetically modified ingredients would not have an identifier on the label stating that there are no GMOs in the product. The marketed foods in Germany containing more than the .09% threshold of GM ingredients is required to have a label noting the genetic modification (Vechione et al., 2015). In contrast in the United States, there are no governmentally required labels signifying whether or not a product contains GM ingredients. Labels regarding genetic modification do exist within the U.S., though, such as the USDA Organic Label and the Non-GMO Project labels shown in Figure 2 above. Hence, a product with a label indicating the food was made with no GM ingredients means the consumer would observe a label provided by a third party in the U.S. and an ordinary label, which does not state the product is genetically modified, in Germany. The question asked had the potential to be confusing and unclear for the survey respondents, but the essential idea of the likelihood of

purchasing a product with a non-GMO label adequately reflects consumer purchasing intent regarding GMFs.

3.5 Description of the Analytical Procedures

To obtains results, I used the statistical software SPSS to conduct descriptive tests, bivariate correlations, reliability estimates, Varimax rotations, computation of new variables, and linear regressions. The current version of SPSS available to students, faculty, and staff at the University of Mississippi is version 19; therefore, SPSS 19 was used. SPSS has the ability to execute a wide variety of statistical analyses and tests, and with practice, I avoided obstacles to this form of research by using SPSS (Green & Salkind, 2010) The initial descriptive tests and correlations provided the means, frequencies, and standard deviations of the variables in this thesis, as well as provide a description of the demographic factors.

I conducted Varimax rotations and factor analyses in the process of creating the new attitudes and knowledge variables from the multiple response questionnaires. Furthermore, the reliability tests of these variables showed whether or not the new variables are usable in my research and usable in future studies. These tests needed an alpha estimate >.70 to be considered reliable, thus also operational. SPSS further facilitated the computation of the new variables with the compute variable function, which allows several variables with the same value scale to be reconfigured into a single variable. These SPSS abilities aided the thesis with only having to test two independent variables, instead of testing the fourteen individual variables about attitudes plus the ten individual variables about knowledge.

Lastly in order to operationalize the dependent variable, purchasing intentions, and delve into its relationships with knowledge and attitudes, I conducted linear regressions within SPSS. Running linear regression tests allows me to look at the dependent variable as continuous, not

dichotomous. I did these linear regressions with the American data and German data individually, which regulated nationality. This regulation allows for a comparison in the following chapters. The regressions showed the relationship between the independent and dependent variables, which were either positive or negative and displayed varying relationship strengths. The results of the linear regressions are presented in the next chapter, Chapter IV, and these results provide a more thorough examination of the relationships between the independent variables, attitudes and knowledge, and the purchasing intentions of consumers in Germany and the United States.

Chapter IV

RESULTS

4.1 Results of the Analytical Procedures

In this section, the results from descriptive tests, means, and correlations are given and interpreted for each variable. First, I provide a context of following national results by presenting the results of the combined data. Next, the results from the tests for each nation are given, beginning with the United States, followed by Germany. Describing the detailed results of both nations separately allows for an easier comparison of the data later in this chapter.

Results of the Combined United States and Germany Sample

First, I conducted descriptive tests on the independent variable knowledge, which measures the cognitive attitudes of consumers regarding GMFs. The means of the statement "The government has educated consumers about genetically modified foods" was $M = 2.35$, and $M = 2.38$ for the second statement assessing knowledge, "Production companies have provided sufficient information to consumers about genetically modified foods." The modes of both statements were equal to "2 = Disagree." Of the 293 respondents, 120, or 41.0%, of the respondents, chose the mode for the first statement regarding the government while 108 respondents, or 36.9%, of the total sample chose the mode value for the second statement pertaining to production companies. The means of both statements, as well as the new knowledge variable ($M = 2.36$), show the overall inclination towards disagreement. This low level of agreement of the total sample indicates that the majority of consumers in both nations will not hastily agree that the government and production companies provide consumers with adequate amounts of information about GMFs.

Next, I ran descriptive tests on the attitudes independent variable for the total data sample. The means for this variable was $M = 2.97$, and the mode was "3 = Neither Agree nor Disagree." The values on the frequency and percentages charts are shown as 1, 1.14, 1.29, …, and 5, due to the variable being made up of seven different statements and five answer choices for each. These values did not clearly indicate which answers the respondents chose, thus making it necessary to look at the descriptive statistics of the individual statements making up the attitudes variable. The means of these seven statements varied between $M = 2.69$, for the statement "Genetically modified foods do not provide critical nutritional values," and $M = 3.45$ for the statement "Consuming genetically modified foods is less enjoyable than consuming non-GMO foods." The means values imply a relatively moderate level of agreement for each of the seven statements assessing attitudes.

Lastly, I conducted tests on the purchasing intentions dependent variable. For the total data sample, $M = 4.98$ and the mode was "4 = Undecided." This occurrence displays uncertainty among a large portion of the respondents. Although, the means was above the neutral answer choice, which denotes that more respondents, 61.5%, showed a degree of likelihood of choosing the non-GMF product, compared to the 11.6% of respondents who indicated with some level of disagreement that they would not purchase the product labeled as containing no genetically modified ingredients. These frequencies and means suggests that, even before the independent variables and nationality are included in the tests, consumers are more likely to purchase a product with the label stating that it has no genetically modified ingredients.

After creating the new variables for each independent and the dependent variable that regulate for nationality, I delved deeper into the descriptive statistics and looked at both Germany and the United States individually.

Results of the American Sample

Beginning with the variable knowledge, the means of the American respondents was equal to 2.37. I also observed that 65.4% of the participants in the United States either strongly disagreed or disagreed that the government had educated consumers about GMFs. Also, a high percentage of survey participants, 55.6%, disagreed that producers had provided sufficient information to consumers about GMFs, while only 15.7% agreed with this claim. The means for the statement "The government has educated consumers about genetically modified foods" was $M = 2.29$, and $M = 2.44$ for the statement "Production companies have provided sufficient information to consumers about genetically modified foods." The mode for the joint knowledge variable, as well as for each individual statement, was "2 = Disagree," demonstrating that there exists a slightly low level of agreement among American consumers that the government and producers provide enough information to consumers.

Next, I ran tests on the attitudes independent variable in the United States data. The means for this variable was $M = 2.69$, while multiple modes exist, the lowest was equal to 2.29. The mode was not shown as a whole number between 1 and 5 due to there being seven statements, each with 5 answer choices, making up the collective attitudes variable. The means of the statements varied between $M = 2.21$, for the statement "I believe that all GMOs should be banned" and $M = 3.18$ for the statement "The production of genetically modified foods is not a natural process, potentially harming nature." The means values implicated a moderate to low level of agreement for each of the seven statements assessing attitudes. Additionally, the mode of these statements was wide-ranging. Three had a mode of "2 = Disagree;" two had a mode of "4 = Agree;" and one had a mode of "1 = Strongly Disagree" and the last statement had a mode of "3 = Undecided." This variation showed diversified attitudes towards GMFs among the American

sample, thus further looking at the individual statements' means and frequency data, as well as comparing these findings to the Germany findings, will benefit the research. Table 4 shows statistics of each individual statement pertaining to attitudes in the American data.

	ATT4	ATT5	ATT6	ATT7	ATT10	ATT13	ATT14	Computed Attitudes Variable
Means	3.1857	2.4837	2.6863	2.4248	2.9673	2.2092	2.8693	2.6928
Std. Error of Mean	0.14574	0.08555	0.09249	0.0888	0.09876	0.09667	0.09119	0.07499
Median	3	2	3	2	3	2	3	2.7143
Mode	4	2	2	2	4	1	3	2.29[a]

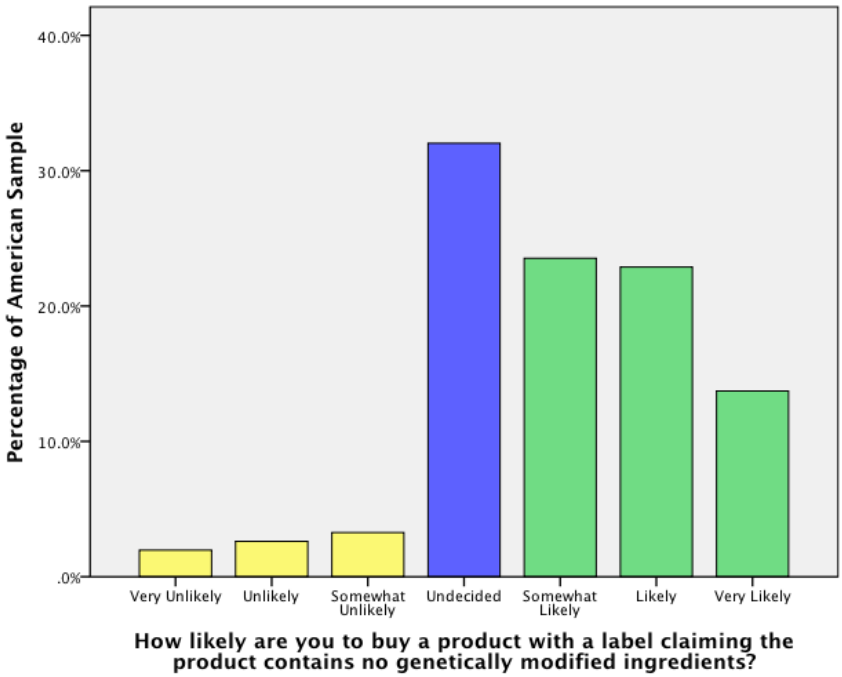
[a] Multiple modes exist. The smallest value is shown

Table 4: Statistics of the Seven Attitudes Statements for the American Sample

Finally, I viewed the results from the analytical tests on purchasing intentions. The means for the dependent variable in the United States was M=4.96, while the mode was "4 = Undecided." These statistics suggested that American consumers showed uncertainty about whether or not to purchase the product with the non-GMO label. A plurality of the respondents, 32.0%, were undecided, but 60.1% showed some degree of likelihood of selecting the non-GMO labeled product, compared to the low 7.8% of respondents that were on some level unlikely to purchase the product. Thus, it is indicated that among Americans, more individuals would consider purchasing a product with the label signifying the product has no genetically modified ingredients. Graph 1 shows the results of the frequencies of the dependent variable responses in America.

The linear regression for the American sample displayed a significant relationship between both cognitive and affective attitudes and purchasing intentions. The results from this are shown in Table 5. In agreement with the results from the total sample, the knowledge and

purchasing intentions relationship for the United States was also negative ($p < .01$, $b = -.33$, $t = -3.30$), meaning that consumers who are more likely to purchase a product with a non-GMO label also exhibited a low level of agreement that the government and production companies have educated and provided sufficient information to consumers. According to the statements within the variable pertaining to the cognitive attitudes of consumers, the results of the linear regression indicate that a perceived lower level of information provided by the government and producers is correlated to a greater likelihood of purchasing the non-GMF labeled product.



Graph 1: American Sample Frequency Distribution for Purchasing Intentions

Furthermore, the attitudes and purchasing intentions relationship was positive ($p < .0001$, $b = .59$, $t = 5.74$). The positive relationship between this independent variable and the dependent variable illustrates that as consumers have increasingly negative attitudes towards GMFs, for example agreeing that all genetically modified organisms should be banned, they are also more likely to purchase the product with the non-GMO label. Thus among American consumers,

negative attitudes are correlated to a higher likelihood of purchasing the non-GMO labeled product, while positive attitudes are linked to a lower likelihood of purchasing the product.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.489[a]	.239	.229	1.1741
a. Predictors: (Constant), Attitudes_US, Knowledge_US				

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	64.981	2	32.490	23.568	.000[b]
	Residual	206.784	150	1.379		
	Total	271.765	152			
a. Dependent Variable: Purchasing Intentions						
b. Predictors: (Constant), Attitudes_US, Knowledge_US						

Coefficients						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	4.159	.393		10.592	.000
	Knowledge_US	-.334	.101	-.235	-3.295	.001
	Attitudes_US	.592	.103	.410	5.744	.000
a. Dependent Variable: Purchasing Intentions						

Table 5: Results of the American Sample Linear Regression

Results of the German Sample

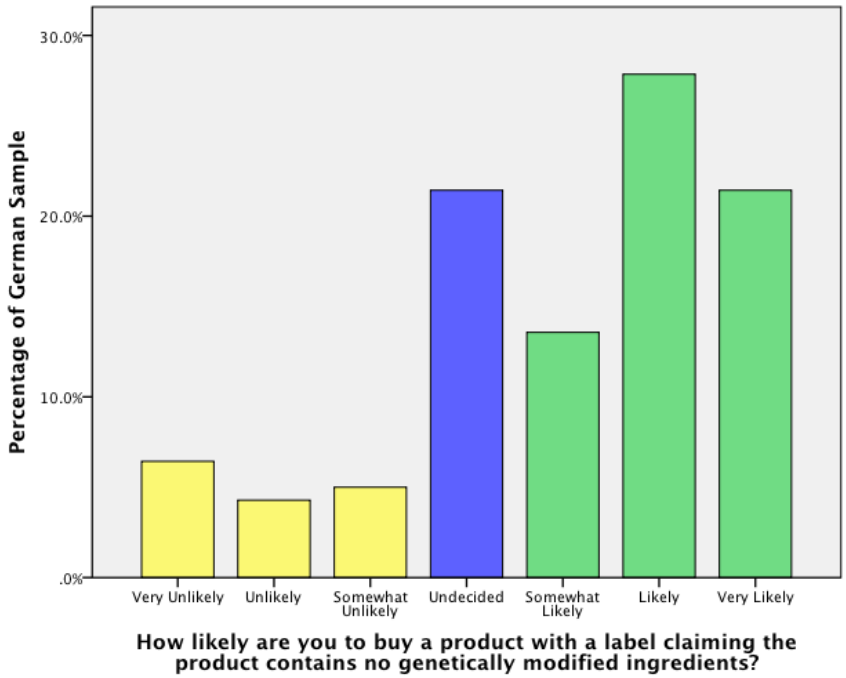
The descriptive tests on the knowledge independent variable for the German data sample had a means of $M = 2.36$ for the complete knowledge variable, which showed a low level of agreement. I observed that 54.3% of the survey participants in Germany either strongly disagree or disagree that the government had educated consumers about genetically modified foods. Furthermore, 36.9% of the respondents selected the mode answer choice of "2 = Disagree" when responding to this statement "The government has educated consumers about genetically

modified foods." The means for this statement was $M = 2.40$. Furthermore, the means for the second statement used in the knowledge variable, "Production companies have provided sufficient information to consumers about genetically modified foods," was $M = 2.31$. The greatest portion of the respondents, 37.9%, disagreed that producers had provided sufficient information to consumers about GMFs, while only 9.3% agreed that producers had given enough information to consumers. The means for the knowledge independent variable and the two statements it contains indicate a lower level of agreement on both aspects of knowledge analyzed. From this result, I determine that consumers in Germany are more likely to agree that the government and production companies have not provided consumers with enough knowledge and information regarding GMFs.

I then conducted tests on the attitudes independent variable in the German data. The means for the total attitudes variable was $M = 3.26$, and the mode was "3 = Neither Agree nor Disagree." The means suggested more moderate attitudes towards GMFs. The means of six out of the seven individual statements were greater than 3, with the exception of the statement "Genetically modified foods do not provide critical nutritional values," which had a means equal to 2.92. The individual means values, which are shown in Table 6, implicate moderate agreement for each of the statements assessing attitudes. Also, the mode of four statements is equal to "3 = Undecided," while the mode of the other three statements is equal to "4 = Agree." The higher level of agreement is for the following statements: "The production of GMFs is not a natural process, potentially harming nature," "Genetically modified foods are harmful to my body," and "I see value in spending money on GMO-free foods." These statistics demonstrate the inclination towards negative attitudes about GMFs among the German sample.

	ATT4	ATT5	ATT6	ATT7	ATT10	ATT13	ATT14	Computed Attitudes Variable
Mean	3.2673	3.7214	2.9214	3.2214	3.1357	3.1286	3.2857	3.4571
Std. Error of Mean	0.05494	0.09015	0.06575	0.09621	0.08434	0.09338	0.10152	0.09089
Median	3.1429	4	3	3	3	3	3	3
Mode	3	4	3	4	3	4	3	3

Table 6: Statistics of the Seven Attitudes Statements for the German Sample



Graph 2: German Sample Frequency Distribution for Purchasing Intentions

The means for the dependent variable, purchasing intentions, in Germany was *M*=5.01, and the mode was "6 = Likely." The results from the tests on this variable are shown in Graph 2 above. The frequencies for this variable in the German data display that 15.7% of the participants showed a level of unlikelihood to purchase the product with the non-GMO label, while 62.9% of the participants indicated a likelihood of choosing the non-GMF product. Excluding the 21.4% who chose "4 = Undecided," the difference in likelihood and unlikelihood is a high 47.2%, with

more consumers showing likelihood. This percentage, plus the mode equal to "6 = Likely," implies that German consumers have a greater likelihood to buy the food with a non-GMO label.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.301[a]	.090	.077	1.6599
[a]. Predictors: (Constant), Attitudes_Germany, Knowledge_Germany				

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	37.507	2	18.754	6.806	.002[b]
	Residual	377.486	137	2.755		
	Total	414.993	139			
a. Dependent Variable: Purchasing Intentions						
b. Predictors: (Constant), Attitudes_Germany, Knowledge_Germany						

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.774	.919		3.019	.003
	Knowledge_Germany	-.100	.165	-.051	-.602	.548
	Attitudes_Germany	.755	.223	.284	3.381	.001
a. Dependent Variable: Purchasing Intentions						

Table 7: Results of the German Sample Linear Regressions

Next, the linear regression for the German sample displayed a significant relationship between attitudes and purchasing intentions ($p < .01$, $b = .76$, $t = 3.38$), but not between knowledge and purchasing intentions ($p > .50$, $b = -.10$, $t = -.60$). Even though the knowledge relationship lacks significance, it is negatively correlated to the dependent variable, which agrees with the combined and American samples. Also similar to the previous samples' results, the relationship between the dependent variable and attitudes is positive. These results show that

knowledge has no significant effect on German consumers in their purchasing behavior when a non-GMO label is present. However, negative attitudes strongly associate with a higher likelihood of purchasing the non-genetically modified labeled product. The results of the linear regression of German data sample are shown in Table 7 above.

4.2 Comparative Analysis of the United States and Germany Samples

In this section, I present the findings of the data analysis through a comparison of the significant results collected in each national sample. Recall that I hypothesized that German consumers are more likely than American consumers to purchase foods with non-genetically modified labels. This difference in purchasing intentions is hypothesized to be a result of the diverse affective and cognitive attitudes experienced by consumers in Germany and the United States. Additionally, the hypothesis asserts that American consumers are a less likely to purchase the non-GMO labeled product. First, the findings for the independent variable knowledge, or cognitive attitudes, are explained, and then a description of the findings for affective attitudes is given. Next, I report on the dependent variable, purchasing intentions, and provide a comparison of the linear regression results in Germany and the United States.

American vs. German Knowledge

Beginning with the independent variable knowledge, the results of the German and American samples are comparatively analyzed. The newly computed knowledge variable has a means equal to 2.37 in the United States and 2.36 in Germany. Both nations have a mode of "2 = Disagree" for this variable, as well as for the two statements that make up the variable. In both nations, the mean and mode statistics show a low level of agreement with the following statements: "The government has educated consumers about genetically modified foods" and "Production companies have provided sufficient information to consumers about genetically

modified foods." The low level of agreement demonstrates that consumers in both Germany and the United States do not believe that the government and producers have given enough information about GMFs to consumers. This cognitive attitude held by consumers in two diverse nations suggests that labels giving information are not readily available in both nations, although due to various reasons.

Next, I observe the individual statements making up the computed knowledge variable. The statement pertaining to the government has an $M = 2.40$ in Germany and an $M = 2.29$ in the United States, a small difference. Only 13.1% of the American sample shows an indication of agreement with the statement, while 65.4% of the participants do not agree that the government has been active in educating consumers about GMFs. The German sample is similar since 10.0% of the respondents agree with the statement and 54.3% disagree or strongly disagree. The major difference is seen through the amount of indifferent responses in each nation. In the United States, 21.6% of the sample neither agrees nor disagrees with the claim, while 35.7% of the German consumers are neutral. The findings of the responses to this statement illustrate a stronger lack of confidence among German consumers on whether or not the government provides enough information about GMFs and also a higher certainty among American consumers that the government does not provide adequate information to consumers.

A parallel situation exists in the analysis of the statement regarding information provided by production companies, however, the percentages for each nation are more similar for this statement than the previous one. The means are 2.31 for Germany and 2.44 for America. In Germany, 62.1% of the sample disagrees or strongly disagrees that producers have provided enough information to consumers about GMFs, and only 13.6% agree with the statement. Also, 24.3%, approximately a quarter of the respondents, neither agrees nor disagrees. Of the

American sample, 55.6% shows disagreement and 15.7% indicates agreement. The neutral portion of the participants in the U.S. is equal to 28.8%. These two national samples are thus comparable and show low agreement levels for the aspect of knowledge involving the information given to consumers about GMFs by production companies.

From the two questions making up the knowledge variable, conclusions can be drawn about the cognitive attitudes of both German and American consumers regarding GMFs. The findings above indicate that consumers in both nations do not think their respective governments or production companies are providing enough information about GMFs to consumers. Furthermore, due to the nature of a common factor analysis, discussed in Chapter III, this variable also provides insight into consumers' overall cognitive attitudes towards GMFs. I find that consumers, both in the United States and Germany, believe that their level of knowledge about GMFs is low, thus this variable, knowledge, should not have a great influence on the purchasing intentions of consumers of GMFs.

American vs. German Attitudes

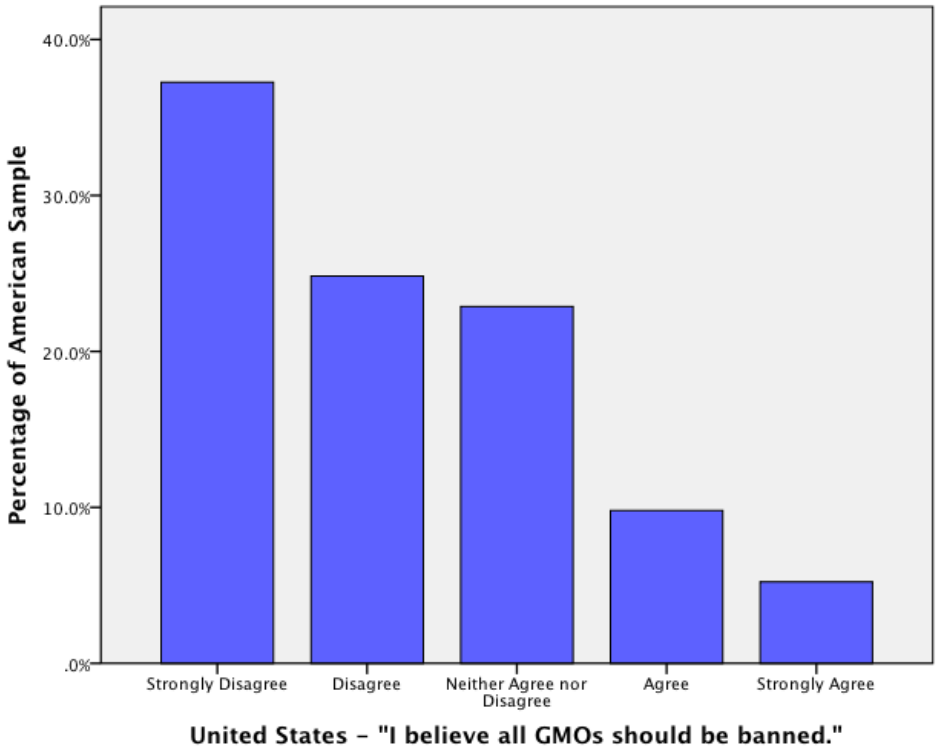
The means for the computed attitudes variable are $M = 2.69$ in the United States and $M = 3.26$ in Germany. This difference shows a higher level of agreement among German consumers with the statements in the survey about attitudes. The American participants have an overall lower level of agreement, indicating slightly more positive attitudes towards GMFs. The German means being greater than 3 shows more negative attitudes among German consumers. Also, the mode in Germany is "3 = Neither Agree nor Disagree," while multiple modes exist in the United States, the lowest of which is 2.29. The means of six of the seven individual statements in Germany are greater than 3, and only one statement within the American attitudes variable, "The production of genetically modified foods is not a natural process, potentially harming nature,"

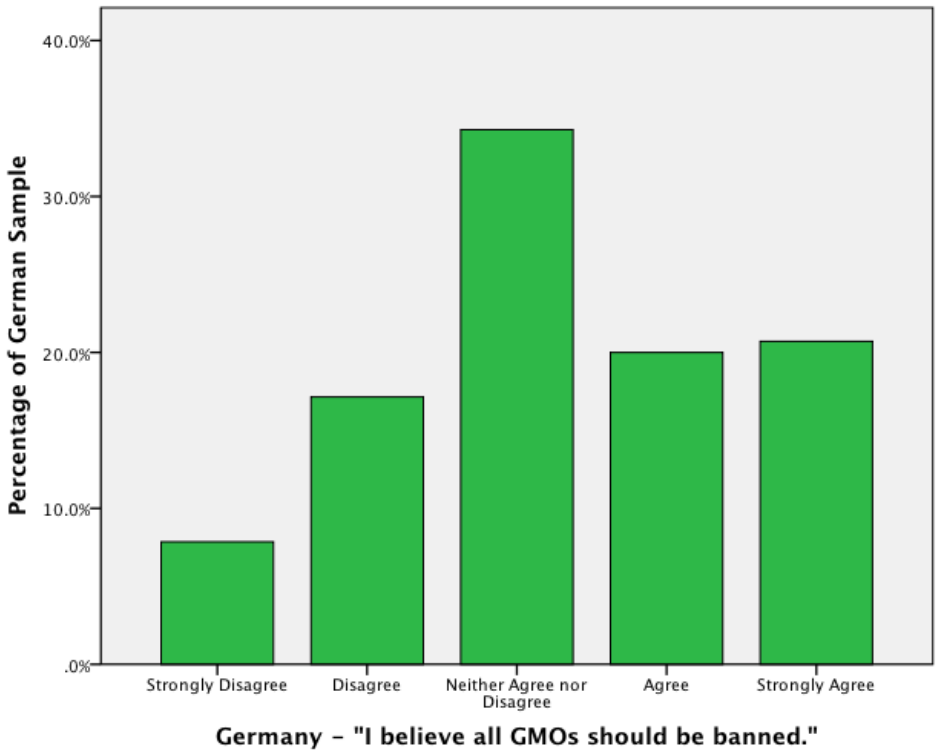
has a mean greater than 3. This comparison of means and modes is consistent with the hypothesis and displays that German consumers, as a whole, have more negative attitudes towards GMFs than American consumers.

The largest gap between the two national means occurs in the statement "I believe that all GMOs should be banned" with an American $M = 2.21$ and a German $M = 3.29$, a difference of 1.08. Also, the mode for Germany is equal to "3 = Neither Agree nor Disagree," and the mode in the United States is equal to "1 = Strongly Disagree." Looking deeper at this statement, there is a substantial divide in the answer frequencies between German and American participants. Graphs 3 and 4 below display the frequencies for each nation. A total of 15% of the American respondents agree or strongly agree that all GMOs should be banned, while a much larger proportion, 40.7%, of the German respondents agree or strongly agree that they should be banned. In contrast, 25% of the German sample disagree or strongly disagree that all GMOs should be banned, compared to 62.1% of the American sample. This contrast suggests that consumers in Germany are more apprehensive and negative towards GMFs, and Americans are, relative to Germans, more positive towards GMFs. Whether the respondents correlate GMOs specifically with genetically modified foods is uncertain through the wording of the question, however, I assume that these attitudes of GMOs carry over to genetically modified foods as well.

American vs. German Purchasing Intentions

The dependent variable, consumer purchasing intentions is measured through the question "How likely are you to buy a product with a label claiming the product contains no genetically modified ingredients?" The answer values are a 7 point Likert scale ranging from "1 = Very Unlikely" to "7 = Very Likely." The means of this variable in Germany is $M = 5.01$ and in America is $M = 4.96$. The modes, although, provide more detail and contrast





Graphs 3 and 4: Frequency Distribution for the Statement: "I believe all GMOs should be banned."

between the nations. The United States has a mode equal to "4 = Undecided," while Germany has a mode equal to "6 = Likely." Also, 62.9% of the German sample shows a degree of likelihood in buying the product with the non-GMO label. Very close behind Germany, 60.1% of the American sample is somewhat likely, likely, or very likely to purchase the non-GMO labeled product. Furthermore, 15.7% of the German participants are either very unlikely, unlikely, or somewhat unlikely to purchase the non-GMO labeled product, and 7.8% of the American sample expresses unlikelihood. In Germany and the United States respectively, 37.1% and 39.9% of the respondents selected the neutral undecided value. These statistics are consistent with the hypothesis in the assumption that more German than American consumers would purchase a food product clearly labeled as containing no genetically modified ingredients. However, the German consumers are only 2.8% more likely than American consumers, which is not a significant difference.

Comparison of the Linear Regressions in the United States and Germany

Lastly, the results of the linear regression tests conducted on the national data samples are analytically compared. Linear regressions provide a description of the relationships between the dependent and independent variables, thus these findings serve as the main findings of the research hypothesis. The *b* and *t* coefficients indicate whether the relationships are positive or negative, and the *p* value (Sig.) allows me to find the significant, hence valid, relationships.

The relationships between attitudes and purchasing intentions in both Germany and the U.S. are positive, while the knowledge and purchasing intentions relationships are both negative. The key difference between the regression results is the lack of significance ($p > .50$) for the knowledge and purchasing intentions relationship in Germany. The other three computed relationships are all significant: knowledge and purchasing intentions in the United States ($p <$

.01), attitudes and purchasing intentions in the United States ($p < .0001$), and attitudes and purchasing intentions in Germany ($p < .0001$). The significance shows whether or not the independent variables are adequate predictors of the dependent variable.

Thus, American consumers' purchasing intentions of non-GMO labeled food products may be predicted through both cognitive and affective attitudes, or rationality/beliefs and emotions/feelings respectively, towards GMFs. In contrast, the purchasing intentions of German consumers may only be predicted through the affective attitudes towards GMFs, not the cognitive attitudes towards them. Furthermore, the *Adjusted R Square* of the United States regression is .229, or 22.9%, while the *Adjusted R Square* for Germany is .077, or 7.70%. This statistic measures how much the multiple independent variables used in the test explain the dependent variable. Since only one relationship within the German sample regression is significant, the *Adjusted R Square* is lower, due to this value increasing if there is a significant correlation and decreasing if there is an independent variable without a significant correlation to the dependent variable.

Chapter V

DISCUSSION

In the first section of this chapter, I will summarize the findings presented in Chapter IV. I will also interpret these results in correlation with both the research model and the theoretical framework set in Chapter I. Section 5.2 gives a description of the limitations and obstacles experienced throughout the process of conducting research for and writing this work. Also, I make suggestions for the future of GMFs regulation policy affecting the government, the producers, and the consumers. Finally in the last section, I explain the future implications of this thesis for future research on genetically modified foods.

5.1 General Discussion

Summary of Findings in Relation to the Hypotheses

My first hypothesis (i.e., **H1**) states that German consumers are more likely than American consumers to purchase a food product with a label stating the product contains no GMOs. The findings from the data collection and analysis do not strongly support this argument. When comparing the German and American response results, only 2.8% more Germans than Americans have the intention to purchase the non-genetically modified product. This percentage difference is minor and does not very strongly support the claim of the hypothesis. Despite the miniscule difference, the hypothesis is proved since a higher percentage of German consumers than consumers in the United States would be likely to purchase the non-GMO product.

The second hypothesis (**H2**) claims that both German and American consumers' purchasing intentions of GMFs will be affected by their affective attitudes and the amount of information provided to them, or lack thereof, by their respective governments and producers, also known as cognitive attitudes. The aspect of **H2** that pertains to attitudes is proved by the

results of the linear regressions conducted in both nations. The relationships between attitudes and purchasing intentions in both Germany and the United States were both significant. Also, these relationships were both negative. However throughout the analytical tests, German consumers tended to have stronger negative attitudes than American consumers. In Germany, the means of the attitudes variables and the statements making up this variable are consistently greater than the means in the United States, thus suggesting that negative attitudes are more common among German consumers. Hence relative to German consumers, Americans have more positive or neutral attitudes towards GMFs, yet these consumers are only slightly less likely to report that they would be likely to buy the GMO-free labeled product. As seen in the deeper analysis of the attitudes variable components, Germans, relative to Americans, have a higher tendency to agree that all GMOs should be banned. This difference in affective attitudes is in part due to a stronger sense of environmental protectionism, a large value on the notion of natural, and greater concern for potential effects of new technologies among consumers in Germany.

In contrast with **H2**, knowledge does not directly affect the purchasing behavior of consumers in both Germany and the United States. Resulting from the linear regressions, the relationship between knowledge and attitudes in the U.S. was significant, but this relationship was not significant (>.05) in Germany. Thus **H2** does not hold true. In addition, I found that knowledge and information provided by government institutions and production companies, according to consumers, is lacking in both Germany and the United States. The means for the knowledge variable in each nation is below the median answer choice, which indicates a collective disagreement that knowledge is readily provided to consumers. However, the underlying reasons for this discrepancy are due to varying explanations (e.g. little production and

sales of GMFs in Germany, little regulation and labeling of GMFs in the United States). Most importantly, the comparative analysis findings of the linear regressions illustrate that knowledge essentially has no effect on the purchasing intentions of German consumers, which does not support the second hypothesis. Both attitudes and knowledge were thought to be important influences on the purchasing intentions of consumers, and this hypothesis only holds true for the United States.

Discussion of Findings

As mentioned in Chapter I, a global controversy encompasses genetically modified foods (Macnaghten et al., 2015). GMFs originally appeared in United States markets in the early 1990s and continued to spread worldwide. Today, most American supermarkets sell GMFs, and well over 100 different genetically modified crops are being produced. In contrast, European supermarkets and consumers are not as accepting of these products. Furthermore, while the United States does not have labeling requirements to identify a product containing genetically modified ingredients, in Germany, there is a threshold of .09%, above which a genetic modification label is mandatory (Vecchione et al., 2015). A transatlantic divide over GMFs arose as a result of these continental differences (Scholderer, 2005). This divide, the differing government regulatory systems, the diverse impacts of anti-GMO groups, and consumer attitudes aid in the development of the global controversy over GMFs.

Further separating Europe and the United States, the U.S. does not have a governmental institution that solely handles GMFs and bioengineered crops. GMFs are thought to be substantially equivalent to conventionally produced foods, thus a separate institution is not perceived as necessary. A contrasting system exists in the European Union and the individual European states. The European Union views GMFs as substantially and inherently different from

conventional foods and has a governing institution that specifically regulates GMFs and the cultivation and sales of GM-crops. Also, each EU member state actively regulates genetically modified foods within their own borders. This difference illustrates the differing viewpoints of the German and American governments towards the potential risks and risk assessment processes concerning GMFs (Macnaghten et al., 2015).

Since there is a known transparent contrast between the American and German governmental regulatory systems and the actions of production companies, my goal in this thesis is to focus on the consumer and GMFs. The role of the consumer is different in each nation, due to the U.S. having a top-down system and Germany having a bottom-up system of regulation. Observing the relationship between the consumer purchasing intentions of and the cognitive and affective attitudes towards GMFs is the primary purpose of this work.

The approach for this research includes assessing consumer purchasing intent when a product contains a non-GMO label, and then comparing the responses of consumers in Germany and the U.S. The finding that only slightly more (2.8%) German than American consumers are likely to purchase a product with a non-GMO label suggests consumers in both regions are open to, and often prefer, buying non-GMF products. Even though a preference for non-GMF products exists among consumers in each nation, only Germany utilizes this public opinion. In the United States, the top-down system prominently benefits the large biotechnology corporations, which impacts the lack of labeling and information provided to consumers. Conversely, consumers in Germany do not base purchasing decisions on the belief that the government and producers provide enough information about GMFs because these individuals understand their government has created regulations to limit the amount of GMFs sold within the nation. Additionally,

German consumers value the notion of natural; hence, knowing that a product has been bioengineered results in the refusal to buy the product.

The overall findings of my research highlight the difference between German and American consumers' purchasing intent in regard to GMFs. This difference in consumer behavior is in part a result of history and cultural traditions in each nation, but also a result of the contrasting governmental views, regulations for biotechnology, the different outlook on food safety and risks, and the various influence power of anti-GMO groups. The regulations and governing institutions in both nations dictate how much information both production companies and the government provide to consumers. American consumers are not provided much information or GMF labeling due to a bottom-up regulation structure. Furthermore, the FDA considers GMFs equivalent to conventionally grown foods, thus there is not a need to provide extra information about genetic modification. However, consumers in Germany show that knowledge about GMFs is unconnected to their purchasing intentions, which displays trust that the government regulations will protect them from the potential risks of GMFs. The stronger negative attitudes in Germany are the consequence of a defined culture and set values within the national community.

In conclusion, I have found that even though both German and American consumers are likely to buy a product claiming to have no GM-ingredients, only Americans are affected by both cognitive and affective attitudes. The level of knowledge provided to consumers by the government and producers in the U.S. directly impacts consumers' purchasing intent of GMFs. While Americans intentions are guided by both cognitive, or rational, and affective, or emotional, attitudes, Germany only take into account the emotional factor.

5.2 Implications

My findings strongly suggest that consumers are aware of GMFs and have developed opinions about GMFs consumption and purchasing. A majority of the consumers in both Germany and the United States would purchase a product with a non-GMO label on it. Thus the significance of a label being on a product has the potential to sway the decisions of consumers. In the United States, I believe the government is afraid of this swaying ability of labeling products containing GM-ingredients. However, I also believe that consumers should have the right, not the privilege, to know what is in the food they are consuming. The United States government therefore needs to create policies that take into consideration the views of consumers. The current top-down structure has a government regulatory system benefitting the large biotechnology companies and disregarding the right of the consumers to knowledge. I suggest that the United States government introduce policies that require the labeling on GMFs. The arguments presented by McHughen (2013) claim that the anti-GMO groups have the ulterior motive of following the European path to eliminate GMFs from the market and that GMFs have been proven to be safe. Focusing on the motives of the anti-GMO groups and the growth of large corporations (e.g. Monsanto) has, in my opinion, taken away the right of consumers to know exactly what they are consuming, including how it was made.

In line with this, in 2014, the U.S. state of Vermont created a law, known as Act 120, that makes labeling GMFs mandatory within Vermont's borders (Grocery Manufacturer's Association, n.d.). The Grocery Manufacturer's Association (GMA) and food producers are not pleased with this new law, but many consumers in Vermont are happy to know, as of July 2016, what type of food products they are purchasing. Vermont provides a template for other states, and eventually the U.S. federal government, to follow. As a result of altering policies to provide

more information to consumers, the transatlantic divide over GMFs between the United States and Europe would steadily decrease. The consumers' right to choice would then have an important value during the policy making process, and the GMFs regulatory system in the United States would most likely begin to mirror the system in Germany and the European Union. If policies requiring labels were to occur in the future, I propose that a separate institution for the regulation of GMFs should be created. In addition, consumers would have the opportunity to decide for themselves whether or not they will purchase and consume GMF or conventional products. The consumer decision in the United States have the potential to increase the market for organic, conventional foods and decrease the market grasp held by GMFs. Yet, the consumers in the U.S. are not affected by exact the same attitudes and values as consumers in Germany, thus the result of the elimination of GMFs within Germany and Europe could be avoided in the United States.

To this end, another implication of the current research is that, if the United States will does not alter their current labeling scheme, there will always be tension between Europe and the United States in the field of agro-biotechnology and GMFs. The German apprehension towards GMFs is based on a cultural identity and the value of consuming foods that are said to be natural or coming from nature, not a laboratory. Attitudes, not knowledge, play the largest role in consumer purchasing intentions in Germany, and the government considered these attitudes when creating institutions and policies to regulate GMFs. In contrast, the United States system is based on benefitting the large production and biotechnology companies, not the consumers. Values and beliefs do not change, thus the German system is not likely to change. I believe the only way for the transatlantic divide to diminish is for the United States regulatory system to

make policies that protect consumer rights to a choice about what to consume, not the desire of large corporations.

5.3 Limitations and Future Research

My project was not without weaknesses and experienced several limitations, which I will explain in the hopes of aiding research in the future. First, there is a lack of existing cross-national comparisons with the content of GMFs. Bredahl (1999) published a qualitative study involving four nations, and Springer et al. (2002) produced a work that compared consumer attitudes within European nations. Other than these two studies, information about comparing consumer purchasing intentions of GMFs is lacking. Therefore, creating a research project based on the comparison of two nations proved challenging. Germany and the United States, however, provide an interesting contrast when discussing GMFs, and studying these two nations specifically offers the diverse perspectives of a prominent European nation and a North American nation. As a result, I developed a cross-national study, while also providing an example and template for future researchers to produce a cross-national work. Moreover in order to further my research, I can examine two different nations or use this work's data and results in comparison with an additional, culturally and governmentally diverse, nation.

Secondly, collecting survey responses was an obstacle. In general, crowdsourcing platforms, such as Mechanical Turk, were new, unfamiliar tools for me, but my advisors helped in utilizing MTurk and Clickworker to gather data. The American responses were collected in a couple of hours, giving hope that collecting the German responses would be easy as well. However, Mechanical Turk is not popular in many nations outside of the United States, thus only two participants, when Germany was controlled for in MTurk, answered the survey in a twenty-four hour period. I was forced to explore other crowdsourcing options for the Germany sample.

After much investigation, I chose Clickworker, a platform founded and based in Germany. This software is more expensive, but it gathered the German responses in less than a day. Therefore, gaining experience in both MTurk and Clickworker will assist my future research endeavors.

Another limitation to this thesis is the cross-sectional design. I used the responses of the German and American data samples as representatives of the entire population. In future research, I suggest first researching the demographics of the selected population (e.g. the ratio of men to women, average age, and average level of education) before gathering responses. Accurately representing the population is important for the validity of the study, and the responses used in this thesis do not reflect the exact demographic properties of each nation. However, the responses are close enough to these demographic properties to be a good representation of the national populations.

A fourth obstacle I faced was time. The stability of the attitudes, knowledge, and purchasing intentions are limited due to time restraints. In future studies with no time restrictions, researchers should avoid measuring these variables only once. I assumed the stability of the attitudes towards GMFs, the knowledge of GMFs, and the purchasing intentions of GMFs. Conducting a longitudinal research project, in which the variables are measured continually over time, will increase the stability and strength of the findings. Also, I would have liked to have more time to create my survey and make sure the questions and statements within the survey were appropriate for my research questions. My survey was usable and I asked relevant questions, but there is always room for improvement, when there is time.

The thesis survey included four scenarios as a part of a policy capturing analysis. Also due to time limitations, this data is not utilized as a part of the analytical procedures. The next step for my research is to test and analyze these responses to gain a different perspective

regarding consumer behaviors and GMFs. The scenarios included cues pertaining to knowledge (i.e. high or low knowledge about GMFs) and attitudes (i.e. positive or negative towards GMFs). The policy capturing technique is a preferred method because it has been consistently used to measure the variability or variations in choices among different individual decision makers and also used to assess the manner in which people process information when asked to make an evaluative judgment (Karren & Barringer, 2002: 337; Zedeck & Kafry, 1977). Using this research method would enable me to delve into the normative, third person opinions of consumers, in contrast to the first person responses used in this thesis.

Lastly due to time restraints, the qualitative responses collected in the thesis survey were not included in the discussion of the results in Chapter IV. Including these open-ended responses would increase the reliability of the results and provide more insight on and a more in-depth explanation of the findings. Thus future research should attempt to combine quantitative and qualitative data to make a stronger argument about consumers and GMFs. Despite the obstacles and limitations I faced throughout the process of conducting research and writing my thesis, I was able to answer my research questions. In the subsequent sections, I will discuss the real world implications of my findings.

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Appendix A: Thesis Survey

Q1 Dear Respondent,

Thank you for taking the time to complete this survey! You responses will be a huge help in completing my senior thesis.

Sincerely,

Maggie Hall

Q2 Definition of genetically modified foods from the World Health Organization:

Genetically modified (GM) foods are foods derived from organisms whose genetic material (DNA) has been modified in a way that does not occur naturally, e.g. through the introduction of a gene from a different organism. Currently available GM foods stem mostly from plants, but in the future foods derived from GM microorganisms or GM animals are likely to be introduced on the market. Most existing genetically modified crops have been developed to improve yield, through the introduction of resistance to plant diseases or of increased tolerance of herbicides. In the future, genetic modification could be aimed at altering the nutrient content of food, reducing its allergenic potential, or improving the efficiency of food production systems. All GM foods should be assessed before being allowed on the market. FAO/WHO Codex guidelines exist for risk analysis of GM food.

Q3 Did you previously know what the acronym GMO stands for?

- ❍ Yes (1)
- ❍ No (2)

Q4 If you see a product label claiming "Non-GMO", would you understand its meaning?

- ❍ Yes (1)
- ❍ No (2)

Q5 Please explain the meaning of a "Non-GMO" label.

Q6 How likely are you to agree with this statement: As a consumer, I expect producers and/or the government to provide information about GMOs: the creation process, effects, risks and benefits.

- ❍ Very Likely (1)
- ❍ Likely (2)
- ❍ Somewhat Likely (3)
- ❍ Undecided (4)
- ❍ Somewhat Unlikely (5)
- ❍ Unlikely (6)
- ❍ Very Unlikely (7)

Q7 Below is a list of statements. Please indicate how you feel about each statement by indicating your level of agreement or disagreement with each statement.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
The lack of knowledge about the effects of genetically modified foods deters me from consuming them. (1)	❍	❍	❍	❍	❍
Most people on my campus have a knowledge of GMOs. (2)	❍	❍	❍	❍	❍
I have actively researched what a GMO is. (3)	❍	❍	❍	❍	❍
Genetically modified foods are substantially equivalent to non-genetically modified foods. (4)	❍	❍	❍	❍	❍
I know and understand the effects of consuming genetically modified foods. (5)	❍	❍	❍	❍	❍
Most of my knowledge about GMOs has come from media sources. (6)	❍	❍	❍	❍	❍
I know of policies and laws that govern genetically	❍	❍	❍	❍	❍

modified food production. (7)					
I know where to go to buy non-genetically modified food products. (8)	❍	❍	❍	❍	❍
The government has educated consumers about genetically modified foods. (9)	❍	❍	❍	❍	❍
Production companies have provided sufficient information to consumers about genetically modified foods. (10)	❍	❍	❍	❍	❍

Q8 Do you believe GMOs are harmful to your health?
- ❍ Yes (1)
- ❍ No (2)

Q9 Why or why not?

Q10 Do you think GMOs have a positive, negative, or no effect on your body?
- ❍ Positive (1)
- ❍ Negative (2)
- ❍ No effect (3)

Q11 Please explain your answer. _____

Q12 How likely are you to agree with this statement: I would describe the relationship between quality of life and the consumption of genetically modified foods as negative.

- ❍ Very Likely (1)
- ❍ Likely (2)
- ❍ Somewhat Likely (3)
- ❍ Undecided (4)
- ❍ Somewhat Unlikely (5)
- ❍ Unlikely (6)
- ❍ Very Unlikely (7)

Q13 Do you think it should be mandatory for producers to label genetically modified foods?

- ❍ Yes (1)
- ❍ No (2)
- ❍ I don't know (3)

Q14 Please explain your answer _____

Q15 Below is a list of statements. Please indicate how you feel about each statement by indicating your level of agreement or disagreement with each statement.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
It is the consumer's responsibility to be aware of GMOs. (1)	❍	❍	❍	❍	❍
It is the producer's responsibility to visibly label and provide awareness of GMOs. (2)	❍	❍	❍	❍	❍
It is the government's responsibility to educate the public about GMOs and create policies/laws to regulate GMOs. (3)	❍	❍	❍	❍	❍
The production of genetically modified foods is not a natural process, potentially harming nature. (4)	❍	❍	❍	❍	❍
Genetically modified foods do not provide critical nutritional values. (5)	❍	❍	❍	❍	❍
Genetically modified foods are harmful to my body. (6)	❍	❍	❍	❍	❍
Consuming genetically modified foods is less enjoyable than	❍	❍	❍	❍	❍

consuming non-GMO foods. (7)					
GMO-containing foods are clearly labeled and easily identifiable. (8)	❍	❍	❍	❍	❍
I believe the advantages of consuming genetically modified foods outweigh the disadvantages. (9)	❍	❍	❍	❍	❍
I see value in spending money on GMO-free foods. (10)	❍	❍	❍	❍	❍
Genetically modified foods are cheaper. (11)	❍	❍	❍	❍	❍
My lifestyle makes it difficult to consume non-genetically modified foods. (12)	❍	❍	❍	❍	❍
I believe that all GMOs should be banned. (13)	❍	❍	❍	❍	❍
Cultivating genetically modified foods is harmful to the environment. (14)	❍	❍	❍	❍	❍

Q16 Do you have friends or family who oppose or support consuming genetically modified foods?
- Yes (1)
- No (2)

Q17 Does their behavior have an influence on your own behavior towards genetically modified foods?
- Yes (1)
- No (2)

Q18 Does your view of the environment affect your consumption behavior, in regard to genetically modified foods?
- Yes (1)
- No (2)

Q19 Please explain how your environmental views affect your food consumption behavior.

Q20 If you have the choice between a GMO product and a non-GMO product, which would you choose h to consume?
- The genetically modified product (0)
- The non-GMO product (1)
- No preference (2)

Q21 How likely are you to buy a product with a label claiming the product contains no genetically modified ingredients?
- Very Unlikely (1)
- Unlikely (2)
- Somewhat Unlikely (3)
- Undecided (4)
- Somewhat Likely (5)
- Likely (6)
- Very Likely (7)

Q22 I have learned about genetically modified foods through a form of media (film, book, etc.) that has affected my consumer behavior towards genetically modified foods.
- Agree (1)
- Disagree (2)

Q23 Which approach best describes your behavior towards consuming genetically modified foods?
- Precautionary: I do not want to consume genetically modified foods because I do not know their effects on my health and the environment. (1)
- I will consume genetically modified foods now and hope their effects will not be severe in the future. (2)
- Other (3) _____

Q24 Please read each of the short scenarios below carefully and answer the question for each.

Q25 A woman realizes she is out of breakfast cereal and therefore goes to a nearby grocery store. She has a negative attitude towards genetically modified foods but also has little knowledge about these foods.

Q26 Choose a percentage below for the likelihood that she will check product labels to see if she is purchasing a genetically modified cereal.

- ❑ 0% (1)
- ❑ 10% (2)
- ❑ 20% (3)
- ❑ 30% (4)
- ❑ 40% (5)
- ❑ 50% (6)
- ❑ 60% (7)
- ❑ 70% (8)
- ❑ 80% (9)
- ❑ 90% (10)
- ❑ 100% (11)

Q27 A woman realizes she is out of breakfast cereal and therefore goes to a nearby grocery store. She has a negative attitude towards genetically modified foods but also she is highly knowledgeable about these foods.

Q28 Choose a percentage below for the likelihood that she will check product labels to see if she is purchasing a genetically modified cereal.

- ❑ 0% (1)
- ❑ 10% (2)
- ❑ 20% (3)
- ❑ 30% (4)
- ❑ 40% (5)
- ❑ 50% (6)
- ❑ 60% (7)
- ❑ 70% (8)
- ❑ 80% (9)
- ❑ 90% (10)
- ❑ 100% (11)

Q29 A woman realizes she is out of breakfast cereal and therefore goes to a nearby grocery store. She has a positive attitude towards genetically modified foods but also has little knowledge about these foods.

Q30 Choose a percentage below for the likelihood that she will check product labels to see if she is purchasing a genetically modified cereal.

- ❑ 0% (1)
- ❑ 10% (2)
- ❑ 20% (3)
- ❑ 30% (4)
- ❑ 40% (5)
- ❑ 50% (6)
- ❑ 60% (7)
- ❑ 70% (8)
- ❑ 80% (9)
- ❑ 90% (10)
- ❑ 100% (11)

Q31 A woman realizes she is out of breakfast cereal and therefore goes to a nearby grocery store. She has a positive attitude towards genetically modified foods but also is highly knowledgeable about these foods.

Q32 Choose a percentage below for the likelihood that she will check product labels to see if she is purchasing a genetically modified cereal.

- ❑ 0% (1)
- ❑ 10% (2)
- ❑ 20% (3)
- ❑ 30% (4)
- ❑ 40% (5)
- ❑ 50% (6)
- ❑ 60% (7)
- ❑ 70% (8)
- ❑ 80% (9)
- ❑ 90% (10)
- ❑ 100% (11)

Q33 Gender:

- ❍ Male (1)
- ❍ Female (2)

Q34 Age:
- ❍ Under 12 years old (1)
- ❍ 12-17 years old (2)
- ❍ 18-24 years old (3)
- ❍ 25-34 years old (4)
- ❍ 35-44 years old (5)
- ❍ 45-54 years old (6)
- ❍ 55-64 years old (7)
- ❍ 65-74 years old (8)
- ❍ 75 years or older (9)

Q35 Please specify your ethnicity.
- ❍ American Indian or Alaska Native (1)
- ❍ Asian (2)
- ❍ Black or African American (3)
- ❍ Native Hawaiian or Other Pacific Islander (4)
- ❍ White (5)
- ❍ Other (6)

Q36 What is the highest degree or level of school you have completed? If currently enrolled, highest degree received.
- ❍ No schooling completed (1)
- ❍ Nursery school to 8th grade (2)
- ❍ Some high school, no diploma (3)
- ❍ High school graduate, diploma or the equivalent (for example: GED) (4)
- ❍ Some college credit, no degree (5)
- ❍ Trade/technical/vocational training (6)
- ❍ Associate degree (7)
- ❍ Bachelor's degree (8)
- ❍ Master's degree (9)
- ❍ Professional degree (10)
- ❍ Doctorate degree (11)
- ❍ Other (12)

Q37 What is your marital status?
- ❍ Single, never married (1)
- ❍ Married or domestic partnership (2)
- ❍ Widowed (3)
- ❍ Divorced (4)
- ❍ Separated (5)

Q38 Do you have children?
- ❍ Yes (1)
- ❍ No (2)

Q39 Are you currently ...?
- ❍ Employed for wages (1)
- ❍ Self-employed (2)
- ❍ Out of work and looking for work (3)
- ❍ Out of work but not currently looking for work (4)
- ❍ A homemaker (5)
- ❍ A student (6)
- ❍ Military (7)
- ❍ Retired (8)
- ❍ Unable to work (9)
- ❍ Other (10)

Q40 Do you currently reside in the United States?
- ❍ Yes (1)
- ❍ No (2)

Q41 In which state is your permanent address?
- ❍ Mississippi (1)
- ❍ Other (please provide below) (2) _____

Q42 IF YOU ARE AN AMAZON TURK WORKER, please enter your username below. It MUST MATCH the username you enter in the HIT at Amazon Turk in order to receive compensation. For example, if you enter "Amazon Worker145" here as a username, you also must enter "Amazon Worker145" in the space provided at Amazon Turk before submitting the HIT. Once you have done this, please click on the arrows below to submit your answers. Thank you!!! WE HIGHLY SUGGEST THAT YOU TAKE A SCREEN SHOT OF THIS PAGE TO SHOW THAT YOU COMPLETED THE SURVEY IF THERE IS ANY PROBLEM WITH THE SUBMISSION.

Your Username (for Amazon Turk Workers only) (1) _____